**CLINICAL AND PATHOLOGICAL SCIENCES**

ORIGINAL ARTICLE

# Music therapy and anxiety in Cuban adult patients undergoing tooth extractions
# Musicoterapia y ansiedad en pacientes adultos cubanos sometidos a extracción dentaria

Alain Manuel Chaple Gil[1*] , Solanch de la Caridad Damas Heredia[2] , José Armando Galván-Cabrera[3] ,
Maicel Eugenio Monzón Pérez[4] , Kelvin Ian Afrashtehfar[5,6]

[1]Universidad Autónoma de Chile, Facultad de Ciencias de la Salud. Santiago de Chile, Chile.
[2]Universidad de Ciencias Médicas de La Habana. La Habana, Cuba.
[3]Universidad Nacional de Cajamarca, Facultad de Medicina Humana. Cajamarca, Perú.
[4]Escuela Nacional de Salud Pública. La Habana, Cuba.
[5]Ajman University, College of Dentistry, Clinical Sciences Department. Ajman Emirate, United Arab Emirates.
[6]University of Bern, School of Dental Medicine, Department of Reconstructive Dentistry and Gerodontology. Berne, Switzerland

*Corresponding Author:* alain.chaple@uautonoma.cl

## ABSTRACT

**Introduction:** Music therapy is a scientific discipline that can influence the decrease of anxiety during medical procedures.

**Objective:** To describe the effects of music therapy on anxiety in Cuban patients undergoing tooth extraction treatment.

**Material and Methods:** A quasi-experimental parallel-group study was conducted. Participants were randomly assigned into two groups (receiving music therapy and not receiving it during tooth extraction treatment). The Cuban version of the Modified Stomatological Treatment Anxiety Scale was used to measure anxiety before and after tooth extraction. Variables such as age, sex, presence of anxiety before and after tooth extraction, and decrease in anxiety were registered. The data were processed in RStudio, applying inferential and Bayesian statistics.

**Results:** In this study, 155 (38.6%) participants were men and 247 (61.4%) were women, for a total of 402 patients. In addition, 93.5% had anxiety before extraction and 73.6% remained anxious after treatment. The odds ratio (1.55) indicates that those who received music therapy have 1.55 times higher odds of experiencing a decrease in anxiety. Bayesian analysis found insufficient evidence to conclude that music therapy reduces anxiety.

**Conclusions:** It cannot be categorically concluded that music therapy decreases anxiety levels during tooth extraction. However, in the group that received music therapy, the majority of participants experienced a percentage reduction in anxiety.

## RESUMEN

**Introducción:** La musicoterapia es una disciplina científica que puede influir en la disminución de la ansiedad durante procedimientos médicos.

**Objetivo**: Describir los efectos de la musicoterapia sobre la ansiedad en pacientes cubanos sometidos a extracción dental.

**Material y Métodos:** Se realizó un estudio cuasi-experimental de grupos paralelos. Los participantes fueron asignados aleatoriamente a dos grupos (con y sin musicoterapia durante la extracción dental). Se utilizó una versión cubana de la Escala de Ansiedad ante el Tratamiento Estomatológico Modificada para medir la ansiedad antes y después de la extracción. Se registraron variables como edad, sexo, presencia de ansiedad y disminución de la misma. Los datos se procesaron en RStudio aplicando estadística inferencial y bayesiana.

**Resultados:** 155 (38.6%) participantes eran hombres y 247 (61.4%) mujeres, para un total de 402 pacientes. El 93.5% tenía ansiedad antes de la extracción y el 73.6% permaneció ansioso después. El odds ratio (1.55) indica que quienes recibieron musicoterapia tienen 1.55 veces más probabilidades de experimentar una disminución de la ansiedad. El análisis bayesiano no encontró evidencia suficiente para concluir que la musicoterapia reduce la ansiedad.

**Conclusiones:** No se puede concluir categóricamente que la musicoterapia disminuye los niveles de ansiedad durante la extracción dental. Sin embargo, en el grupo que recibió musicoterapia, la mayoría de los participantes experimentó una reducción porcentual de la ansiedad.

# INTRODUCTION

Music therapy is a scientific discipline that uses music and its elements (rhythm, melody, harmony, etc.) to promote health, well-being, and quality of life. Its therapeutic use has spread to various health areas, including dentistry. Music can influence the emotional state of patients, producing positive effects on their physical and mental wellbeing. Music therapy applied to dentistry can be beneficial for patients of all ages, especially those who have fear or anxiety associated with dental treatments.[1,2,3,4,5]

Over the past few decades, dental practice has benefited from major scientific, technological, and material advances as well as infection control procedures. In addition, public awareness and knowledge of oral health have been growing worldwide. Despite these advances, many patients experience anxiety related to the dental environment and specific dental treatments, which continues to be a major challenge in the delivery of their care. While anxiety is an emotional state that helps normal individuals defend themselves against a variety of threats, anxiety disorders are a dysregulation of these normal defensive mechanisms, either with excessive or deficient responses.[2,6,7,8,9]

Dental treatment is often painful, stressful, and anxiety-provoking in patients, which can hinder the healing process and negatively affect their quality of life. Music therapy is based on the idea that music can reduce stress and anxiety, decrease pain perception, and improve the quality of life of patients undergoing dental treatments. Dental professionals have sought techniques, including music therapy, to relieve pain and anxiety in patients.

Music therapy in dentistry can be applied in a variety of ways, such as live music, where the music therapist plays an instrument in the dental office while the patient receives treatment; pre-recorded music, which can be listened to by the patient through headphones while the treatment is being performed; and personalized music therapy programs designed for each patient according to their musical needs and preferences.

Music therapy in dentistry has been shown to be beneficial for patients of all ages, especially those with fear or anxiety associated with dental treatment. Studies have shown that Music can reduce preoperative anxiety, decrease pain perception during treatment, and improve patient satisfaction. In addition, music therapy can be an effective tool for the management of chronic pain associated with dental disorders such as temporomandibular dysfunction.

Dental procedures tend to produce anxiety in most patients, hence the need to implement techniques to facilitate and achieve their cooperation.[10]

Even though modern stomatology has tools capable of eradicating pain in any type of maneuver aimed at the care and treatment of the patient, anxiety and its negative consequences are associated with pain and fear in dental treatments. This phenomenon results from the fact that dental treatment is associated with pain. Surgical extraction is a source of anxiety and psychological stress as it forces patients to face situations that they are unaware of and that involve certain risks.

Music therapy has several physiological effects on breathing rate, blood pressure, stomach contractions, and hormone levels. Heart rhythms speed up or slow down so that they synchronize with musical rhythms, and can also alter the electrical rhythms of the brain. Music therapy can positively affect health and sound can be a great healer and reducer of anxiety and/or stress generated by situations of daily life related to procedures that could generate them.[10,11,12,13]

In the Cuban context, this topic has been little studied; therefore, it would be useful to investigate these relationships with patients in the environment. Therefore, this study has the **objective** to describe the effects of music therapy on anxiety in Cuban patients undergoing tooth extraction treatment.

# MATERIALS AND METHODS

### Study Design & Sample

A quasi-experimental parallel-group study was conducted in which participants were randomly assigned to the following groups: experimental or study (who received music therapy during tooth extraction treatment) and control (who received tooth extraction treatment without music therapy). The sample was randomly selected from among adult participants who attended the "Ana Betancourt" Dental Clinic in Havana, Cuba.

The study participants were comprised of 402 patients who attended the General Comprehensive Dentistry service of the institution and met the inclusion criteria.

### Inclusion criteria

Adult patients of both sexes aged > 18 years that required dental extraction treatment.

### Exclusion Criteria

Pregnant female patients, people with physical and/or mental disabilities, and all those who wanted to abandon the research in the middle.

### Measuring Instruments

The Modified Stomatological Treatment Anxiety Scale (EATEM-vc) was used[14] to measure anxiety before and after tooth extraction.

The purpose of this scale is to assess how anxious a patient may be when they visit the dentist. Before applying it, we explained the anxiety experienced before dental treatment.

Each item had the following scores.

Relaxed = 1
Mildly anxious = 2
Moderately anxious = 3
Very anxious = 4
Extremely anxious = 5

The total score is the sum of the values of each item, with a range of 6 to 30, according to the following classification scale: 6: no anxiety, 7-12: slightly anxious, 13-14: moderately anxious, 15-22: very anxious, and 23-30: extremely anxious. [14]

**Variables**

The variables studied were age (in numbers), sex (female or male), application of music therapy (yes or no), the items of the EATEM-vc scale questionnaire (before and after tooth extraction), and level of anxiety (before and after tooth extraction), which were subsequently converted to a dichotomous variable of the presence of anxiety (before and after tooth extraction). The presence of anxiety before and after tooth extraction was adapted to a variable called decreased anxiety, in which a decrease in anxiety after tooth extraction was assessed.

**Procedure**

Participants were asked for informed consent, which was written and signed in agreement with their participation in the study. It had a clause that alleged the possibility that they could leave the study at any time, while at the same time informing them about the details of the study. The study adhered to the rules of the Declaration of Helsinki were always followed.

Anxiety was measured before tooth extraction. Tooth extraction was then applied to both groups, but only the experimental group received music therapy during the procedure. After treatment, anxiety was measured again in both groups. The decision to apply music to patients was randomized.

To develop the above, the EATEM-vc was applied and blood pressure was measured when the patient was in the waiting room waiting to enter to undergo tooth extraction. This and the second application of the instrument to determine patient anxiety was carried out by a dental assistant or someone other than the researcher. The participants in the study group, once inside the consultation, were played music of their choice at all times they were inside the dental consultation. Once inside the office, the patient was comfortably seated in the dental chair, with his back resting on the backrest and his head comfortably placed on the head, but managed to make it relatively fixed. The height at which the chair was placed and the location of the dentist varied depending on the technique applied to the upper jaw or mandible, and the tooth to be extracted. After tooth extraction was completed, the EATEM-vc was reapplied and blood pressure was measured. All the data were stored in a database built on Google Forms.

Patients' musical preferences were distributed among the following musical genres:

• Lounge music: This is based on genres such as electronica, jazz, and many others. It mixes different rhythms using minimal instrumentation.

• Classical music: The most used music and the one that shows great results. It transmits emotions to those who listen to it. It is often used for relaxation exercises.

• Meditation music: This is a combination of classical music and natural sounds.

• Chill-Out Music: includes various styles of electronic music that have an electronic base, a smooth rhythm, and experimental nuances.

Playlists (Table 1) was created for each of these genres suggested by the artificial intelligence ChatGPT, and the researchers checked the relevance of each genre. Thus, the following tracks were established for each list:

| Table 1: Playlists by music genre suggested by *ChatGPT* for use in research | | | |
|---|---|---|---|
| **Music *Far Away*** | **Classical music** | **Meditation Music** | **Chill Out Music** |
| Romantic Nights - 3:36<br><br>Beautiful Day - 3:24 AM<br>Serenity - 3:37<br><br>Spaghetti House (Tropical House)<br><br>Sunset Lounge Music | Lullaby by Brahms<br><br>Mozart's Piano Concerto No. 21<br>Adagio for Strings by Samuel Barber<br><br>Vivaldi's Four Seasons<br><br>Beethoven's Moonlight<br><br>Hail Mary by Bach/Gounod<br><br>Canon en Re de Pachelbel<br><br>Mahler's Symphony No. 5<br><br>Gershwin's Rhapsody in Blue<br><br>Serenade for strings by Tchaikovsky. | Weightless by Marconi Union<br><br>Om Shanti Om De Robert Gas & On Wings of Song<br><br>Zen Meditation by Eric Chiryoku<br><br>Gayatri Mantra by Deva Premal<br><br>Ambient 1: Music for Airports by Brian Eno<br><br>Sanatam Kaur by Ong Namo<br><br>Ajit Kaur by The Light<br><br>Miserere by Gregorio Allegri<br><br>Dawn Chorus by Jon Hopkins<br><br>Ashana's Soulmerge | Comical Lanes (Dancing Room) Café du Soleil<br><br>Sunset Lounge Music Yoga of the Sea<br><br>Drinking (Velvet Lounge) Lounge Safari Buddha Chillout do Mar Café<br><br>Old Style (Hollywood Party) Lounge Safari Buddha Chillout do Mar Café<br><br>Blues Chill (Guitar Sensation) Lighton<br><br>Sexual Music (Healing Games) Gotan Club Lounge for Sex (Relaxation) Lighton<br><br>By the Sea (House Music) Jessica Armada<br><br>Aquarium (Electronic Sounds) Gotan Club |

**Data analysis**

The results were reflected in relative and absolute frequency tables, and statistical tests were used to determine whether music therapy had a significant effect on reducing anxiety in the experimental group compared with the control group. To do this, the *odds ratio* (OR) and *chi-square* test were used.

Statistical tests to compare anxiety before and after treatment in the case-control groups, taking into account the application of music therapy, were determined from *Bayes* analysis (Multiple Binary Logistic Regression Model) and taking into account the p-value, logarithm of the *Bayes* factor (BF), and 95% credible interval (CI). A p-value equal to or less than 0.05 was considered significant.

The data were collected in a Microsoft Excel® 2021 spreadsheet, which was exported for processing to RStudio® using the libraries "gtsummary", "report" and "ggstatsplot". (DataFrame available in Zenodo).[15]

## RESULTS

In the present study, 155 participants (38.6%) were men and 247 (61.4%) were women, totaling 402 patients. The participants' ages ranged from 19 to 82 years. Music therapy was applied to 203 patients (50.5%), while 199 (49.5%) underwent extraction treatment without music. (Table 2)

The median and mean ages were 57 and 54 years, respectively, reflecting considerable variability in age distribution. The proportion of female participants was higher than that of males (61.4% vs. 38.6%). Although the median and mean ages were similar, the broad age range suggests partial homogeneity. Additionally, the gender distribution was unbalanced due to the predominance of female participants. (Table 2)

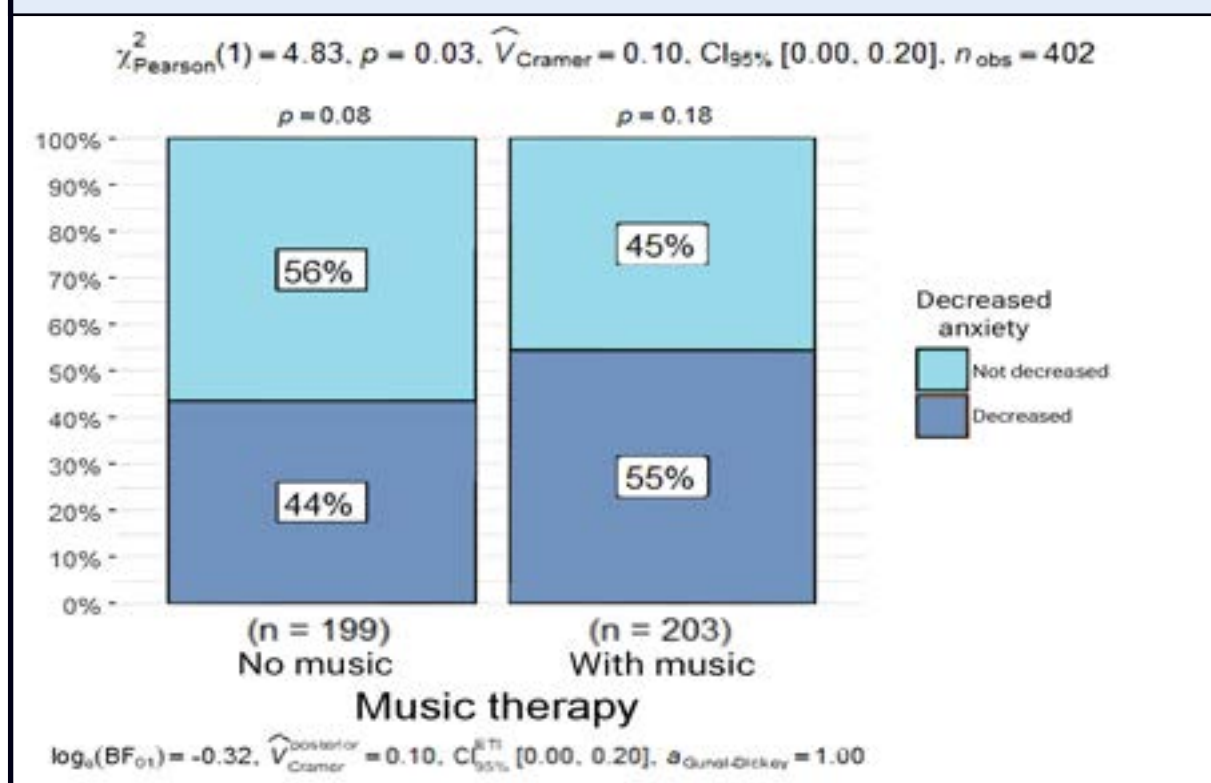| Table 2. Distribution of patients according to age, sex, decreased anxiety, and the application of music during tooth extraction | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Global N = 402 | | No Music N = 199 | | With music N = 203 | | P value |
| | No. | % | No. | % | No. | % | |
| Age (years) | | | | | | | |
| Median (RIQ) | 57 | 40, 66 | 60 | 44, 66 | 55 | 37, 65 | |
| Mean (DE) | 54 | 18 | 56 | 18 | 53 | 18 | - |
| Rank | 19, 82 | | 19, 82 | | 23, 82 | | |
| Sex, n (%) | | | | | | | |
| Female | 247 | 61.4 | 135 | 67.8 | 112 | 55.2 | |
| Male | 155 | 38.6 | 64 | 32.2 | 91 | 44.8 | - |
| Decreased anxiety, n (%) | 198 | 49.3 | 87 | 43.7 | 111 | 54.7 | 0.036 |

Prior to tooth extraction, 93.5% of patients experienced anxiety, and 73.6% remained anxious afterward. The chi-square test yielded a p-value of less than 0.05 in each case, suggesting that the observed differences are statistically significant and may be influenced by factors such as the gender imbalance in the sample. (Table 3)

| Table 3. Anxiety before and after tooth extraction according to sex and music application during treatment. (n=402) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Anxiety Before Tooth Extraction | | | | Anxiety After Tooth Extraction | | | P Value |
| | | Yes | | No | | Yes | | No | |
| | | No. | % | No. | % | No. | % | No. | % |
| With Music | Male | 86 | 42.4 | 5 | 2.5 | 61 | 30.0 | 30 | 14.8 |
| | Female | 112 | 55.2 | 0 | - | 87 | 42.9 | 25 | 12.3 | 0.012 |
| | Subtotal | 198 | 97.6 | 5 | 2.5 | 148 | 72.9 | 55 | 27.1 |
| No Music | Male | 45 | 22.6 | 19 | 9.5 | 26 | 13.1 | 38 | 19.1 |
| | Female | 113 | 66.8 | 2 | 1.0 | 122 | 61.3 | 13 | 6.5 |
| | Subtotal | 178 | 89.4 | 21 | 10.5 | 148 | 74.4 | 51 | 25.6 | <0.001 |
| Total | | 376 | 93.5 | 26 | 6.5 | 296 | 73.6 | 106 | 26.4 |
| p Value | | <0.001 | | | | <0.001 | | | |

*Note: The "P Value" column values 0.012 and <0.001 span the With Music and No Music blocks respectively.*

The odds ratio (OR) test result (1.55) indicates that patients who received music therapy were 1.55 times more likely to experience reduced anxiety compared to those who did not receive it. The OR credible interval ranged from 1.05 to 2.31. (Table 4)

| Table 4. Odds ratio in relation to the application of music therapy and the reduction of anxiety after tooth extraction | | |
|---|---|---|
| | OR (95% CI) | P-value |
| Music Therapy – Decreased Anxiety | 1.55 (1.05 to 2.31) | 0.028 |

Bayesian analysis (Figure 1) showed a negative Bayes Factor (BF), supporting the hypothesis that music therapy does not significantly improve anxiety. Furthermore, the confidence interval (CI) included zero, indicating inconclusive evidence regarding its effectiveness. The p-value (0.08) exceeded the 0.05 significance threshold, confirming that the difference between groups was not statistically significant. These findings suggest that music therapy may not be effective in reducing anxiety, highlighting the need for further research to validate these results.

**Figure 1: Bayesian analysis in relation to the application of music therapy during tooth extraction and the reduction of anxiety**



$$\chi^2_{Pearson}(1) = 4.83, \; p = 0.03, \; \widehat{V}_{Cramer} = 0.10, \; CI_{95\%} \; [0.00, 0.20], \; n_{obs} = 402$$

$$\log_e(BF_{01}) = -0.32, \; \widehat{V}^{posterior}_{Cramer} = 0.10, \; CI^{ETI}_{95\%} \; [0.00, 0.20], \; a_{Gunel-Dickey} = 1.00$$

## DISCUSSION

Various dental procedures can cause anxiety in patients, leading to systemic disturbances and increased stress levels.[16] Studies have shown that extractions tend to be the most stressful dental procedure, which significantly impacts patients' anxiety levels.[17] In addition, the noise that occurs when drilling during dental procedures has been identified as a crucial factor that causes anxiety and headaches in patients, especially those with migraines.[18] Gender differences have also been observed, with women typically having higher levels of dental anxiety compared to men.[19,20] Therefore, it is critical for dental professionals to be aware of these factors and take them into account during patient evaluations and treatment planning to ensure a safe and comfortable experience for individuals undergoing various dental procedures.

Although the results of the presence of anxiety in patients after undergoing tooth extraction with music therapy decreased considerably with respect to the group that did not receive music during treatment, the findings related to more in-depth analyses did not show a causal relationship. This is contradicted by research such as that of *Packyanathan et al.*[10] with a much smaller sample than that of the present research. They made inferences with the p-value according to Pearson's chi-square and had significance in this case, a point that coincides with the present one, but more aspects were needed to analyze in this Indian population. *Yamashita et al.*[8] also provided similar results, claiming that music during third molar extraction suppressed sympathetic activity during incision, flap retraction, ostectomy, separation of the crown of the tooth from the root, thus decreasing anxiety after treatment. Although these authors used a sample of 40 patients and statistical inferences, they do not demonstrate causality in their results.

Other authors have shown that music has a favorable effect on reducing anxiety during tooth extraction treatments; [2,9,21,22,23,24,25] *Kim et al.*,[26] with a sample of 219 patients, found a slight statistical significance in the reduction of anxiety in patients undergoing the treatment under study. *Aravena et al.*,[1] in a study of 42 patients, a group was exposed to 432Hz and 440Hz music, finding a decrease in anxiety in patients undergoing extraction and receiving the first frequency mentioned above.

Listening to music has been shown to effectively reduce anxiety levels.[27,28,29] Different types of music, such as the traditional Turkish music of the maqams of Hicaz & Huseyni,[30] Mozart's classical music[31] and songs from various genres, such as ambient, pop, and metal, have shown significant anxiety-reducing effects. Personalized musical interventions have also been shown to be effective in managing negative effect and stress. In addition, music has been used as an intervention to relieve anxiety in various settings, for example, during heart surgery.[31,32,33] Music therapy is a valuable tool for managing anxiety, as it can positively influence mood, reduce stress, and calm people in different contexts.

It is recognized that the sample of this study was not homogeneous with respect to the distribution of both sexes, however, in general it could be seen that women experienced a higher percentage of anxiety before and after tooth extraction compared to men. These results are consistent with research alleging that women tend to have higher levels of anxiety than men.[34,35,36,37,38]

Women tend to experience higher levels of anxiety compared to men, as evidenced by multiple research studies. The prevalence of anxiety disorders is markedly higher in women than in men, and several biological, psychological, and social factors contribute to this difference.[34,35,36] Factors such as femininity have been identified as a risk factor, and masculinity may act as a protective factor for the development of anxiety.[35] In addition, women are more likely to develop other internalizing disorders such as depression, while men tend to develop externalizing disorders such as substance abuse.[37] Studies have also shown that women have a more severe clinical presentation of anxiety disorders, greater subjective distress, and a higher prevalence of social anxiety disorder compared to men.[38]

A Bayesian analysis to conclude that music can reduce anxiety levels during tooth extraction requires considering several studies on the subject. The investigations of *Apriyono et al.,*[39] showed that classical music and Qur'an-wall-therapy significantly reduced anxiety levels before tooth extraction, and that Qur'an-wallotal was more effective. In addition, a study conducted by Meliala & Kusumaratna[40] found that the music therapy intervention significantly reduced children's anxiety during tooth extraction compared to the control group. Also, Challa & Moses[41] highlighted the efficacy of auditory distraction aids, such as music, in reducing anxiety during dental procedures in pediatric patients. These findings support the idea that music, particularly classical and baroque music, may be a valuable non-pharmacological tool for reducing anxiety levels during dental procedures, such as tooth extraction.

In the present research, the Bayesian analysis did not yield significant results, since it does not relate the possibility that the application of music during tooth extraction decreases or eliminates patients' anxiety levels. This is due to the presence of some limitations present in the study.

Among the **limitations** of this study are the facts that this analysis was based on a single study, the sample size was relatively small, and other variables that could affect anxiety were not considered.

## CONCLUSIONS

It cannot be categorically concluded that the application of music during the tooth extraction procedure decreases anxiety levels in patients receiving this treatment. However, in this research it was evidenced that in the group of patients who received music therapy, during the procedure, they did experience a percentage reduction in anxiety levels in the vast majority of participants.

## RECOMMENDATIONS

More studies with larger sample sizes are needed to confirm these results; it is recommended to conduct studies that control other variables that could affect anxiety, as well as to perform Bayesian analyses with more complex models that consider uncertainty in model variables and parameters.

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