The effects of binaural beat technology on physiological and psychological outcomes in adults: a systematic review protocol

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Review question

What are the effects of binaural beat technology on physiological and psychological outcomes in adults?

Review objective

The review objective is to determine the current evidence related to the effectiveness of binaural beat technology on physiological and psychological outcomes in adults.

Background

Mental health problems are important health issues in this century, which can severely affect people’s health and daily life. Depression is a common mental health problem and has been reported as one of the ten leading causes of disability-adjusted life years (DALYs) lost.
a quantification of the burden of disease from mortality and morbidity. One DALY can be considered of as one lost year of "healthy" life. The World Health Organization\(^1\) projected that depression will be the top three causes of DALYs lost by 2030. Literature indicates that depressed moods threaten a person's life and more attention should be paid to this issue. Another common mental health problem is anxiety. Anxiety can result in negative alterations in physiological and psychological functions.\(^2\) Adults suffering mental health problems, such as depression and anxiety, are often managed by antipsychotic medications. Given the concerns of detrimental side effects caused by antipsychotic drugs, use of non-pharmacological care strategies has become vital.

Use of music has been suggested to be effective in managing psychological and emotional problems. Music has been shown to positively influence a broad range of conditions including alleviating anxiety, promoting relaxation, improving mood, reducing pain, decreasing agitation, improving exercise performance and increasing food intake among various populations.\(^3\) Music has shown to have a beneficial impact on physiological conditions such as heart rate, blood pressure, respiratory rate, myocardial oxygen consumption, gastrointestinal function and pain.\(^3\)–\(^8\) Music can also have positive impact on psychological and social health such as reducing fear, anxiety, stress and grief, and promoting expression, self-determination, cooperation, relationships and enhanced communication.\(^7,9\)

Binaural beats technology is a type of auditory processing artifact that has been developed in recent years, and has been used with music to improve physical and mental health\(^10,11\). The binaural beat theory was proposed in 1973 by Oster.\(^12\) Oster proposed that the effect on auditory brainstem responses depends on the different frequencies of each tone. For example, if a pure tone with a frequency of 400 Hz is presented to one ear, and a comparable pure tone with a frequency of 410 Hz is presented to the other ear, your brain “hears” a third frequency with a binaural beat of 10 Hz, which is the exact difference between the two frequencies.\(^10,13,14,15\)

Electroencephalography changes when one is listening to beats: \(\alpha\) waves (8–13 Hz) indicating relaxation; \(\beta\) waves (13–25 Hz) involving cognitive activity and logical thinking in an active state of consciousness; \(\theta\) waves (4–8 HZ) relating with the subconscious; and \(\delta\) waves (<4 Hz) involving a deep sleep state.\(^16\) The binaural beats stimulate the brainstem automatic responses.\(^12,13,17\) Binaural beat tones can affect brainwave activity frequency, which may have an effect on states of consciousness, psychomotor performance and mood.\(^14,15,18\)

Studies have reported the effects of binaural beat tones on physiological and psychological outcomes. Wahbeh et al.\(^13\) studied the binaural beats in healthy adults and found a significant decrease in insulin-like growth factor-1 and dopamine. Another study by Wahbeh\(^14\) found that binaural beats improved depression and immediate verbal memory recall in healthy adults. Binaural beats were found to decrease acute preoperative anxiety among ambulatory surgery
Binaural beats can also reduce anxiety. Currently, there is no review paper focusing on the effects of binaural beat technology on physiological and psychological outcomes in adults. This review will determine the current best evidence on the effects of binaural auditory beats in adult.

**Keywords**

binaural beat; binaural auditory beats; binaural beat entrainment; adult, physiological; psychological; depress*; anxiety; anxious; blood pressure; electroencephalography; heart rate variability

**Inclusion criteria**

**Types of participants**

This review will consider studies that include all adults who are aged 18 or over.

**Types of intervention(s)/phenomena of interest**

This review will include studies that evaluate the effects of binaural beat technology on physiological and psychological responses in adults. The comparator will be no binaural beat technology.

**Types of outcomes**

This review will consider studies that include physiological and psychological outcomes.

The primary outcomes include depression and anxiety.

The secondary outcomes are blood pressure, electroencephalography and heart rate variability.

**Types of studies**

This review will consider any experimental study design including randomized controlled trials, non-randomized controlled trials, quasi-experimental, and before and after studies. Observational, cohort, case-control and qualitative studies will be excluded.

**Search strategy**

The search strategy incorporates both published and unpublished studies. A three-step search strategy will be utilized in this review. An initial limited search of MEDLINE and CINAHL will be undertaken followed by an analysis of the text words contained in the title and abstract, and of the index terms used to describe article. A second search using all identified keywords and
index terms will then be undertaken across all included databases. Thirdly, the reference list of all identified reports and articles will be searched for additional studies. Authors of primary studies will be contacted for missing information or to clarify unclear data. Studies published in English or Chinese will be considered for inclusion in this review. Studies from all time periods up to the commencement of the search will be considered for inclusion in this review.

The databases to be searched include: PubMed, CINAHL, EMBASE, PsyInfo, PsychArticles, JBI, Cochrane Library, Centre for Reviews and Dissemination as well as Chinese publication databases. The Chinese databases will include:

- Chinese Electronic Theses and Dissertations Service (http://www.cetd.com.tw)
- National Central Library (http://www.ncl.edu.tw/journal/journal_docu01.htm)

The search for unpublished studies will include:

- http://mednar.com/mednar/

Initial keywords to be used will be:

binaural beat, binaural auditory beats, binaural beat entrainment, adult, physiological, psychological, depress*, anxiety, anxious, blood pressure, electroencephalography and heart rate variability

Corresponding words in Chinese will be used to search Chinese language databases.

**Assessment of methodological quality**

Papers selected for retrieval will be assessed by two independent reviewers for methodological validity prior to inclusion in the review using standardized critical appraisal instruments from the Joanna Briggs Institute Meta Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI) (Appendix I). Any disagreements that arise between the reviewers will be resolved through discussion, or with a third reviewer.

**Data collection**

Data will be extracted from papers included in the review using the standardized data extraction tool from JBI-MAStARI (Appendix II). The data extracted will include specific details about the interventions, populations, study methods and outcomes of significance to the review question.
and specific objectives. Authors of primary studies will be contacted for missing information or to clarify unclear data.

**Data synthesis**

Quantitative data will, where possible, be pooled in statistical meta-analysis using JBI-MAStARI. All results will be subject to double data entry. Effect sizes expressed as odds ratio (for categorical data) and weighted mean differences (for continuous data) and their 95% confidence intervals will be calculated for analysis. Heterogeneity will be assessed statistically using the standard Chi-square. Plausible explanations for variations in treatment effect will be explored using subgroup analyses. Where statistical pooling is not possible the findings will be presented in narrative form including tables and figures to aid in data presentation where appropriate.

**Conflicts of interest**

None

**Acknowledgements**

None
References


Appendix I: Appraisal instruments

MAStARI Appraisal instrument

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**JBI Critical Appraisal Checklist for Randomised Control / Pseudo-randomised Trial**

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Overall appraisal:  Include ☐ Exclude ☐ Seek further info. ☐

Comments (Including reason for exclusion)

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Appendix II: Data extraction instruments

MAStARI data extraction instrument

JBI Data Extraction Form for Experimental / Observational Studies

Reviewer ______________________ Date ______________________
Author ______________________ Year ______________________
Journal ______________________ Record Number ______________________

Study Method

RCT □ Quasi-RCT □ Longitudinal □
Retrospective □ Observational □ Other □

Participants

Setting

Population

Sample size

Group A _______________ Group B _______________

Interventions

Intervention A

Intervention B

Authors Conclusions:

Reviewers Conclusions: