

## Effect of music on reducing anxiety in children during dental treatment

### Avaliação do impacto da música como redutor de ansiedade no atendimento odontológico de crianças

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#### ABSTRACT

**Objective:** The objective of this study was to evaluate the impact of music on anxiety in children during dental care. **Methods:** A total of 40 children 5 to 11 years old were selected; they were randomized into 2 groups (n = 20): group 1: experimental, children were subjected to music therapy; group 2: control, children were not subjected to music therapy. We measured oxygen saturation, heart rate and levels of Corah anxiety scale and pain scale. The results for heart rate were evaluated by ANOVA. The Kruskal Wallis (Dunn) test was used to evaluate the oxygen saturation results and the Wilcoxon test for Corah anxiety and pain scores. **Results:** There was a significant decrease in heart rate (pulse) in children who listened to music during dental treatment ( $p = 0.05$ ). In the group without music, heart rate remained unchanged throughout the care ( $p = 0.53$ ). There was no significant difference in oxygen saturation or Corah anxiety and pain scores in children who listened to music during dental care ( $p > 0.05$ ). **Conclusion:** It can be concluded that music is a non-pharmacological alternative that reduces anxiety levels in children during dental treatment.

**Indexing terms:** Music therapy. Pediatric dentistry. Child.

#### RESUMO

**Objetivo:** O objetivo desse trabalho foi avaliar o impacto da música como redutor de ansiedade no atendimento odontológico de crianças. **Métodos:** Foram selecionadas 40 crianças na Clínica Infantil da Faculdade de Odontologia da PUC-Campinas com a faixa etária variando entre 5 a 11 anos de idade, distribuídas de forma randomizada em 2 grupos (n = 20): grupo 1: experimental, as crianças foram submetidas à terapia musical; grupo 2: controle, as crianças não foram submetidas à terapia musical. As crianças foram acolhidas na recepção e orientadas quanto ao procedimento. Foram feitas a aferição da saturação de oxigênio, frequência cardíaca, aplicação da escala de ansiedade de Corah e escala de dor. Os resultados da frequência cardíaca foram submetidos ao teste de ANOVA. Foram aplicados os testes não paramétricos de Kruskal Wallis (Dunn) para avaliação dos resultados da saturação de oxigênio e o teste de Wilcoxon para os resultados da escala de ansiedade de Corah e de dor. A significância foi de 5%. **Resultados:** Houve redução significativa na frequência cardíaca (pulso) nas crianças que escutaram música durante o atendimento odontológico ( $p = 0.05$ ). No grupo sem música, a frequência cardíaca manteve-se inalterada durante todo o atendimento ( $p = 0.53$ ). Não houve diferença significativa na saturação de oxigênio, escala de ansiedade de Corah e de dor nas crianças que escutaram ou não a música durante o atendimento odontológico ( $p > 0.05$ ). **Conclusão:** Pode-se concluir que a música é uma alternativa não farmacológica que reduz os níveis de ansiedade na criança durante o tratamento odontológico.

**Termos de indexação:** Musicoterapia. Odontopediatria. Criança.

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## INTRODUCTION

Fear and stress are the main factors that cause anxiety in children when they undergo dental treatment. Numerous factors are responsible for these situations, such as dental instruments and equipment and negative experiences of family members from dental treatment. The office may be the cause of anxiety in children, and in addition, the sensation of having part of the body invaded can generate in the pediatric dental patient an escape or avoidance behavior [1-3].

In the early stages of dental treatment, pain prevention or reduction strategies such as the use of anesthesia are of great importance and cause fear in the child. Pharmacological support is an alternative in controlling anxiety. There are several non-pharmacological methods that have been proposed in the dental treatment of children: psychological intervention, acupuncture, cryotherapy, transcutaneous electrical nerve stimulation, vibratory stimulation, low-intensity light therapy and management techniques. Verbal and non-verbal communication, the hand over the mouth technique and music are alternatives in controlling children in the dental office [1,4].

Music is used in clinics by professionals as a strategy to improve patient well-being [5,6]. It may be an alternative to reduce anxiety and provide a relaxing and comfortable environment for the child, thereby reducing cortisol levels [7-9]. Music has been used to reduce anxiety in various health areas, since it acts physiologically in lowering systolic and diastolic blood pressure [10,11]. In addition, music also acts emotionally by increasing serotonin levels and activating brain areas responsible for reward and can modify brain activity during pain stimulus [12,13].

Gordon et al. [14] observed that 43% of children and adolescents suffer from anxiety disorder before dental treatment. Music therapy used by dentists and their assistants has been an alternative to sedation or administration of anxiolytics. This method is not invasive, and it is economical and well accepted by patients. It elevates mood, is reinforcing and motivating and decreases stress levels [5,8,15].

Marwah et al. [16], Yeung [17], Singh et al. [18], Navit et al. [19], Di Nasso et al. [10], Ozkalayci et al. [20] and Ramar et al. [21] observed that music contributed positively in children's dental treatment. Ganesh et al.

[22] reported that music combined with brushing helps in the control of dental biofilm in children. Nuvvula et al. [23] concluded that 3D distraction may also be another alternative for controlling children's anxiety during dental treatment.

Thus, to increase the scientific evidence on the use of music in pediatric dentistry, this study evaluated music in controlling anxiety in children undergoing dental treatment. The null hypothesis was that music has no effect on the control of a child's anxiety during dental treatment.

## METHODS

### Sample

We selected 40 children from the Children's Clinic of the School of Dentistry of PUC-Campinas.

### Inclusion criteria

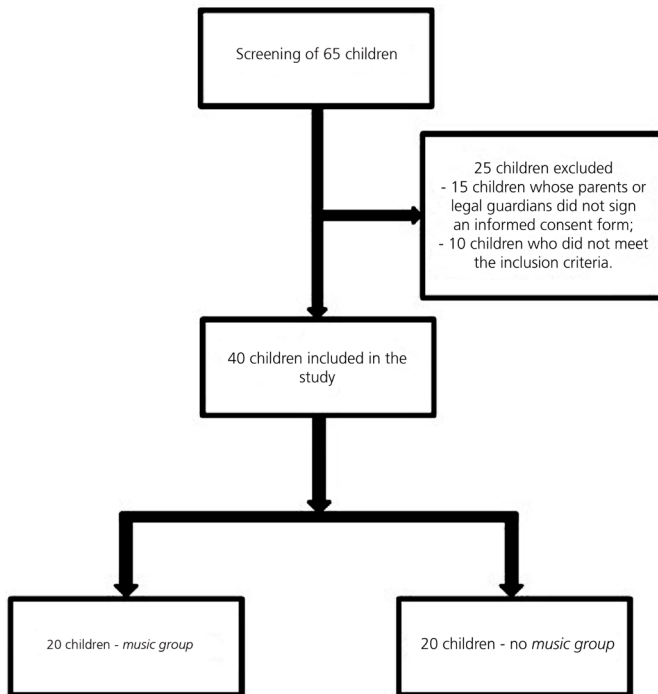
- Children 5 to 11 years old with at least 1 deciduous tooth.
- Children who did not use anxiolytics.
- Children whose parents or legal guardians signed an informed consent form.
- Children who signed an assent form;
- Children who underwent dental procedures, impressions, endodontics and surgery.

### Exclusion criteria

- Patients under psychological and/or psychiatric treatment.
- Children with physical and/or mental deficiency.

### Sample groups

The children included in this study were divided randomly ([www.random.org.br](http://www.random.org.br)) into 2 groups (n = 20): music group (experimental) and no music (control) (figure 1). The number of 20 samples per group was obtained from the sample calculation using the ANOVA statistical test, with minimum difference between mean of treatments of 0.10, standard deviation of 0.09, number of treatments of 4, power of 0.80 and alpha of 0.05. The number of patients required for each group was calculated to be 20.



**Figure 1.** Inclusion of children in the study.  
Music/experimental group.

### *Music selection*

A selection of 50 children's songs in Portuguese was proposed for the children who were seen at the clinic. Thirty-seven were selected by the children and stored in mp3 format on handsets (Nokia Lumia 1520, Manaus, Brazil).

### *Welcome*

The welcome was carried out through a conversation with the children at the reception about what would be done in the research and treatment with the dentist and assistants. Next, 4 songs were played live with 6-string guitar (Menphis São Bernardo do Campo, Brazil) for the children, the team of professionals, and parents (or legal guardians).

### *Care and treatment with professional*

After the reception, the children were taken to the treatment rooms. After sitting in the chairs before the start of treatment, the children received the handsets (Nokia Lumia 1520, Manaus, Brazil) with mp3 songs and

headphones (Mex AM-569, Shanghai, China). The songs were played and the same repertoire that the children listened to was connected to the sound in the room. The selection included the 37 songs that were played during the time of each visit.

### **No music/control group**

#### *Welcome*

The welcome was done through a conversation with the children at the reception about what would be done in the research and treatment with the dentist and assistants.

#### *Care and treatment with professional*

After welcoming the children, they were led to the treatment rooms.

### **Evaluation methods**

In both groups, oxygen saturation and heart rate were measured with a finger oximeter (G-TECH, Model Oled graph, Beijing, China) before and after the reception (beginning of treatment), during dental care and after the end of treatment.

The pain scale was applied before the welcome and after the end of treatment [24]. For the application of the pain scale, the children were told to describe their emotional state (feeling) at the moment of our contact, through the images on the scale. The children were instructed to choose the image that represented how they felt during the different evaluation times.

The Corah dental anxiety scale [25,26] was applied before the welcome and after the end of the treatment, where the children were asked to answer the questions on the scale that corresponded with their feeling (state) at the moment of our contact.

The results were analyzed in the Biostat 4.0 program. The Shapiro Wilk normality test was performed, and the results for heart rate showed normal behavior, so ANOVA was used for data analysis. The results for oxygen saturation, Corah anxiety scale and children's pain scale showed non-normal behavior, the Kruskal-Wallis (Dunn)

nonparametric test was used to evaluate the oxygen saturation results and the Wilcoxon test for the Corah anxiety and pain scores. The level of statistical significance was set at 5%.

The present study was approved by the Research Ethics Committee of our institution (protocol no. 2.140.833). All procedures were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

## RESULTS

The characteristics of the study population are displayed in tables 1 and 2. Concerning the use of music for the reduction of anxiety levels, there was a significant

reduction in heart rate (pulse) in children who listened to music during dental care ( $p = 0.05$ ). In the group without music, the heart rate remained unchanged throughout the care ( $p = 0.53$ ). There was no significant difference in oxygen saturation, Corah anxiety scale, and pain in children who listened to music during dental care (table 3).

## DISCUSSION

Music has been used as a tool for welcoming, relaxing and in non-pharmacological methods for the control of anxiety, pain and stress in dentistry [8,17,27]. Another possibility found in the literature is the use of music to stimulate children during brushing [22]. This work examined music as a non-pharmacological method for the reduction of anxiety in children as in the works of Marwah

**Table 1.** Music group (experimental n = 20).

| Gender   | Previous visit | Local anesthesia | Psychological behavior | Number    | Reason for visit | Number    |
|----------|----------------|------------------|------------------------|-----------|------------------|-----------|
| Male 14  | Yes 13 (93%)   | Yes 11 (79%)     | Extroverted            | 4 (28.5%) | Pain             | 6 (42.8%) |
|          |                |                  | Anxious                | 2 (14.2%) | Caries           | 2 (14.2%) |
|          |                |                  | Fearful                | 3 (21.4%) | Fracture         | 2 (14.2%) |
|          |                |                  | Insecure               | 2 (14.2%) | Malocclusion     | 2 (14.2%) |
|          |                |                  | Distrustful            | 3 (21.4%) | Prosevation      | 2 (14.2%) |
| Female 6 | No 1 (7%)      | No 3 (21%)       | Extroverted            | 1 (16.6%) | Pain             | 2 (33.3%) |
|          |                |                  | Anxious                | 1 (16.6%) | Caries           | 2 (33.3%) |
|          |                |                  | Fearful                | 3 (50%)   | Fracture         | 0 (0%)    |
|          |                |                  | Insecure               | 1 (16.6%) | Malocclusion     | 1 (16.6%) |
|          |                |                  | Distrustful            | 0 (0%)    | Prosevation      | 1 (16.6%) |

**Table 2.** No music group (control n = 20).

| Gender    | Previous visit | Local anesthesia | Psychological behavior | Number    | Reason for visit | Number    |
|-----------|----------------|------------------|------------------------|-----------|------------------|-----------|
| Male 9    | Yes 08 (89%)   | Yes 6 (66.6%)    | Extroverted            | 1 (11.1%) | Pain             | 2 (22.2%) |
|           |                |                  | Anxious                | 2 (22.2%) | Caries           | 2 (22.2%) |
|           |                |                  | Fearful                | 1 (11.1%) | Fracture         | 2 (22.2%) |
|           |                |                  | Insecure               | 0 (0%)    | Malocclusion     | 1 (11.1%) |
|           |                |                  | Distrustful            | 5 (55.5%) | Prosevation      | 2 (22.2%) |
| Female 11 | No 1 (11%)     | No 3 (33.3%)     | Extroverted            | 4 (36.3%) | Pain             | 6 (55%)   |
|           |                |                  | Anxious                | 2 (18%)   | Caries           | 3 (27%)   |
|           |                |                  | Fearful                | 2 (18%)   | Fracture         | 2 (18%)   |
|           |                |                  | Insecure               | 1 (9%)    | Malocclusion     | 0 (0%)    |
|           |                |                  | Distrustful            | 2 (18%)   | Prosevation      | 0 (0%)    |

**Table 3.** Minimum (MN), maximum (MX), arithmetic mean (MA), standard deviation (SD), median (MD) and interquartile deviation (IQD) values of heart rate (pulse), oxygen saturation, Corah anxiety scale and pain scale of children treated with (n = 20) and without (n = 20) music.

|       | Children cared for without the use of music (n = 20) |         |                |        |             |        |            |        |
|-------|--|---------|----------------|--------|-------------|--------|------------|--------|
|       | Pulse  |         | O <sub>2</sub> |        | Corah scale |        | Pain scale |        |
|       | Before   | After   | Before         | After  | Before      | After  | Before     | After  |
| MN    | 58   | 58      | 96             | 73     | 4           | 4      | 0          | 0      |
| MX    | 113  | 113     | 99             | 99     | 14          | 12     | 10         | 10     |
| MA    | 91.35  | 87.15   | 97.85          | 95.55  | 6.55        | 6.45   | 2.10       | 1.10   |
| (SD)  | (14.36)  | (15.48) | (0.93)         | (6.35) | (2.91)      | (2.83) | (3.40)     | (2.38) |
| MD    | 93.00  | 85.00   | 98.00          | 97.50  | 6.00        | 5.50   | 0.00       | 0.00   |
| (IQD) | (12.25)  | (21.00) | (1.25)         | (1.75) | (4.25)      | (3.50) | (2.50)     | (2.00) |
| (p)   | 0.53   |         | 0.13           |        | 0.72        |        | 0.28       |        |
|       | Children cared for with the use of music (n=20)      |         |                |        |             |        |            |        |
|       | Pulse  |         | O <sub>2</sub> |        | Corah scale |        | Pain scale |        |
|       | Before   | After   | Before         | After  | Before      | After  | Before     | After  |
| MN    | 60   | 56      | 95             | 70     | 4           | 4      | 0          | 0      |
| MX    | 122  | 120     | 99             | 100    | 15          | 11     | 4          | 4      |
| MA    | 93.80  | 85.00   | 97.55          | 96.70  | 6.20        | 5.30   | 1.60       | 1.00   |
| (SD)  | (14.85)  | (15.73) | (1.19)         | (6.37) | (3.31)      | (2.25) | (1.66)     | (1.52) |
| MD    | 92.50  | 82.50   | 98.00          | 98.00  | 4.50        | 4.00   | 2.00       | 2.00   |
| (IQD) | (16.25)  | (19.00) | (1.00)         | (2.00) | (3.00)      | (2.25) | (2.50)     | (2.00) |
| (p)   | 0.05*  |         | 0.38           |        | 0.16        |        | 0.19       |        |

\*Statistically significant differences.

et al. [16], Yeung [17], Singh et al. [18], Navit et al. [19], Nuvvula et al. [23], Di Nasso et al. [10], Ozkalayci et al. [20], and Ramar et al. [21]

The present study included 40 children, 20 children in each group, agreeing with Marwah et al. [16] and Aitken et al. [28] In this study, the number of 20 children for each group was based on the sample calculation using the statistical ANOVA test, with a power of 0.80 and alpha of 0.05. The children included in the present study did not use anxiolytics, in line with Marwah et al. [16], because the use of medications to control anxiety could alter the results of the study. Included in the study were children who needed dental treatment, impressions, endodontics and surgery, as they are considered procedures that could generate anxiety in children in the dental office, according to Marwah et al. [16], Aitken et al. [28] and Navit et al. [19]. The present study included children in a randomized fashion, as reported in studies by Yeung [17], Marwah et al. [16], Singh et al. [18], Navit et al. [19], Nuvvula et al. [23], Di Nasso et al. [10], Ozkalayci et al. [20] and Ramar et al. [21].

The limitation of this study was the inclusion of children between 5 and 11 years old. The way of interpreting

and answering the pain and Corah dental anxiety scales might have been influenced by the age of the child. Often younger children have difficulty understanding the Corah dental anxiety scale. Regarding pain scale, younger children often chose the happiest figures even when sad or crying.

Differently from Moola et al. [27], Marwah et al. [16], Yeung [17], Singh et al. [18], Mejia-Rubalcava et al. [8], Navit et al. [19], Nuvvula et al. [23], Di Nasso et al. [10], Ozkalayci et al. [20] and Ramar et al. [21], the present study used a 6-string guitar and played 4 live songs in the process of receiving and caring for the children, to generate a bonding between the children, dental team, parents/guardians. The use of live music in this process helped to reduce the tension of the patients, improving the environment, as well as assisting in the approach of the children with the dental team during the care.

The use of heart rate to measure anxiety during dental treatment was also described by Aitken et al. [28], Marwah et al. [16], Singh et al. [18], Navit et al. [19], Nuvvula et al. [23], Ozkalayci et al. [20], Gupta et al. [5] and Ghadimi et al. [1] Here, we used the finger oximeter to measure heart rate because this is a direct measure of physiological excitation; its increase is attributed to stress

during dental procedures. The finger oximeter was also used by Ozkalayci et al. [20] and Marwah et al. [16] to measure the levels of oxygen saturation in patients. This instrument has a coupled light sensor that determines the amount of oxygen in arterial blood by contact with the skin. The oximeter's sensors take immediate and regular readings, and the instrument can be used on the fingers, toes, or the ear.

The Corah anxiety scale in the present study was used in agreement with Aitken et al. [28] and Wu & Gao [3] because it is an instrument used to assess and survey the emotional state of children in the dental office at the time of treatment. The pain scale was used in this study, as in the studies of Aitken et al. [28] and Gupta et al. [5] because it is one of the tools most used for pain evaluation, where it is easy for children to describe their different emotional stages using the face illustrations presented.

The use of music in the care of the children in the dental office caused a decrease in heart rate, reducing the anxiety of the patients. These results reject the null hypothesis and agree with Marwah et al. [16], Yeung [17], Singh et al. [18], Navit et al. [19], Nuvvula et al. [23], Di Nasso et al. [10], Ozkalayci et al. [20] and Ramar et al. [21] Emotionally, music acts on increasing serotonin levels and activating the brain areas responsible for reward and induces response in the autonomic nervous system with its calming and tranquilizing effect by modifying brain activity during the stimulation of anxiety sensations [12, 13].

Music, when offered to patients, mainly according to their preference and choice, as was the case in our study and in the works of Marwah et al. [16] and Singh et al. [18], increases neural and parasympathetic activities in the brain, helping to control anxiety. Music activates the parasympathetic nervous system, which is responsible for reducing heart rate, resulting in anxiety control, explaining the results of the present study.

Aitken et al. [28] and Gupta et al. [5] evaluated the effects of music in pediatric dentistry and concluded that music did not decrease anxiety levels and caused an increase in heart rate. This disagreement with our results could have been due to the fact that in our study, children were involved in the choice of the music repertoire and that there was an initial welcome for the children and parents/guardians with the dental team before treatment.

In the present study, oxygen saturation did not show a significant difference in the two groups, agreeing

with Marwah et al. [16], Mejia-Rubalcava et al. [8] and Yaman Aktas & Karabulut [29]. Oxygen saturation shows alterations due to other individual factors such as age, sex, elevated blood pressure and previous visits, and it is linked to the psychological response of each patient [8].

There was no significant difference in the Corah anxiety scale in this study, which confirms the results obtained by Aitken et al. [28]. According to Lamarca et al. [30], children anticipate more pain than they experience during dental treatment, which could reinforce the results obtained in the present study, since the Corah anxiety scale was checked before and after dental treatment. Although children liked the music and asked for more during treatment, they may have transferred feelings acquired during the treatment to the time of the application of the scale, making it difficult to obtain reliable results representing their emotional state after the treatment.

There was no significant difference in this work in the perception of pain with the use of music, confirming the results obtained in the works Aitken et al. [28] and Gupta et al. [5] Lamarca et al. [30] stated that pain is strongly linked to anxiety. Pre-treatment anxiety could have influenced the evaluation of pain in children with high degree of anxiety and stress, promoting a negative expectation and changing the sensory quality of pain.

Therefore, it was possible to observe that music can be an alternative for the emotional control of children during dental treatment, however Gujjar et al. [31] suggest that technology-based interventions included music are useful as adjunct to standard dental care and that evidence regarding the effectiveness of these interventions in children and adult population is still scarce. Yet, emerging technology based interventions hold promise because, potentially, these may be capable of overcoming the shortcomings of traditional treatment of dental anxiety. New studies should be done to elucidate the neurological mechanisms of music played during pediatric dental treatment, to support this non-pharmacological alternative for the control of anxiety in children.

## CONCLUSION

It can be concluded that music is a non-pharmacological alternative that reduces anxiety levels in children during dental treatment.



## Collaborators

SK TSHISWAKA, method development and manuscript writing. SL PINHEIRO, advisor, assistance with preparing and writing the research project, data collection, statistical analysis, and manuscript revision.

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