

The sound of music: can music help to reduce hypertension?

Música no coração: poderá a música ajudar a reduzir a hipertensão?

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*“I go to the hills when my heart is lonely
I know I will hear what I’ve heard before
My heart will be blessed with the sound of music
And I’ll sing once more”*

The Sound of Music, Julie Andrews (1965)

Abstract

Given the prevalence of chronic diseases in society, the search for solutions to control their progression is urgent. Hypertension, as a metabolic risk factor for chronic diseases, is considered the greatest cause of premature death, globally. In Portugal, for example, it is estimated that 42.6% of the adult population has hypertension. Being overweight/obese, consuming high amounts of salt and physical inactivity are some of the factors promoting hypertension. Some lifestyle changes may help in reducing blood pressure. However, the prescription of antihypertensives may be necessary. As a complement to this prescription, there are "social prescriptions" that aim to meet the patients' needs through non-clinical prescribed interventions, for example, dance, music, among others. This Literature Review will investigate the potential for music to become a social prescription for hypertension. After identifying and analyzing papers that met specific inclusion criteria, there was a common trend in the reduction of blood pressure (systolic and/or diastolic) in the group that listened to music as a complement to their pharmacological prescription. Thus, although there is a need for further studies, music seems to be an interesting prescription to be implemented.

Keywords: music; music therapy; hypertension

Resumo

Dada a prevalência das doenças crónicas na sociedade, é urgente a procura de soluções para que haja o controlo da sua progressão. A hipertensão, enquanto fator de risco metabólico para as doenças crónicas, é considerada a maior causa de morte prematura, globalmente. Em Portugal, por exemplo, estima-se que 42,6% da população adulta tem hipertensão arterial. Ser obeso/ ter excesso de peso, consumir elevadas quantias de sal e a inatividade física, são alguns dos fatores promotores de hipertensão. Algumas mudanças no estilo de vida poderão ajudar na redução da pressão arterial. No entanto, a prescrição de anti hipertensores poderá ser necessária. Como complemento a esta prescrição, surgem as “prescrições sociais” que visam colmatar as necessidades dos pacientes, através de intervenções não clínicas prescritas, por exemplo, dança, música, entre outras. Esta Revisão Temática averiguará o potencial que a música tem de se tornar uma prescrição social para a hipertensão. Após a identificação e análise de estudos que reuniram critérios de inclusão específicos, verificou-se uma tendência comum na redução da pressão arterial (sistólica e/ou diastólica) no grupo que ouviu música como complemento à sua prescrição farmacológica. Assim, apesar de ainda haver a necessidade de realizar mais estudos, a música parece ser uma prescrição interessante a ser implementada.

Palavras-chave: música; terapia musical; hipertensão

Abbreviations

BP - Blood Pressure

DASH - Dietary Approach to Stop Hypertension

DBP - Diastolic Blood Pressure

ECG - Electrocardiogram

HBP - High Blood Pressure

HR - Heart Rate

NCDs - Noncommunicable Diseases

RCT - Randomized Control Trial

SBP - Systolic Blood Pressure

WHO - World Health Organization

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Introduction

The research into the effects of arts on health and well-being has increased, alongside the developments in practice and policy activities in different Member States across the World Health Organization (WHO) European Region. At the 76^o World Health Assembly (WHA76, Geneva, 2023), the artists Renée Fleming¹ and Pretty Yende² were announced as Goodwill Ambassadors for Arts and Health. The WHO Director-General, Dr. Tedros Ghebreyesus, indicated that “their involvement will inspire individuals, communities and policy-makers to recognize and harness the transformative power of the arts in the pursuit of better health for all”⁽¹⁾. Although, there has been little consistency in policy development across the Member States in the Region due to the lack of awareness of evidence, a turnaround is expected⁽²⁾.

Following the first Expert Meeting on Noncommunicable Diseases (NCDs) Prevention and Control and the Arts⁽³⁾, held in 15-16 December 2022, different forms and functions of arts and health interventions, as well as existing evidence were discussed, including promising delivery mechanisms as social prescriptions. In 2022, WHO has released a toolkit on how to implement social prescriptions in a local context. Social prescribing, in this toolkit, means for health-care workers to “connect patients to a range of non-clinical services in the community to improve health and well-being”. Although social prescribing isn’t an intervention by itself, it’s a pathway that helps to address the patient’s needs. Evidence shows that

¹ American Soprano

² South African Operatic Soprano

people with chronic conditions are one of the groups that are likely to benefit the most from social prescribing.⁽⁴⁾

According to the “CultureForHealth Report - Summary” (2022), culture is defined as “an important resource in this context when approaching health holistically”. The findings of this Report confirm that “arts and cultural activities are important in promoting the positive mental health and well-being of populations”⁽⁵⁾ being, as well, cost-effective interventions for complex health challenges, while alleviating pressures on limited health resources⁽⁴⁾. The “CultureForHealth” project aims to share experiences and successful stories regarding the role of culture in well-being and health in the European Union. However, it is still important to notice that there are still socio-economics inequalities regarding the access to culture and art, especially in older ages⁽⁶⁾.

One of the artistic interventions that can be used is Music, defined as “a pattern of sounds made by musical instruments, voices, or computers, or a combination of these, intended to give pleasure to people listening to it”⁽⁷⁾. Music is described in the Report as it is designed to “alleviate stress and anxiety and promote social engagement and connection”⁽⁵⁾. Music has an undeniable impact on society. Whether in terms of religious, entertainment purposes, there seems to exist a music shaped for every instance and mood. Besides this powerful influence, music has also been considered as a promising non-pharmacological intervention for improving health outcomes⁽⁸⁾. In January 2023, an EU-funded project called *HEART.FM* has been developing an app that “will monitor people’s response as they listen to music and then tailor that music to benefit them”. This app will exploit advances in wearable Electrocardiogram (ECG) monitors and

portable blood pressure sensors with artificial intelligence algorithms to create a listening regimen that regulates blood pressure (BP)⁽⁹⁾.

Cardiorespiratory variables (BP, HR) can be modified by musical structure: organization or composition of music by beats per minute, sequences, melody and pauses. BP and HR seem to increase with faster tempos and simpler rhythmic structures compared with baseline and decrease during the silent and pauses⁽⁸⁾.

The British Heart Foundation shared a study that found out that listening Mozart or Strauss music for 25 minutes, lowered significantly both Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP).⁽¹⁰⁾

According to WHO, 1.28 billion adults (30-79 years old) have hypertension or high blood pressure (HBP), being the major cause of premature death worldwide and the leading metabolic risk factor for NCDs. Of all WHO regions, the Eastern Mediterranean had the highest prevalence (37,8%) in 2019, followed by the European Region (36,9%)⁽¹¹⁾. Hypertension characterizes when the pressure in the blood vessels is too high (higher than 140/90 mmHg)⁽¹²⁾. The first value (140 mmHg) characterizes the SBP and the second (90 mmHg) characterizes the DBP. Being overweight or obese, consuming a high-salt diet, not being physically active, among others, are a few factors that increase the risk of having HBP. Life changes e.g., healthier diet, quitting tobacco etc., can help lower the blood pressure, but, sometimes, is still necessary a pharmacological treatment: ACE inhibitors, Angiotensin-2 receptor blockers, Calcium channel blockers and Diuretics⁽¹³⁾. WHO recommends an initiation of pharmacological treatment when it's confirmed the diagnosis of hypertension and when the SBP and DBP are the same or higher as the values previously mentioned⁽¹⁴⁾.

As a complement to this medical prescription (if needed), this Literature Review aims to understand if Music has an influence on the reduction of BP, to be considered as a possible social prescription for people with hypertension, globally.

Methodology

For the development of this Literature review, studies in English, published over the last 10 years from two main platforms: PubMed and ScienceDirect were considered. In both, the following keyword combination was included: the following keyword combination: (“music” OR “music therapy”) AND “hypertension”. The last search was made on the 25th of May 2023.

The inclusion criteria for this Literature Review were: to be a Randomized Control Trial design (RCT), a Systematic Review or a Meta-Analysis (as these are epidemiologically stronger); the study population considered needed to be hypertensive (SBP >140 mmHg; DBP pressure >90 mmHg), or pre-hypertensive (SBP = 120-140 mmHg; DBP = 80-90 mmHg)³ as is considered a preliminary stage of hypertension. Pregnant women were not considered as study population. Animal studies weren't included, either. Upon collecting the studies that met the previous criteria, the duplicates were eliminated. The software used for referencing was EndNote20.

It will be first explained the influence of music on the cardiovascular system, and then, the proper results from studies will be shared, followed by a critical analysis.

³ These values are from The British Heart Foundation, updated in March 2023: <https://www.bhf.org.uk/informationsupport/risk-factors/high-blood-pressure>

Results

2 Meta-analysis, 1 Systematic Review and 5 Randomized Control Trials (RCT)s met the criteria previously mentioned. Although in the meta-analysis were incorporated a few of the RCTs, it is still important to highlight them individually to better understand the approach that was used, after the global context provided by the meta-analysis.

The act of listening to music can be a very simple, accessible, enjoyable experience. However, analyzing it in depth, it turns out to be a complex one, as it involves psychological, emotional, and cardiorespiratory changes, based on the individual response to the music. As this is based on so many individual factors (personal preference, prior music experience, among others), there isn't a universal response to a certain music. One of the main findings from a systematic review from 2022 is that the *tempo* (in other words, the speed) of music may be directly correlated with changes in BP. The *tempo* influences more than the music type itself⁽⁸⁾.

There are still questions regarding the influence that music has on the Cardiovascular System, and, consequently, on BP. Recently, a meta-analysis has explained that when the sound waves of music act on the brain, it increases the excitability of the nervous system, promoting the secretion of hormones, such as acetylcholine, and, therefore, slowing down the HR. Also, it reduces sympathetic nerve excitability, produces sedative and antihypertensive effects, and regulates endocrine to reduce renin-angiotensin II secretion to reduce blood pressure. Another hypothesis given by studies on device-guided breathing is that, modulating autonomous cardiovascular regulation by slowing down the breathing

frequency, will lower the baroreflex sensitivity, increasing the parasympathetic tonus, decreasing the BP. ⁽¹⁵⁾ Finally, the last mechanism of action is that music interventions can lead to increased brain dopamine levels via calmodulin dependent. This increases the dopamine levels that will inhibit sympathetic activity via dopamine-2 receptors which will also reduce the BP⁽¹⁶⁾.

A recent meta-analysis has included 20 Randomized Control Trial (RCT)s that evaluated the effect of music therapy for patients with hypertension (N = 2306). From this population, 1154 patients have received music therapy. The results showed an effective reduction of the systolic blood pressure, diastolic and heart rate. However, it wasn't indicated the type of music used⁽¹⁵⁾.

Another meta-analysis conducted for 24 years, included RCTs with a follow-up duration superior to 28 days. The search resulted in 1689 publications, having a total of 296 patients. Only 10 of these publications had followed the criteria, and pooling the mean reduction in blood pressure, each study showed reductions in both SBP and DBP. The mean age of the patients was 73.6 and 53% were male. It indicates that it seems to be a trend of a decrease of mean SBP and DBP using music intervention but did not reach a statistical significance. A note from this meta-analysis is the complicating factor, that is, the large variation in the type of music. There was highlighted that most of the interventions were classical, relaxing or slow music - and, possibly, slow music (60 to 80 beats per minute) with a duration of 30 min, should be most beneficial⁽¹⁶⁾.

From a systematic review, music resulted in improvement in SBP (by reducing it), compared to the control group. A nonsignificant difference in DBP was found for participants in the music group compared with control group. It concludes that music may improve SBP and should be considered as a component of care of hypertensive patients⁽¹⁷⁾.

A RCT had a total population of 87 hypertensive patients (46 males and 41 females) with a mean age of 61.1 years. The intervention group practiced deep breathing exercise guided by sound cues, and the control group listened to music during 8 weeks. 93.1% of them successfully completed this study. There was a significant reduction in systolic and diastolic blood pressure in both groups (slightly bigger on the control group). The blood pressure reduction between the two groups was not significant, as the values were very similar. They have conclude that the deep breathing exercise didn't augment the benefit of music in reducing BP⁽¹⁸⁾

Diving into more specific types of music, a recent RCT has given the background that "half of the hypertensive patients did not achieve the target blood pressure with pharmacotherapy, partly due to poor compliance". For this reason, the researchers wanted to understand the effect of Thai instrumental folk music listening on blood pressure in Thai hypertensive patients. The participants (N=120) were divided into the control group and the group that would be listening to Thai instrumental folk music, once a day for a month.

The results showed a significant reduction of the SBP and DBP on the music listening group, referring that this therapy could be used, simultaneously, with pharmacological treatment⁽¹⁹⁾.

A Prospective RCT was conducted on a population of prehypertensive or stage I hypertensives (N=100), who were randomly divided equally into two groups: on group 1 (music along with lifestyle modifications); on group 2 (only lifestyle modifications). The lifestyle modifications included: exercise, meditation, diet modification. Besides the lifestyle modification, the group 1 listened to *Bansurd* music⁴ (ancient side blown flute) for about 15 min daily, for 3 months, on their personal favorite device (mobiles, ipods, etc.). The final analysis was done on 49 participants from group 1 and 47 from group 2. As a result, there was a reduction on DBP (~2.5 mmHg) on group 1. The BP was monitored using a sphygmomanometer. The implementation of only lifestyle modifications didn't normalize the BP of group. This highlights that music can be a useful adjunct to normalize it⁽²⁰⁾.

Another RCT was conducted in a local elderly home in Adana, Türkiye, to investigate if the Turkish classical music has a positive effect on blood pressures and anxiety levels in elderly patients (aged > 60 years), for 28 days. They were divided, equally, into the music and control group. The intervention group would

⁴ The researchers have chosen this style (*Raga*) played by this particular instrument, *Bansuri*, because, according to ancient literature in music, a few *Ragas* of Indian music could normalize BP. Also, flute is one of the most common instruments used in musical pieces meant for relaxation or meditation in India.

listen to Turkish classical music for 25 minutes, and the control group would rest during the same time. Thereafter, the SBP and DBP were measured with a sphygmomanometer. The mean reduction in SBP was 13.00 mmHg in the music therapy group and 6.50 mmHg in the control group. The median reductions in DBP were 10 mmHg both in the music therapy and control groups. The study has concluded that both Turkish classical music and resting alone have positive effects in patients with hypertension⁽²¹⁾.

Finally, a RCT was conducted in a group of 30 pre-hypertensive young adults (18 - 25 years old), that were assigned into two groups, the music, and the control group⁵. The music used was “The Best Relaxing Piano and Flute Music Ever”, which was administered 5 days per week, for 30 minutes - in a total of 4 weeks. The space where they were listening to the music was comfortable and the temperature was also carefully regulated. The control group didn't listen to the music. However, in both groups was implemented two components of lifestyle modification: the Dietary Approach to Stop Hypertension (DASH) eating plan and a limit of daily sodium intake to less than 100 mmol/day. The BP was measured by Digital Blood Pressure measuring Device (Omron Sem-1 Model). As a result, there was a higher reduction in the mean SBP in the music group, comparing to the control one, and no difference in DBP between the groups. Following this

⁵ Although in this study, there were excluded young adults taking medications (anti-hypertensive), inclusive, this could be a refreshing perspective on music therapy, as in this study the DASH diet will be implemented in both groups.

information, music appears to be a promising tool to prevent the progression of pre-hypertension toward hypertension⁽²²⁾.

Critical Analysis

While analyzing the previous results, in some studies there was a significant reduction in one or both BP (SBP and DBP). None indicated an increase of these, nor a negligible reduction in both. Something in common to all is the need for studies with a larger population. Apart from the meta-analyses, the RCT only contained studies carried out in populations of 30 to 120 hypertensive patients. The duration of all is also something to improve, since only the (Kunikullaya et al., 2015) had a maximum duration of 3 months.

As for the intervention, one of the limitations is the fact that, sometimes, the music style wasn't indicated, and this could have a possible influence on the personal response. Based on the previous information, the *tempo* of the music seems to influence the BP. However, something that also deserves to be investigated is the relationship between the music style and the patient preference, to increase the effectiveness of therapy by prescribing a "tailored" music based on the preference. The specificities of the type of music presented in a few RCT are also relevant: from Thai to Turkish classical music, it seems to be a tendency towards a cultural preference, which may require a culturally shaped intervention for music, when thinking about the application of this strategy on a global scale. It could also be seen that studies were not only studying the influence of music on blood pressure, but also on other conditions such as stress,

that may blur the intended objective. More studies with well-defined cardiovascular variables, and better population selection criteria are also essential. Something missing in some studies is the description of the antihypertensive medication that the population was taking (if it is the same or not), which may also influence the results. Thus, there is still a lot of divergence on the best method, especially duration, to guarantee the best results. Divergence is also found in the possible cause-effect, being this a topic that needs to be studied.

While analyzing the participants from the RCT, is interesting to notice that most of the populations have > 60 years old, and, according to the information that they are the group that may not access so easily to cultural events due to socio-economics inequalities, it would be important to guarantee strategies that will promote an equal access to music-related cultural events / listening at home as an alternative.

Summarizing, there are still three main doubts/aspects to improve that remain: the traditional ones such as the age, the population, the duration of the study; improving the variables of the paper by clarifying that the only aspect to be studied is the interaction between music and hypertension; clarifying the music style and the pharmacological prescription.

Conclusion

High blood pressure is a metabolic risk factor for many non-communicable diseases. It was studied if music could be considered as a social prescription for hypertensive patients. Upon the results, there seems to exist a trend towards a decrease of BP in groups where music was introduced. However, there are still uncertainties regarding the possible cause-effects that justify this phenomenon. There are no clear recommendations on how music intervention should be prescribed. From the previous studies, the duration varied from 4 weeks to 3 months, and the time of music listening had varied from 15 to 30 minutes, daily. However, it seems that slower/classic/relaxing music may be the preferred music style for decreasing BP.

Considering the great potential of this intervention for its cost-effective characteristics, more robust, with a larger population and with more music styles studies are needed. Also, there is a need to clarify the cause-effect relationship between music intervention and blood pressure.

With proper studies, this approach seems to be a good complementary prescription to be applied.

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Annex

Author and year	Title	Type of study	N° of participants	Duration	Outcomes
Cao et al. (2023)	Adjuvant music therapy for patients with hypertension: a meta-analysis	Meta-analysis	2306		Music therapy can effectively control BP and heart rate, reduce the SBP (MD = - 9.00, 95%CI: - 11.99-- 6.00), DBP (MD = -6.53, 95%CI: -9.12-- 3.93), heart rate (MD = -3.76, 95%CI: - 7.32-- 0.20)
Kühlmann et al. (2016)	Systematic review and meta-analysis of music interventions in hypertension treatment: a quest for answers	Meta-analysis	296	≥ 28 days	Of the 1689 abstracts reviewed, 10 RCT were included. Random-effects pooling of the music intervention groups showed a trend toward a decrease in mean SBP from 144 mmHg to 134 mmHg, and in mean DBP from 84 mmHg to 78 mmHg. Fixed-effect analysis of a subgroup of 3 trials with valid control groups showed a significant decrease in pooled mean SBP and DBP in both intervention and control groups. A comparison between music intervention groups and control groups was not possible due to unavailable measures of dispersion.
Amaral et al. (2016)	Effects of music therapy on blood pressure of individuals with hypertension: a systematic review	Systematic Review			Music resulted in improvement in SBP (-6.58 95% CI: -9.38 to -3.79), compared with control group. A nonsignificant difference in diastolic blood pressure was found for participants in the music group compared with control group.
Kow et al. (2018)	The impact of music guided deep	RCT	87	8 weeks	There was significant reduction in SBP and DBP from baseline by 8

	breathing exercise on blood pressure control - A participant blinded randomised controlled study				weeks in both groups. The reduction in SBP in the control arm was 10.5mmHg compared to 8.3mmHg (p<0.001) in intervention group. DBP reduction in control and intervention groups were 5.2 mmHg (p<0.001) and 5.6 mmHg (p<0.001), respectively. The absolute difference in SBP reduction from baseline in intervention group and control group was -2.2 (95%CI: -7.8 to 3.5) and DBP was -0.4 (95%CI: -2.9 to 3.6). However, blood pressure reduction between the two groups was not significant.
Im-On et al. (2018)	Effect of Thai instrumental folk music on blood pressure: a randomized controlled trial in stage-2 hypertensive patients	RCT	120	1 month - Home BP (day 0 th and 30 th) -Office BP (day 0 th and 120 th)	Home SBP and DBP in the music listening group were significantly reduced compared with baseline (-9.5 ± 7.1 mmHg (95%CI -11.43, -7.64) and -6.1 ± 5.7 mmHg (95%CI -7.51, -4.53), respectively). Both home SBP and DBP at day 30th of the music listening group were significantly lower than in the control group (-6.0 mmHg (95%CI -8.58, -3.40) and -3.15 mmHg (95%CI -5.20, -1.09), respectively), while the differences of office SBP and DBP between two groups were not significant.
Kirthana Ubrangala Kunikullaya et al. (2015)	Combination of music with lifestyle modification versus lifestyle modification alone on blood pressure reduction	RCT	100	3 months	Mean of DBP pre and post intervention were overall = 85.1(6.8) and 83(8.7){P = 0.004}, awake = 87.7(7.6) and 85.9(9.2){P = 0.021}. Regression analysis showed association between DBP change and post-intervention stress score in the music intervention group. Significant change in BP was seen among those who were pre-hypertensives prior to intervention.

Tansel Bekiroglu et al. (2013)	Effect of Turkish Classical music on blood pressure: a randomized controlled trial in hypertensive elderly patients	Randomized Controlled Trial	60	28 days	The mean reduction in SBP was 13.00 mmHg in the music therapy group and 6.50 mmHg in the control group. The baseline adjusted between treatment group difference was not statistically significant (95% CI 6.80-9.36). The median reductions in DBP were 10 mmHg both in the music therapy and control groups. The between treatment group difference was not statistically significant (Mann-Whitney <i>U</i> test, $P = 0.839$). The mean reduction in HAMA-A was 1.63 in the music therapy group and 0.77 in the control group. The baseline adjusted between treatment group difference was not statistically significant (95% CI 0.82-1.92).
(Ali Mir et al., 2021)	Relaxing music reduced blood pressure and heart rate among pre-hypertensive young adults: A randomized control trial	Randomized Controlled Trial	30	4 weeks	There was a significant reduction in SBP (8.73 mmHg, $p < .001$) and HR (6.42 beats/minute, $p = .002$); however, the reduction in DBP (1.44 mmHg, $p = .101$) was not statistically significant in the music group. Control group did not exhibit any significant reduction in SBP (0.21 mmHg, $p < .836$), DBP (0.81 mmHg, $p < .395$) and HR (0.09 beats/minute, $p < .935$).

