LETTER TO EDITOR / LIST REDAKCII

EFFECTS OF VIBROACOUSTIC THERAPY ON PHYSIOLOGICAL RESPONSES RELATED TO STRESS AND ITS MEASUREMENTS IN ADULTS: A SCOPING REVIEW PROTOCOL

ÚČINKY VIBROAKUSTICKÉ TERAPIE NA FYZIOLOGICKÉ REAKCE SOUVISEJÍCÍ SE STRESEM A JEHO MĚŘENÍM U DOSPĚLÝCH: PROTOKOL SCOPING REVIEW

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ABSTRAKT
Východiska: Vibroakustická terapie (VAT) je zdravotnický přístup, který využívá kombinaci hudby a nízkofrekvenčních zvukových vibrací pro terapeutické účely. V klinické praxi je VAT používán pro management stresu. Poznání fyziologických reakcí souvisejících se stresem je však v souvislosti s VAT nedostačující.
Cíle: Cílem plánovaného scoping review je prozkoumat fyziologické reakce a jejich měření v kontextu výzkumných studií o VAT.
Metodika: Budeme realizovat scoping review dle metodiky Joanna Briggs Institutu. Použijeme strategii o třech krocích a budeme vyhledávat v těchto zdrojích – BMČ, CINAHL, EMBASE, ERIC, PubMed, ProQuest, PsycINFO, Scopus, Web of Science a navíc v Google Scholaru a dalších zdrojích šedé literatury (Clinical Trials a Current Controlled Trials). Vyhledávání nebude omezeno jazykem ani dobou publikace. Výběr relevantních studií a extrakce dat bude provedeno dvěma nezávislými hodnotiteli.
Výsledky: Výsledky vyhledávání budou prezentovány v tabulkové formě a prostřednictvím narativního popisu. Budeme analyzovat vliv VAT na stres a fyziologické reakce související se stresem za účelem zjistit, zda VAT podporuje stimulační nebo sedativní fyziologické reakce. Budeme také analyzovat charakteristiky nízkofrekvenčního zvuku a hudby, abychom zjistili jejich potenciál pro stres management.
Diskuze: Výsledky scoping review pomohou porozumět potenciálu VAT v rámci stres managementu a identifikovat vhodné způsoby měření. Tyto závěry mohou přinést důležité informace pro budoucí výzkum VAT a stresu u dospělé populace.

Klíčová slova: Stres. Fyziologická měření. Vibroakustická terapie. Hudba. Scoping review.

ABSTRACT
Background: Vibroacoustic therapy (VAT) is a healthcare approach that uses a combination of music and low frequency sound vibration for therapeutic purposes. In clinical practice, VAT is used for stress management but there is limited knowledge about stress-related physiological responses to VAT.
Objective: The aim of the planned scoping review is to explore physiological responses to stress and their measurements in the context of research studies on VAT.
Methods: We will conduct a scoping review according to the Joanna Briggs Institute methodology. We will use a three-step strategy and search the BMC, CINAHL, EMBASE, ERIC, PubMed, ProQuest, PsycINFO, Scopus, Web of Science databases as well as Google Scholar and other grey literature sources (Clinical Trials and Current Controlled Trials). There will be no limitation in language or publication period. Study selection and extraction of data will be done by two independent reviewers.
Results: The results of the search will be presented in a tabular form and accompanied by a narrative summary. We will analyse the effects of VAT on stress and stress-related physiological responses to find out if VAT tends to initiate sedative or stimulative physiological reactions. We will analyse also the characteristics of low-frequency sound and music that proves to have potential for stress management.
Discussion: The outcomes of the scoping review will help to understand the potential of VAT in stress management and identify suitable outcome measures. This may have important implications for future research of VAT and stress in adult population.

Key words: Stress. Physiological measurement. Vibroacoustic therapy. Music. Scoping review

INTRODUCTION

Stress is a common worldwide problem. It can be classified as acute, episodic, or chronic. It is caused by multiple stressors in modern society such as criminality, health care issues, medias and information, economics, etc. [1]. Chronic stress, due to its many varied symptoms, e.g. fatigue, headaches, difficulty sleeping, digestive problems, and low self-esteem, has a negative impact on quality of life. Furthermore, stress influences the neurobiological and neuroendocrine activity of the organism and

acts as an etiological factor in many diseases, e.g., diabetes mellitus or asthma [2, 3]. Currently, chronic stress has been implicated as an etiological factor in every psychiatric disorder in current nosological systems [2]. Current research in genetics and epigenetics accounts for gene-environment interactions in determining the response to stress and the development of mental illness [4].

Notwithstanding decades of research (modern theories of stress date back to the 1930s), an integrative theory of stress response and method of its measurement does not yet exist. The first definition only considered stress as a non-specific physiological response to any demand for change [5]. Further authors also accented various psychological and environmental factors. According to Monroe and Slavich [6], stress response measures include stress exposure (major life events or chronic stressors), environmental (prior and other stress exposures), psychological (personality, cognitive style, coping), neurobiological (HPA axis, sympathetic nervous system, genetics), behavioral (sleep/wake, diet, activity), and illness outcomes. Immediate stress response includes changes in the autonomous nervous system, heart rate, blood pressure, electrodermal activity, hormonal response, behavioral changes, increased alertness and vigilance, decrease in cognitive skills, and changes in perception [7].

Due to the complex and understudied relationship between the body's biochemical markers and the intensity of the perceived stress, multimodal measurements are recommended [8] including:

- Subjective perception of stress by psychological scales and questionnaires, e.g. Perceived Stress Scales [9] or the Visual Analog Scale for Stress [10].
- Measuring various biochemical markers in the research of stress, e.g. heart rate variability, galvanic skin response / skin conductance, electrocardiography (ECG), electroencephalogram, skin temperature, pulse photoplethysmography, respiration, pupil diameter, electromyography, or blood pressure. Physiologically, a stress reaction is related to the dominance of the sympathetic nervous system, whereas relaxation and coping with stress signalize the dominance of the parasympathetic nervous system. The connection between different physiological reactions and stress / relaxation response of the organism was described, although this issue has not been understood well so far [11].

Treatment of stress includes various preventive techniques, pharmacotherapy, cognitive-behavioral intervention, and mindfulness-based stress reduction techniques. Based on results of experimental studies [12], vibroacoustic therapy may be one potential approach for ameliorating the symptoms of chronic stress.

Vibroacoustic therapy (VAT) is an approach defined as using sinusoidal low-frequency sound in 30–120 Hz range complemented by music for therapeutic purposes [13]. Different methods and technologies are used to deliver VAT, but three main elements are typical for most of them – low frequency sound vibration, the client's preferred music listening, and practitioner support [14]. The application of low frequencies and music listening is also referred to as Vibroacoustic Treatment, Physioacoustic Therapy (PAT), Resonant Sensory Stimulation (RSS) [15] or a vibrotactile intervention [16]. The first prototype for the induction of low-frequency sound was created in the second half of the 20th century by the Norwegian music educator Olav Skille [14]. Later, due to increased development in modern technology, new types of equipment were designed which could induce a low frequency sound, e.g. Physioacoustic Sound System [17], the music vibration table MVT® [18], the HealBED [19], AcusticA – based on the "Harmonic Vibro-Message Unit" [20], and VIBROBED® [21] among others.

Some authors [14] report the positive effect of VAT on chronic stress; these effects were observed in the autonomous nervous system [22], pulse and blood pressure [23], and anxiety [24]. According to the effects on physiological responses, the auditory music is classified as stimulating and relaxing [25]. Low frequency sound vibration may induce a physiological response [26]. The two-pronged approach of music and low frequency sound vibration [18] – the music addressing psychological symptoms, the vibration for physiological symptoms – is typical for VAT although some practitioners sometimes use only low frequency sound without music [27].

Based on these previous studies, VAT may be an easily implemented preventive strategy for stress reduction in adults. Systematic reviews are needed to prove the effectiveness of VAT for chronic stress relief. However, there is no overview of vibroacoustic treatment programs used for stress management that could be used to prepare the protocol of such a systematic review and little is currently known about this topic. Therefore, a scoping review is

planned to explore the extent of the literature, map and summarize the current evidence, and inform future researchers and practitioners in the field [28]. The aim of the proposed scoping review is to explore the measurements and effects of physiological responses and subjective perception related to chronic stress in the context of research studies on vibroacoustic treatment. A preliminary search of Epistemonikos, the Cochrane Database of Systematic Reviews, the JBI Evidence Synthesis, and PROSPERO showed there is no systematic review or scoping review available on this topic. Review questions based on the PCC format for scoping reviews [28] were formulated:

- Review question 1: "What measurements of physiological responses or subjective perception related to chronic stress in adults in research studies on vibroacoustic therapy are employed?"
- Review question 2: "What effects of vibroacoustic therapy are reported in research studies on physiological responses and subjective perception related to chronic stress in adults?"

METHODS AND MATERIALS

The proposed scoping review will be conducted in accordance with Joanna Briggs Institute methodology for scoping reviews [28] and according to the extended PRISMA statement for scoping reviews [29]. The objectives, inclusion criteria, and methods for this scoping review are specified and documented in this prospectively registered protocol.

Inclusion criteria

- *Participants/population:* This scoping review will include adults of both sexes. We will consider typical population, as well as patients and persons with disabilities, health problems, and chronic disease. We will exclude studies in children and adolescents up to the age of 18 years or studies on mixed population (children, youths, adults) without distinctive analysis of results for the adult subgroup.
- *Concept:* This review will consider studies that included the measures of any biomarkers related to physiological stress reaction such as heart rate variability (HRV), measurement of salivary cortisol, galvanic skin response, and electromyography. We will analyze the different measurements used in the research studies and the effects of vibroacoustic therapy on physiological reactions and subjective perception related to chronic stress.
- *Context:* This review will focus only on physiological reactions related to chronic stress that were measured in the context of vibroacoustic therapy. We will include papers on various devices with technologically modified low frequency sound vibrations with / without music such as physioacoustic therapy, the music vibration table (MVT), and HealBED. Excluded will be any kind of vibration therapy based on mechanical oscillations (such as Vitafone or Whole Body Vibration) or vibroacoustic stimulation using musical stimuli without technologically modified low frequency sound such as resonance therapy (often described as vibroacoustic stimulation). The demographic context will be unlimited here. We will consider studies from clinical as well as non-clinical settings.
- *Types of study:* This scoping review will consider all quantitative research studies and also systematic reviews. Unpublished sources such as dissertations and conference abstracts will also be included. Text, opinion papers, all types of non-systematic reviews, bachelor theses, qualitative studies, and books (with exception of monographs with research studies) will be excluded.

Search strategy

A three-step strategy is used:

- Firstly, limited searches of PubMed and Scopus will be undertaken followed by analysis of the text words contained in the title and abstract, and of the index terms used to describe article (see Table 1 for an example of a full search strategy).
- Secondly, a search using all identified keywords and index terms will be undertaken across all included databases, searching for keywords in abstracts. The search strategy will be adapted for each included information source.
- Thirdly, the reference lists of all identified articles will be hand searched for additional studies.

Research studies published in all possible languages with title and abstract in English without any time limitation will be considered for inclusion in this review. The databases searched will include: Bibliographia Medica Čechoslovaca (Medvik), CINAHL plus, EMBASE, ERIC, PubMed, ProQuest Central, PsycINFO, Scopus and Web of Science.

Sources of grey literature to be searched include Google Scholar (first 100 hits), Clinical Trials, and Current Controlled Trials.

Study selection and data extraction

Following the search, all identified citations will be collated and uploaded into Zotero-5.0.85, and duplicates will be removed. Titles and abstracts of studies retrieved using the search strategy and those from additional sources will be screened independently by two reviewers (JD & JK) to identify studies that met the inclusion criteria outlined above. A third reviewer (EC) will be involved in cases of disagreement. Potentially relevant studies will be retrieved in full, and their full texts will be assessed in detail against the inclusion criteria by two independent reviewers (JD & JK). Reasons for exclusion of full-text studies will be recorded and reported in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews (PRISMA-ScR) flow diagram [29].

Data will be extracted from papers by two independent reviewers (JK & ZV) using a data extraction tool developed by the authors (see the data extraction tool filled for two studies found during the preliminary search in Table 2 and 3). The data extracted will include details about the author and year of publication, study design, geographic location, characteristics of participants, the type of VA device (brand name) and characteristics of intervention, the measurement tools for assessing outcomes, and key findings on the effects of VAT on physiological

Table 1. Search strategy for Scopus. Search was made on 29th of September, 2021 / searched in article titles / abstracts / keywords

No.	Search	Results
1	vibroacoustic therapy*	62
2	vibro-acoustic therapy*	9
3	vibroacoustic treatment	168
4	physioacoustic	10
5	"low-frequency sound stimulation"	6
6	vibrotactile intervention	94
7	vibroacoustic music	47
8	Somatron	21
9	1 – 8 OR	344
10	stress	2 735 058
11	physiologic*	1 214 795
12	heart rate	636 771
13	electromyography	125 192
14	galvanic skin response	9 457
15	cortisol	80 868
16	adrenaline	26 055
17	dopamine	241 486
18	electroencephalogram	108 499
19	EEG	138 019
20	SpO*	2 051 997
21	respiration	297 387
22	pupil diameter	6 199
23	pulse	909 957
24	temperature	5 304 471
25	brain assessment	198 637
26	10 – 25 OR	12 511 809
27	9 + 26 AND	87

Table 2 Data extracted tool filled for a study found during the preliminary search [12]

Author and year	Delmastro, DiMartino, Dolciotti, 2018 [12]
Title	Physiological Impact of Vibro-Acoustic Therapy on Stress and Emotions through Wearable Sensors
Study design / JBI level of evidence	Case series
Geographic location / setting	Italy / volunteers from the same working environment
Characteristics of participants	8 young adults (4 f / 4 M), 30-41 y, 6 of them married with children at scholar age, and 2 not married. 2 women have a past experience with a neurological or psychiatric disease in their family, 2 women characterised by anxiety and one of them with a previously diagnosed autoimmune thyroid disease (a pharmacological treatment). One man and a woman presented an anxiety condition related to the health status of their family.
Type of VA device (brand name)	AcousticA, based on their patent "Harmonic Vibro-Message Unit"
Characteristics of intervention	Selected relaxing melodies, 20 min., 20Hz-17kHz
Measurement tools	Stress related (measured baseline, VAT, recovery): HRV; GSR Other: The State-Trait Anxiety Inventory test (the sample was not homogenous); Customised satisfaction survey including questions about their perception of the therapy
Effects of VAT on physiological reactions related to stress	General decreasing trend in HR (heart rate), SCRs (skin conductance response) and their amplitude, confirming the relaxing component of therapy. A person with high values in State-Trait Anxiety Inventory differed (according to authors long-term application of VAT would be needed)

Table 3 Data extracted tool filled for a study found during the preliminary search (Zheng et al., 2019)

Author and year	Zheng et al., 2009
Title	Effects of a low-frequency sound wave therapy programme on functional capacity, blood circulation and bone metabolism in frail old men and women
Study design / JBI level of evidence	Single-blind randomized, controlled trial
Geographic location / setting	Finland; 2 senior service centres
Characteristics of participants	49 participants Health problems: Frail elderly (up to 12 diagnosed diseases) Gender: 14 males/35 females; Age: 62-93y
Type of VA device (brand name)	Next Wave Ltd, Finland (Physioacoustic Sound Wave Therapy System (reclining chair)
Characteristics of intervention	Intervention group (n=30): VAT (3x a week, 30min. session, 6 months; 1x a month a placebo session) Control group (n=19): no intervention VAT: 27-113 Hz, 9 different combinations of the rhythms and frequencies during the entire intervention
Measurement tools	Stress related: blood pressure (measured by standard automatic sphygmomanometer pre/post-test); skin surface temperature (measured by thermistor with probes during sessions) Other: weight/height; bioimpendence assessments for body composition; peripheral quantitative computed tomography (PQCT) assess. (measuring bone mineral density); blood serum (cholesterol, triglycerides, high-density and low-density and very low-density lipoprotein) + osteocalcin (marker of bone turnover), tartrateresistant acid phosphatase (marker of bone resorption), assessment of isometric muscle strength and balance (dynamometer chair and force platform)
Effects of VAT on physiological reactions related to stress	No statistical difference in blood pressure and skin temperature (blood pressure decreased significantly in each session including placebo sessions and control group; skin temperature significantly higher at the end of sessions including placebo sessions)

reactions related to stress. Any disagreements that arise between the reviewers (JD & JK) will be resolved through discussion or with a third reviewer (EC). The results of the search will be presented in a tabular form and accompanied by a narrative summary.

CONCLUSION

The proposed scoping review will provide an overview of physiological reaction in any adult population in the context of VAT. Its outcomes will deepen our understanding of the potential of low frequency sound and music on stress and will bring implications for future research. Based on this knowledge it will be easier to suggest a suitable methodology for researching the impact of VAT on stress in concrete clinical population.

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