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The impact of music tuned to 432 Hz on human behaviour: A Systematic Review

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ABSTRACT

Music has always held an important role in human society. Scientist have explored its therapeutic possibilities on multiple occasions, and music proved itself as a very effective tool in in numerous areas. This article aims to review available research focusing on the recent phenomenon of 432 Hz music and its potential beneficial effects. This review represents the first attempt at analysing the results of scientific research on this tuning. Electronic databases were searched for articles on the topic, and thirteen entries were included in the systematic review after full-text assessment. The results presented a mixed picture, and a clear understanding of the effects of 432 Hz could not be reached due to several limitations. Further research is needed to better evaluate 432 Hz effectiveness as a potential non-invasive therapeutic aid.

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INTRODUCTION

Music has a profound influence on many different domains of human psychology and physiology. Over the course of many years of scientific research, the multipotentiality of music has intrigued scientists, who studied the possibility of exploiting its beneficial effects. Music has proven to be effective on a variety of areas, such as pain reduction (Lee, 2016), preoperative anxiety (Bradt, Dileo & Shim, 2013), cardiovascular health (Trappe, 2010), and physical performance (Terry, Karageorghis, Curran, Martin & Parsons-Smith, 2020), to name a few. Peculiar and controversial effects also emerged, such as the Mozart effect, an enhancement in spatial task performance after the exposure to the first movement of Mozart sonata KV 448 (Pietschnig, Voracek & Formann, 2010). This effect, initially observed by Rauscher, Shaw & Ky (1993), was incredibly hard to replicate in subsequent research, and to this day little support for the Mozart effect is available (Pietschnig et al., 2010).

In this systematic review, I will focus on an emerging area of scientific enquiry that centre on assessing the benefits of a recent internet phenomenon: music tuned at 432 Hz, which has attracted listeners from all over the world (Rosenberg, 2021). Proponents of this frequency advocate for its beneficial effects compared to standard 440 Hz tuning (Tuis, 2010) (Crotti, 2017), and a quick search on YouTube can yield results with millions of views. However, the roots of this movement are far more ancient: in 1989, the Schiller Institute, an entity created by Lyndon LaRouche, petitioned the Italian legislature to change the worldwide standard pitch of A-440Hz to the slightly lower A-432 Hz (Rosenberg, 2021). Although this campaign was supported by many relevant names in the opera, it was ultimately unsuccessful (Rosenberg, 2021). Even Giuseppe Verdi advocated for the lowered A-432 Hz, considered more optimal for his music (Rodríguez, 2016).

Nowadays, the debate has evolved beyond the intent of preservation of Western Art music towards the potential implications that this frequency could have on listeners (Rosenberg, 2021). 432 Hz has become a niche musical preference among a small community of listeners, who create, consume, and share music, along with testimonies and know-how (Rosenberg, 2021). A common practice involves converting music from 440 Hz to 432 Hz, by slowing down (by 32 hundredths of a tone) the original pitch of the track thanks to software like Audacity (Calamassi & Pomponi, 2019) (Rosenberg, 2021). However, according to Prince Charles Alexander, professor at Berklee College of Music, most listeners can't discern the difference between A-440 Hz and A-432 Hz (Fact Check-Debunking, 2021).

This systematic review aims to evaluate existing research and synthesize data to provide a comprehensive overview of the impact of the music tuned to 432 Hz on human physiology and psychology. A comprehensive search of scientific databases yielded a selection of 13 articles for

inclusion. The results of this review may help clarify the potential benefits and limitations of this tuning in music therapy and wellness practices.

METHODS AND MATERIALS

Databases and search strategy

PubMed, PsycNet, Cochrane, SpringerLink, ScienceDirect and Google Scholar databases were analysed using different keywords, often between quotation marks to maximize relevancy (**Table 1**). Only articles with an abstract written either in English or Italian were assessed, with no restriction on publication dates. Following the removal of 24 duplicates, articles were then excluded based on title, abstract and full-text assessment in accordance with PRISMA guidelines (Page et al., 2021).

Table 1. Databases and search terms

Database	Keywords
PubMed	432 Hz music
PsycNet	432 Hz music / 432 Hz pitch
Cochrane	432 Hz music
SpringerLink	“432 Hz music”
ScienceDirect	“432 Hz music”
Google Scholar	“432 Hz music” / “432 Hz pitch” / “432 Hz sound”

Study Selection Criteria

The eligible studies were selected based on the following inclusion criteria:

1. Type of studies: all research articles, regardless of study design, entirely written either in English or Italian, irrespective of publication date.
2. Type of participants: only human subjects regardless of age or health.
3. Outcome measure: qualitatively or quantitatively discussed the effect of music tuned to the specific frequency of 432 Hz on the well-being of the participants.

Studies excluded did not address the effects of 432 Hz frequency, were conducted without the involvement of human subjects or did not meet the language requirements. Studies without results or studies without clear understanding of the influence of 432 Hz frequency on participants were also excluded.

The PRISMA flowchart (**Fig.1**) portrays the selection criteria used in this review. I independently screened titles and abstracts to assess compliance with inclusion criteria. Full-text articles of the

eligible studies were then acquired and evaluated to further verify their compliance. Citing articles and references of the eligible papers were also assessed.

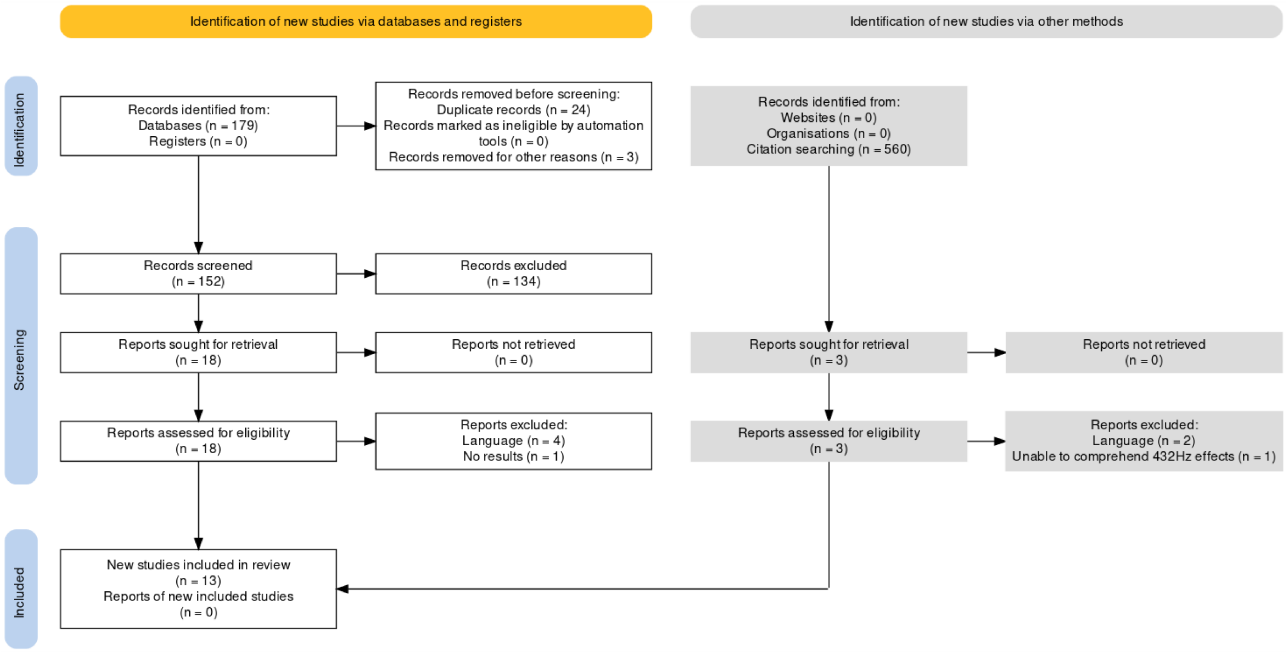

Fig.1 Flowchart of the systematic review (Haddaway, Page, Pritchard & McGuinness, 2022).

Data extraction and synthesis

The extracted data were organized within an Excel spreadsheet. Emphasis was placed on number, health and type of participants; pre-intervention findings; intervention details and outcomes; methodology implemented; and whether the music was composed in 432 Hz or converted later using specialized software.

RESULTS

Study Characteristics

Fig.1 illustrates the study selection criteria in detail. 179 articles were found during the initial research. 24 duplicates were removed, with an additional 3 entries excluded for other reasons (**Table 2**). Of the remaining 152 articles, 134 were excluded after screening title and abstract (**Table 2**) and 18 were assessed for eligibility. 13 articles were included as 5 did not satisfy the admission criteria (**Table 3**). Citating articles and references of the eligible articles were also analysed, with 560 entries identified. 3 were assessed for eligibility, but did not respect the inclusion criteria (**Table 3**).

Table 2. Number of articles excluded sorted by reason

Database	Results	TrialSearch	No Information	No human subjects	Language	Not pertinent	Study protocol
PubMed	13	0	0	2	0	3	0
PyscNet	0	0	0	0	0	0	0
Cochrane	12	2	1	0	0	0	0
SpirngerLink	1	0	0	0	0	0	0
ScienceDirect	5	0	0	1	0	2	0
Google Scholar	135	0	0	2	0	111	1

Table 3. Articles excluded and reasons, after full-text assessment.

Author, year	**Reasons for exclusion**
Calamassi & Bambi (2023)	No results published
Erdal et al. (2021)	Language
Seprian, Hidayah & Masmuri (2023)	Language
Obregón & C.R (2017)	Language
Penagos & Castillo (2022)	Language
Prioreschi, Coriasco, Francioni, Paternostro & Del Moro (2021)	Unable to comprehend the effects of the 432 Hz frequency on the participants
İlgar, Polat & Bala (2021)	Language
Fastl, Patsouras & Rader (2003)	Language

Detailed study descriptions

This section will provide an outline of the studies included in this systematic review. Emphasis will be placed on the aims, methodologies, cohort of participants and interventions implemented, so to offer a detailed understanding of the various approaches used to analyse the impact of 432 Hz on well-being.

Di Nasso et al. (2016) investigated the effects of the 432 Hz music on the perception of anxiety during endodontic treatment, dividing patients scheduled for root canal procedure in two groups, listening or control. The listening group had music tuned to 432 Hz reproduced during the treatment, while control group proceeded without any music (Di Nasso et al., 2016). Before the dental intervention, the interviewer administered Corah's Dental Anxiety Scale (Corah's DAS) and objective measures of

vital signs (heart rate, systolic blood pressure, diastolic blood pressure) were recorded before, during and after the procedure (Di Nasso et al., 2016).

Daokar et al. (2018) evaluated the impact of the 432 Hz frequency and audiovisual aids on the anxiety level of patients. Patients with irreversible pulpitis or pulp necrosis on maxillary and mandibular molars were randomly divided into three groups: listening to music tuned to 432 Hz, audiovisual aid, and control (Daokar et al., 2018). Participants initially completed Corah's DAS, then vital parameters (diastolic blood pressure, systolic blood pressure, heart rate and respiratory rate) were measured (Daokar et al., 2018). Those measurements were again monitored after the rubber dam isolation and re-evaluated after its removal (Daokar et al., 2018). Music or videos were played during the endodontic procedure according to the subject preferences in the respective intervention groups, while in the control condition nothing was reproduced (Daokar et al., 2018). Overall anxiety was measured objectively by vital signs and subjectively by Corah's DAS, and those measures were then compared (Daokar et al., 2018).

Halbert et al. (2018) analysed 16 individuals affected by high blood pressure to assess the effects of low frequency music on this cohort. Subjects were divided in 2 groups, with each scheduled for 2 visits: an experimental and a control one (Halbert et al., 2018). The order of the sessions was randomized for every participant, and both visits initially consisted of 20 minutes of movie and 10 minutes of stressor exposure involving mental arithmetic (Halbert et al., 2018). Participants were equipped at the beginning of the experiment with devices to measure blood pressure and heart rate, and after an initial blood draw, patients were instructed to relax for 20 minutes (Halbert et al., 2018). Then, only during the experimental visit, subjects listened to music alternating between 432 Hz and 440 Hz frequencies for 30 minutes, with each frequency lasting 10 minutes (Halbert et al., 2018). Group A had the frequency shifted from 440 Hz to 432 Hz and then back to 440 Hz, while group B followed the opposite pattern (Halbert et al., 2018). During the control session, no music was reproduced, the participants only watched a movie (Halbert et al., 2018). Lastly, during the last 10 minutes of each visit, subjects were required to perform mental arithmetic (Halbert et al., 2018). Systolic blood pressure, diastolic blood pressure, heart rate and blood samples were retrieved at different time points during the experiment (Halbert et al., 2018).

Calamassi & Pomponi (2019) focused on the potential health benefits that music tuned to 432 Hz might have compared to the standard 440 Hz frequency. This study consisted in 2 groups taking part in 2 listening sessions, with a 24-hour washout period between them (Calamassi & Pomponi, 2019). Every group listened to both music tuned to 432 Hz and 440 Hz in different sessions, and the starting sequence was determined at random (Calamassi & Pomponi, 2019). In the second listening session

the frequencies were reversed (Calamassi & Pomponi, 2019). Vital parameters, including blood pressure, heart rate, respiratory rate and oxygen saturation were recorded before and after the intervention, and five questionnaires were implemented to assess subjective feelings (Calamassi & Pomponi, 2019). Lastly, attention levels were measured by two nurses who observed participants' behaviours and filled a scoring grid (Calamassi & Pomponi, 2019). A corrigendum for this study was issued in 2020, correcting an error regarding the result observed in one variable (Calamassi & Pomponi, 2020).

Dubey, Kumar, Singh, Jha & Kumar (2019) investigated the effects of 432 Hz upon the sleep quality and latency among subjects with delayed sleep latency. Only participants who could achieve N2 stage in 2 previous studies were included, and all of them were scheduled for daytime nap studies with and without music (Dubey et al., 2019). EEG, electrocardiogram (ECG) and electromyogram (EMG) were implemented during the duration of the nap for a minimum of 1 hour and 30 minutes (Dubey et al., 2019).

Aravena et al. (2020) addressed the influence of 432 Hz on anxiety levels of individuals scheduled for simple dental extraction. Patients were randomly divided in three groups: two intervention conditions (432 Hz and 440 Hz) and a silent control group. To assess dental anxiety, Corah's Modified Dental Anxiety Scale (Corah's MDAS) was implemented, along with the withdrawing of saliva samples for cortisol analysis (Aravena et al., 2020). Both were carried out before and after the procedure (Aravena et al., 2020). Interventions and measurements were performed between 2 pm and 4 pm to monitor cortisol levels according to the circadian cycle (Aravena et al., 2020). The protocol was the same for all conditions, consisting of a 15-minute listening session using headphones in the operating room; however, only the intervention conditions were exposed to music (Aravena et al., 2020).

Calamassi, Luciesare, Pomponi & Bambi (2020) explored the potential advantages of 432 Hz over 440 Hz in enhancing sleep among patients with spinal cord injuries. Patients were divided in 2 groups: the first one received MP3s containing music tuned to 432 Hz, while the second was provided with music at 440 Hz (Calamassi et al., 2020). They were invited to listen to music for at least 30 consecutive minutes a day for 10 continuous days (Calamassi et al., 2020). During this period, quality of sleep and stress levels were measured using a modified version of the Sleep Scale and Perceived Stress Scale (PSS), respectively, and patients were instructed to notify any factor emerging during the listening period that may have interfered with the measurements (Calamassi et al., 2020). After a wash out interval, the groups were reversed and the same instruments as in the first phase were implemented (Calamassi et al., 2020). Following the conclusion of the second listening phase, a

questionnaire evaluating the adherence to the protocol, subjective perceptions and any new factor that arose in the second period was administered (Calamassi et al., 2020).

Menziletoglu, Guler, Cayır & Isik (2021) compared binaural beats to music tuned to 432 Hz to understand which one is more effective at reducing dental anxiety in patients scheduled for mandibular third molar surgery. VAS was implemented to evaluate preoperative anxiety, and patients were divided into three conditions: binaural beats, 432 Hz and control (Menziletoglu et al., 2021). The binaural beats group and the 432 Hz group listened for 10 minutes to either binaural beats (tuned 220 Hz for the right ear and 210 Hz for the left one) or 432 Hz music, respectively, whereas the control group simply waited 10 minutes in the operating room (Menziletoglu et al., 2021). All patients received local anaesthesia prior to the procedure, and VAS was obtained before the administration of local anaesthesia and after the intervention (Menziletoglu et al., 2021).

Buzzi et al. (2022) investigated the effects of music tuned to 432 Hz on sedation levels – assessed using the COMFORT Behaviour Scale (CBS) - in Iraqi patients admitted to the Pediatric Intensive Care Unit (PICU). The participants were exposed to music intervention twice a day, reproduced continuously for 1 hour using stereo speakers (Buzzi et al., 2022). Nurses filled the CBS before, after 30 minutes and after 1 hour of musical intervention; along with the recording of vital signs such as heart rate, respiratory rate, blood pressure and oxygen saturation (Buzzi et al., 2022).

Calamassi et al. (2022) focused on the possible influence of 432 Hz on the reduction of anxiety and stress in emergency nurses during the COVID-19 pandemic. Participants were randomized in three study groups: one listening to music tuned to 432 Hz, one listening to music tuned to 440 Hz and a control group (Calamassi et al., 2022). The listening parties took place during the nurses' breaks from their shifts, and subjects from the control group had the possibility to perform their usual break activities (Calamassi et al., 2022). Vital parameters (heart rate, blood pressure, respiratory rate) were recorded, as well as pain perception which required the use of the Visual Analog Scale (VAS) (Calamassi et al., 2022). Lastly, State-Trait Anxiety Inventory (STAI X1) was implemented to assess stress and anxiety (Calamassi et al., 2022). Other implementations comprehended different tools to investigate different aspects. These tools were used to assess observable behaviours and to evaluate satisfaction with the listening experience (Calamassi et al., 2022). In addition, a blank space was provided to describe sensations about the listening party, or any activities performed during the break (Calamassi et al., 2022). Another point of interest was the productivity perceived by the nurses after the break, both with and without music (Calamassi et al., 2022).

Kopka (2022) investigated the impact that music tuned to 432 Hz and 440 Hz may have on perceived arousal. 12 excerpts from 6 songs tuned to the studied frequencies were implemented in the study

(Kopka, 2022). In addition, 2 excerpts from 2 songs were used to adjust the volume and familiarizing participants with the experiment (Kopka, 2022). Excerpts were played twice, apart from the two used to regulate the volume – totalling 26 (Kopka, 2022). Control questions were introduced to exclude participants who did not take part in the experiment conscientiously, along with a 10-point Likert scale used to rate the songs in terms of perceived hypoarousal or hyperarousal (Kopka, 2022).

Branislav (2022) implemented the electroencephalogram (EEG) to analyse the impact of 432 Hz and 440 Hz music on right-handed patients. The focus of this study was on the emotional response and degree of liking of the musical content (Branislav, 2022). To assess the emotional response, brain reactions of beta rhythm, alpha levels of the frontal cortex and theta waves were monitored (Branislav, 2022).

The results of each individual article will be discussed and analysed in detail in the subsequent section.

DISCUSSION

ANXIETY

Calamassi et al. (2022) studied the possible effects of 432 Hz on alleviating anxiety and stress in emergency nurses during the COVID-19 pandemic, using STAI X1 to measure these variables. They found that STAI X1 scores decreased significantly in all 3 groups, with no significant differences between them (Calamassi et al., 2022). However, in the 432 Hz condition, male subjects experienced a statistically significant reduction in STAI X1 scores in respect to female subjects (Calamassi et al., 2022).

ENDODONTIC ANXIETY

Dental anxiety is one of the main reasons for missing dental appointments (Aravena, Almonacid & Mancilla, 2020), and it comprehends emotions ranging from mild apprehension to extreme anxiety (Di Nasso et al., 2016).

Di Nasso et al. (2016) assessed the effects of 432 Hz on the perception of anxiety during root canal therapy. The study concluded that music had effects on the subjective perception of anxiety during endodontic therapy: patients felt more relaxed, and music distracted them form the dental instruments noises (Di Nasso et al., 2016). Unfortunately, there were no groups using music tuned to the standard diapason of 440 Hz, so distinguishing the specific effects of the 432 Hz frequency from the general

benefits that any music might have is challenging. Also, the interventions were performed by different operators with different emotional approaches, possibly producing variability (Di Nasso et al., 2016).

Daokar et al. (2018) further analysed this matter, evaluating the influence of the 432 Hz frequency and audiovisual aids on dental anxiety. In the 432 Hz condition, a significant decrease in heart rate was found, followed by a decrease in systolic blood pressure, although not significant (Daokar et al., 2018). A small increase in diastolic blood pressure and a statistically significant increase in respiratory rate was also observed (Daokar et al., 2018). Those objective measures were considered indicative of reduced anxiety in the participants of the 432 Hz condition (Daokar et al., 2018). However, the subjects in the audiovisual condition experienced a more significant decrease of systolic blood pressure and heart rate, suggesting higher anxiety reduction (Daokar et al., 2018). The authors attribute this reduction to the shift in attention towards relaxing videos rather than anxiety-inducing dental equipment (Daokar et al., 2018). In addition, there was a significant rise in diastolic blood pressure and respiratory rate compared to the 432 Hz condition (Daokar et al., 2018). As for the previous study by Di Nasso et al. (2016), due to the absence of intervention groups using music tuned to 440 Hz, the challenge of distinguishing the effects of the 432 Hz frequency from the general benefits that any music might produce remains.

Aravena et al. (2020) addressed this limitation. Targeting individuals scheduled for simple dental extraction, Corah's MDAS and salivary cortisol were used to assess anxiety levels (Aravena et al., 2020). Music tuned to both 432 Hz and 440 Hz was found to be effective in significantly decreasing anxiety levels compared to the control group, according to the Corah's MDAS results (Aravena et al., 2020). There were no differences in emotional response and perception of anxiety when using this questionnaire between musical frequencies (Aravena et al., 2020). Regarding salivary cortisol, the authors concluded in the abstract that cortisol levels in the 432 Hz condition were significantly lower compared to 440 Hz and control group (Aravena et al., 2020). However, according to the data reported in the results of the study, while there's indeed a decrease in cortisol levels in both the 432 Hz and 440 Hz conditions and a slightly increase in the control condition, the changes are not significant (P=0.93, P=0.87, P=0.99, respectively) (Aravena et al., 2020).

A more recent study by Menziletoglu et al. (2021) compared binaural beats to 432 Hz music to assess which one is more effective at reducing endodontic anxiety in patients appointed for mandibular third molar surgery. A significant decrease in anxiety in both binaural and 432 Hz conditions was observed, although the reduction was statistically comparable across the two groups (Menziletoglu et al., 2021). However, 432 Hz music was found to be more effective in reducing anxiety (Menziletoglu et al., 2021).

ATTENTION

According to a study by Calamassi & Pomponi (2019), which investigated the possible health benefits of 432 Hz on human well-being, mean attention levels rose during the listening of 432 Hz music. No such effect was observed in the 440 Hz condition (Calamassi & Pomponi, 2019).

Branislav (2022) used EEG to analyse the effects of 432 Hz and 440 Hz music on right-handed patients, with emphasis over the emotional response and degree of liking of the content. A significant mean difference in the beta wave activity was observed, indicating that music tuned to 432 Hz might influence the brain's state of alertness and concentration (Branislav, 2022).

PRODUCTIVITY

The previously discussed study by Calamassi et al. (2022), which focused on reducing perceived anxiety and stress levels in emergency nurses during the COVID-19 pandemic, assessed post intervention productivity by means of a questionnaire. Both auditory groups were more productive after the intervention compared to the control condition, with no difference between 440 Hz and 432 Hz (Calamassi et al., 2022).

SLEEP

Dubey et al. (2019) analysed how 432 Hz music influences sleep quality and latency in subjects with delayed sleep latency. A nearly significant difference was observed in the latency of stage 1 of the NREM sleep in the music condition, as well as a highly significant difference in the energy of the alpha frequencies in the right frontal and temporal regions (Dubey et al., 2019). This effect was also acknowledged in beta and alpha frequencies in the right frontal and temporal regions (Dubey et al., 2019). Furthermore, a non-statistically significant decrease in the latency of stage 2 was detected, along with a statistically significant increase in alpha power during the same stage (Dubey et al., 2019). Alpha represents the relaxed state of mind, and this increase during stage 2 of NREM sleep could indicate probable calming effects of 432 Hz music on the sleeping brain (Dubey et al., 2019). As previously noted for other studies, the lack of comparison between 440 Hz and 432 Hz hinders our ability to discern whether the benefits observed are unique to the 432 Hz frequency or could be attributed to any music in general.

Calamassi et al. (2020) further investigated the possible advantages that 432 Hz music might have over 440 Hz in improving sleep among patients with spinal cord injuries. The average of sleep scores significantly increased in the 432 Hz condition compared to 440 Hz, while no significant improvements on average hours slept each night in both conditions was observed (Calamassi et al., 2020). Furthermore, fewer minutes were used to fall asleep in some subjects in both conditions (Calamassi et al., 2020).

STRESS

As previously discussed in the study by Calamassi et al. (2020), stress levels were assessed using PSS in patients with spinal cord injuries. No significant improvements in PSS in both conditions (432 Hz and 440 Hz) were observed (Calamassi et al., 2020).

Calamassi et al. (2022) focused on the possible benefits of either 432 Hz or 440 Hz on the stress perceived by emergency nurses during the COVID-19 pandemic. As earlier stated, STAI-X1 was implemented to assess stress levels, and a significant reduction in STAI-X1 scores was observed in all 3 groups, with no significant differences among them (Calamassi et al., 2022). Males on the 432 Hz condition, however, experienced a statistically significant reduction in STAI-X1 scores in contrast to the female counterparts (Calamassi et al.,2022).

AROUSAL

Kopka (2022) analysed the potential influence that music tuned to 432 Hz and 440 Hz may have on perceived arousal, implementing excerpts tuned to both frequencies and a Likert scale. This study found that, for excerpts tuned to 432 Hz, the mean value of hyperarousal was slightly higher, while mean values of hypoarousal were higher for the 440 Hz frequency (Kopka, 2022). According to the author, this finding could be explained due to greater familiarity with the 440 Hz frequency (Kopka, 2022).

VITAL PARAMETERS

HEART RATE

In an experiment centred at assessing the influences of 432 Hz music on dental anxiety, Di Nasso et al. (2016) found that the heart rate of patients exposed to this frequency during endodontic treatment decreased at the treatment midpoint and then slightly rose at the end, compared to the control group.

Halbert et al. (2018) investigated the effects of low frequency music on 16 individuals affected by high blood pressure. A decrease in heart rate when listening to 432 Hz music was observed, compared to 440 Hz music (Halbert et al., 2018). In addition, the order in which participants listened to music influenced their heart rate, with participants listening to 432 Hz music first experiencing a greater overall reduction (Halbert et al., 2018).

Calamassi & Pomponi (2019), as outlined earlier, focused on the potential health effects of the 432 Hz music versus 440 Hz music, implementing listening sessions while recording vital parameters. A reduction in the heart rate was observed for both conditions; however, the decrease discovered in the 432 Hz condition was more pronounced (Calamassi & Pomponi, 2019).

Calamassi et al. (2022), later implemented a similar approach, this time focusing specifically on the cohort of emergency nurses during the COVID-19 pandemic, while also introducing a non-listening control group. This time, no variation in heart rate in all 3 conditions was observed (Calamassi et al., 2022).

Buzzi et al. (2022) addressed the impact of music tuned to 432 Hz on sedation levels in Iraqi patients admitted to the PICU. A steady decrease in heart rate was observed during musical intervention; furthermore, heart rate constantly decreased as more days were spent in the PICU while musical intervention was applied (Buzzi et al., 2022).

SYSTOLIC AND DIASTOLIC BLOOD PRESSURE

Di Nasso et al. (2016), while investigating the influences of 432 Hz music on endodontic anxiety during root canal therapy, found that systolic blood pressure decreased at the treatment midpoint, followed by a slight increase as the therapy ended. Diastolic blood pressure decreased in the same point; however, it then rose, stabilizing at the end (Di Nasso et al., 2016).

In the previously discussed study by Halbert et al. (2018), which explored the effects of low frequency music on subjects with high blood pressure, no significant effects were found for either 432 Hz or 440 Hz music on both diastolic and systolic blood pressure.

Calamassi & Pomponi (2019), in their study concerning the possible health effects of 432 Hz and 440 Hz using listening sessions alongside the monitoring of vital parameters, acknowledged a reduction in both systolic and diastolic blood pressure in the 432 Hz condition; nevertheless, the decrease wasn't statistically meaningful (Calamassi & Pomponi, 2019). On the other hand, a rise in systolic as well as diastolic blood pressure was observed in the 440 Hz condition (Calamassi & Pomponi, 2019).

Calamassi et al. (2022), during an experiment focused on improving anxiety and stress levels using music tuned either to 432 Hz or 440 Hz in emergency nurses during the COVID-19 pandemic, noticed a decrease in systolic blood pressure in the 432 Hz group. However, no significant changes in diastolic blood pressure were reported in the 3 groups (432 Hz, 440 Hz and control) (Calamassi et al., 2022).

In their study evaluating the efficacy of 432 Hz music in influencing sedation levels in patients admitted to PICU, Buzzi et al. (2022) found a decrease in systolic and diastolic blood pressure after 1 hour of musical intervention. However, these changes in blood pressure levels were not associated with the number of days spent in the PICU (Buzzi et al., 2022).

RESPIRATORY RATE

Calamassi & Pomponi (2019), while examining the health effects of 432 Hz music compared to music tuned to 440 Hz, found a reduction of respiratory rate in the 432 Hz condition, although not significant.

A different conclusion was reached by Calamassi et al. (2022) in their study concerning the influences of 440 Hz and 432 Hz music on stress and anxiety levels in emergency nurses. A highly significant (P=0.000) decrease of respiratory rate was observed in the 432 Hz group, compared to a non-significant and less pronounced decrease recorded in the 440 Hz group (Calamassi et al., 2022).

In the experiment by Buzzi et al. (2022), assessing the benefits of musical intervention on children in the PICU, a steady reduction of respiratory rate during the 1-hour musical intervention was found. In addition, the respiratory rate continued to decrease as children spent days in the PICU while musical intervention was applied (Buzzi et al., 2022).

OXYGEN SATURATION

In the previously assessed study by Calamassi & Pomponi (2019), focusing on the probable health benefits of 432 Hz vs 440 Hz, no changes in oxygen saturation were reported in either condition.

Buzzi et al. (2022), while examining music tuned to 432 Hz and its effect on children admitted in the PICU, observed a constant increase in oxygen saturation during the 1-hour musical intervention.

SEDATION

Buzzi et al. (2022) evaluated sedation levels achieved using music tuned to 432 Hz on children in the PICU. CBS, implemented to assess sedation, was steadily lowered during the 60 minutes of intervention (Buzzi et al., 2022). Furthermore, CBS was seen to be associated with the days spent in the PICU while the intervention took place (Buzzi et al., 2022).

SUBJECTIVE PERCEPTIONS

Partecipants in the study by Calamassi & Pomponi (2019) were given five questionnaires to assess subjective feelings. The variables headache, tiredness, stress, happiness, and satisfaction with myself improved after listening to music tuned to 432 Hz, with a slight increase in the variable “feeling better” (Calamassi & Pomponi, 2019). The variable tiredness improved more in the 440 Hz condition, while general satisfaction was lower (Calamassi & Pomponi, 2020).

Patients with spinal cord injuries, studied by Calamassi et al. (2020), reported their impressions in a questionnaire at the end of the experiment. Less subjects stated improvements in mood and movement in the 440 Hz condition compared to the 432 Hz condition (Calamassi et al., 2020).

In the cohort of emergency nurses examined by Calamassi et al. (2022), a questionnaire was administered at the end of the work shift to investigate general satisfaction regarding the listening session. Satisfaction was high between the two frequencies, with no relevant differences (Calamassi et al., 2022).

CONCLUSION

This systematic review has analysed various studies discussing the potential impact of the 432 Hz tuning on human psychology and physiology. The 13 articles included provided a general understanding of the potential benefits on outcome measures such as vital parameters, sleep, productivity, dental anxiety, and others. However, the results are mixed, with some articles showing no differences when comparing 432 Hz to the standard 440 Hz tuning in the same outcome measures. More studies comparing the two frequencies are needed to establish a clearer understanding.

Further research should focus on understanding whether the resulted effects are due to the 432 Hz frequency or different factors including placebo, individual preferences, volume, and audio equipment. A standardized protocol across subsequent studies is needed to better corroborate the validity of future findings.

Several limitations were present in this systematic review. Due to the recent nature of the research field, the body of literature was relatively small, highlighting the need for further studies. Additionally, due to language constraints, six articles were excluded, which might have provided more data in either supporting or refuting the effects of 432 Hz music. A quality assessment of the included studies was not carried out, so the findings could be influenced by potential biases or weaknesses in methodological quality or reporting quality. Furthermore, most articles included in the systematic review studied specific groups, impeding generalizability of the results to a wider population.

In conclusion, despite the mixed results and several limitations, the potential of 432 Hz as a non-invasive therapeutic aid calls for further assessment.

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