TUMI ORAL HEALTH
e-ISSN 3119-7701

TUMI Oral Health
Torres-Paredes, V. TUMI Oral Health.2026;1(6):1-7
https://doi.org/10.64716/297txm60

ORIGINAL RESEARCH **OPEN ACCESS**

Music listening and dental anxiety in children aged 4–8 years: a quasi-experimental study

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ABSTRACT

Background: Music listening may complement behavior guidance during pediatric dental care. **Objective:** To describe anxiety before and after treatment with and without music, and examine distributions by age and music genre. **Methods:** A nonrandomized controlled study included 64 children aged 4–8 years recruited by convenience in Trujillo, Peru, in 2025: 32 with music and 32 without music. Anxiety was assessed with the Facial Image Scale. Age and genre distributions were compared using two-sided Fisher–Freeman–Halton exact tests. **Results:** After treatment, the music group comprised 17 children with mild anxiety (53.1%) and 15 with mild-to-moderate anxiety (46.9%). The within-group before-and-after comparisons yielded $p = 0.0015$ with music and $p = 0.862$ without music. The exploratory comparison at age 5 yielded $p = 0.0357$. Mild anxiety occurred in 15 of 17 children receiving classical music (88.2%) and 6 of 15 receiving children's music (40.0%); the genre comparison yielded $p = 0.0098$. **Conclusions:** Lower anxiety categories were observed after treatment with music. Classical music was associated with a more favorable anxiety distribution than children's music. Nonrandomized allocation limits causal interpretation; age findings remain exploratory. Trial registration: Not reported in the study documentation.

Keywords: Dental Anxiety; Music; Child; Child, Preschool; Pediatric Dentistry.

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Journal homepage: https://tumijournal.com/index.php/oral-health/en/index
https://doi.org/10.64716/297txm60
Editor-in-Chief: Jhair Alexander Leon-Rodriguez

Received: August 25, 2026
Revised: September 29, 2026
Accepted: October 30, 2026
Available online: November 1, 2026

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Introduction

Dental anxiety can interfere with children's cooperation and access to dental care. A global meta-analysis estimated a pooled prevalence of 23.9% among children and adolescents, with higher estimates in younger age groups, although measurement instruments and study quality varied [1]. Anxiety is influenced by the clinical environment, anticipated discomfort, and previous experiences; prior treatment alone does not necessarily make subsequent care less distressing [2,3]. These factors are particularly relevant when young children require procedures involving local anesthesia and sustained cooperation.

Nonpharmacological behavior guidance includes communication, preparation, distraction, and relaxation. A systematic review found variable effects across techniques and outcome scales [4]. The corresponding pediatric dentistry guideline issued conditional recommendations, generally supported by low-certainty evidence, and emphasized patient and family preferences [5]. Parental presence is another contextual factor, although available evidence does not establish a uniform effect on anxiety or behavior [6]. An adjunct that is simple to deliver may therefore be useful, provided its effects are evaluated with an appropriate comparator.

Music has been investigated as an auditory distraction during dental treatment. Recent syntheses reported potential benefits, but populations, procedures, and intervention protocols differed [7]. A 2024 meta-analysis of 24 controlled trials found lower anxiety overall during invasive procedures; however, its pediatric subgroup did not show a statistically significant effect and overall heterogeneity was substantial [8]. A subsequent pediatric review of seven randomized trials involving 476 children reported lower self-rated anxiety with music, alongside concerns about risk of bias [9]. These findings support further evaluation in specific clinical settings without assuming a uniform response.

The Facial Image Scale (FIS) offers a brief pictorial assessment of children's current feelings. Its original validation and later comparisons with other pediatric scales support its practical use in dental settings [10,11]. This study aimed to describe anxiety before and after dental treatment with and without music among children aged 4–8 years in a university clinic in Trujillo, Peru. Secondary objectives were to examine anxiety distributions within age strata and compare classical with children's music. The study explored whether music listening was accompanied by lower reported anxiety during pediatric pulp treatment.

Materials and methods

Study design and setting

This prospective, quasi-experimental controlled before-and-after study was conducted in pediatric teaching and internship services at a university dental clinic in Trujillo, Peru, during the first semester of 2025. Both assessments occurred during one visit. Allocation was nonrandomized. Reporting drew on TREND for nonrandomized evaluations and TIDieR for intervention description [12,13].

Population, sample and sampling

Convenience recruitment from a sampling frame of 250 children yielded 64 participants, with 32 per group. Planning used 95% confidence, 80% power, and proportions of 0.258 and 0.604. A two-independent-proportions calculation gives approximately 31 children per group. This planning approximation was not specific to the five-category FIS outcome.

Eligibility Criteria

The analyzed children were aged 4–8 years. Eligibility required the absence of systemic disease (American Society of Anesthesiologists physical status I), an appointment for pulp treatment, and written consent from a parent or legal guardian. Children were excluded for lack of cooperation during treatment, conditions preventing participation, hearing problems, ear infection, or absent parental consent.

Study variables

The exposure was music listening during dental care, compared with care without music. Anxiety was classified into five ordered categories. The overall analysis compared anxiety before and after treatment within each group. The age analysis described anxiety in children assessed with or without music within each age stratum; the genre analysis described anxiety associated with classical or children's music. The latter two analyses were distributions by exposure category, not before-and-after comparisons.

Data collection instrument

The FIS consisted of five faces ranging from very happy to very sad. Each child selected the face that best represented their feelings [10]. The five ordered responses were classified in this study as mild, mild to moderate, moderate, moderate to severe, and severe anxiety. These category labels describe the study classification and should not be interpreted as independently validated clinical severity thresholds.

Procedure

After authorization and parental consent, children completed the FIS before treatment. The intervention group heard music during care; controls received care without music. Both groups repeated the FIS afterward. Seventeen children received classical music and 15 received children's music. The repertoire included Vivaldi's The Four Seasons and Mozart recordings. Music listening was used as auditory distraction during dental treatment.

Statistical Analysis

Anxiety categories were summarized as counts and percentages for each group before and after treatment, by age, and by music genre. The overall percentages used 32 children per group at each assessment. Age and music-genre percentages were calculated horizontally within each row. The combined age total used 64 children; the genre total used 32. Values were rounded to one decimal place, so displayed percentages may sum to 99.9% or 100.1%.

Data processing used Microsoft Excel and SPSS version 27. The p values in Table 1 refer to before-and-after comparisons within each group. For the independent age-specific and music-genre comparisons, two-sided Fisher–Freeman–Halton exact tests were used because of sparse cell counts. Exact probabilities were calculated in Python by enumerating all contingency tables with the observed row and column totals; the p value summed probabilities no greater than that of the observed table. Categories with zero observations in both groups contributed no information to the test. The significance threshold was 0.05.

The age and genre analyses describe anxiety under the corresponding exposure categories and do not estimate within-child changes. The five age-specific comparisons were exploratory and were not adjusted for multiple testing. Differences between age-specific p values were not interpreted as evidence that age modified the response to music; such a conclusion requires a direct interaction analysis.

Ethical considerations

The Comité de Bioética en Investigación of Universidad Privada Antenor Orrego approved the study under Resolution No. 000407-2025-UPAO on 11 April 2025. Administrative permission was issued on 14 April 2025. The study followed the stated principles of the 2013 Declaration of Helsinki [14]. Parents or legal guardians provided written informed consent after receiving information about the research and the right to withdraw without affecting dental care. Records were coded and used for research purposes. Separate child assent and prospective trial registration were not reported in the study documentation.

Results

Before treatment, moderate-to-severe anxiety was the most frequent category without music, affecting 13 children (40.6%), whereas moderate anxiety predominated with music, affecting 15 (46.9%). After treatment, the music group comprised 17 children with mild anxiety (53.1%) and 15 with mild-to-moderate

Table 1. Anxiety levels before and after dental treatment with and without music

Anxiety level	Without music		With music	
	Before	After	Before	After
Mild anxiety	0 (0.0)	0 (0.0)	0 (0.0)	17 (53.1)
Mild to moderate	6 (18.8)	6 (18.8)	5 (15.6)	15 (46.9)
Moderate	9 (28.1)	12 (37.5)	15 (46.9)	0 (0.0)
Moderate to severe	13 (40.6)	10 (31.3)	8 (25.0)	0 (0.0)
Severe	4 (12.5)	4 (12.5)	4 (12.5)	0 (0.0)
Total	32	32	32	32
p†	0.862		0.0015	

Values are n (%). Each group included 32 children; total N = 64. Percentages use the denominator of each measurement column and are rounded to one decimal place; displayed percentages may not sum to exactly 100%.
† p compares anxiety before and after treatment within each group.

anxiety (46.9%). Without music, 12 children (37.5%) had moderate anxiety, 10 (31.3%) had moderate-to-severe anxiety, and 4 (12.5%) had severe anxiety. The within-group before-and-after comparisons yielded p = 0.862 without music and p = 0.0015 with music (Table 1).

Five-year-olds formed the largest stratum, with 12 children per group. Among these children, mild anxiety was recorded in 8 receiving music (66.7%) and 2 receiving care without music (16.7%). Mild anxiety was also the most frequent category with music at ages 4, 6, 7, and 8, affecting 75.0%, 60.0%, 60.0%, and 66.7%, respectively. The exact comparisons yielded p = 0.1429, 0.0357, 0.7143, 0.4603, and 0.1342 at ages 4, 5, 6, 7, and 8, respectively (Table 2).

Mild anxiety occurred in 15 children receiving classical music (88.2%) and 6 receiving children's music (40.0%). Mild-to-moderate anxiety was recorded in 2 (11.8%) and 6 (40.0%), respectively. Three children receiving children's music had moderate anxiety (20.0%), whereas none receiving classical music was in this category. Neither genre group included moderate-to-severe or severe anxiety. The distributions differed in the exact comparison (p = 0.0098; Table 3).

Discussion

The overall analysis showed a shift toward lower anxiety categories in children receiving music during dental care. After treatment, their responses were confined to mild and mild-to-moderate anxiety, whereas moderate and moderate-to-severe anxiety remained frequent without music. The within-group p values were 0.0015 with music and 0.862 without music. These comparisons address change within each group; their different significance levels do not themselves establish a difference in change between groups. Nonrandomized allocation and baseline differences also limit causal interpretation.

The observed direction is consistent with some pediatric investigations. James et al. studied 150 children aged 6–8 years in three groups and reported favorable anxiety changes with music distraction and aromatherapy during

Table 2. Anxiety levels by age in children treated with and without music

Age (years)	Group	Mild	Mild to moderate	Moderate	Moderate to severe	Severe	Total	p
4	Without music	0 (0.0)	1 (25.0)	2 (50.0)	1 (25.0)	0 (0.0)	4	0.1429
	With music	3 (75.0)	1 (25.0)	0 (0.0)	0 (0.0)	0 (0.0)	4	
5	Without music	2 (16.7)	2 (16.7)	4 (33.3)	4 (33.3)	0 (0.0)	12	0.0357
	With music	8 (66.7)	2 (16.7)	2 (16.7)	0 (0.0)	0 (0.0)	12	
6	Without music	1 (20.0)	1 (20.0)	2 (40.0)	1 (20.0)	0 (0.0)	5	0.7143
	With music	3 (60.0)	1 (20.0)	1 (20.0)	0 (0.0)	0 (0.0)	5	
7	Without music	1 (20.0)	2 (40.0)	2 (40.0)	0 (0.0)	0 (0.0)	5	0.4603
	With music	3 (60.0)	2 (40.0)	0 (0.0)	0 (0.0)	0 (0.0)	5	
8	Without music	1 (16.7)	2 (33.3)	3 (50.0)	0 (0.0)	0 (0.0)	6	0.1342
	With music	4 (66.7)	2 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	6	
	Total	**26 (40.6)**	**16 (25.0)**	**16 (25.0)**	**6 (9.4)**	**0 (0.0)**	**64**	—

Values are n (%) within each age/group row; the total row uses N = 64. † Two-sided Fisher–Freeman–Halton exact p values compare children with and without music within each age stratum; these five exploratory comparisons are unadjusted for multiple testing. The table describes anxiety by age and music exposure. —, not applicable to the combined total.

Table 3. Anxiety levels according to music genre

Music genre	Mild	Mild to moderate	Moderate	Moderate to severe	Severe	Total	p
Classical	15 (88.2)	2 (11.8)	0 (0.0)	0 (0.0)	0 (0.0)	17	0.0098
Children's music	6 (40.0)	6 (40.0)	3 (20.0)	0 (0.0)	0 (0.0)	15	
Total	21 (65.6)	8 (25.0)	3 (9.4)	0 (0.0)	0 (0.0)	32	—

Values are n (%) within each music-genre row: classical, n = 17; children's music, n = 15; total, n = 32. † Two-sided Fisher–Freeman–Halton exact test comparing anxiety distributions between genres. The table describes anxiety according to the genre used. —, not applicable to the total row.

restorative treatment [15]. Janthasila and Keeratisiroj evaluated 128 children aged 10–12 years in four groups and found benefits of music combined with aromatherapy [16]. These studies support the plausibility of auditory distraction, although differences in age, procedure, co-interventions, and anxiety measurement prevent direct comparison of effect magnitude.

A crossover trial in children aged 4–8 years undergoing pulpotomy and steel crown treatment found no significant difference between music and audio stories on the measured outcomes [17]. Its age range and treatment setting are closer to those of the present study, but it compared two active distractions rather than music with no music. Similarly, a randomized trial combining lavender–neroli aromatherapy with music could not isolate music's contribution [18]. These distinctions matter because the effects of a familiar sound, redirected attention, and additional behavioral support may overlap.

The age analysis addressed the first secondary objective by comparing anxiety distributions in children with and without music at each age. Mild anxiety predominated among children receiving music in every age stratum. The exact comparison at age 5 yielded $p = 0.0357$; the other age-specific comparisons did not reach the 0.05 threshold. This exploratory finding does not demonstrate a greater treatment effect at age 5. The five comparisons were unadjusted for multiplicity, stratum sizes were small, and no age-by-exposure interaction was estimated. Age-specific patterns should therefore be interpreted as hypotheses for further study.

Music selection and delivery also warrant consideration. Trials comparing preferred music or different auditory beats with conventional care have reported favorable anxiety outcomes for some auditory approaches [19,20]. In the present genre analysis, mild anxiety was more frequent with classical music (88.2%) than with children's music (40.0%), and the overall distributions differed in the exact comparison ($p = 0.0098$). This association addresses the second secondary objective. The groups were small, with 17 and 15 children, and genre allocation was not randomized; preferences and other participant characteristics may have influenced the difference. These findings do not establish a causal advantage of classical music, and selection should consider the child's preferences and tolerance.

Other distraction studies illustrate how intervention components and outcome selection influence interpretation. A trial comparing five sensory methods evaluated auditory distraction alongside visual, olfactory, tactile, and gustatory approaches [21]. A smartphone piano intervention combined active engagement with sound and showed different findings across self-report and observer-rated measures [22]. Device-based brainwave entrainment represents another distinct intervention [23], while reviews of virtual reality and dental applications have examined heterogeneous digital approaches [24]. Their results cannot be transferred directly to passive music listening, but they support careful description of the child's interaction with each distraction.

The FIS measures the child's reported feelings at the assessment time. A lower score after treatment may reflect auditory distraction, relief that the procedure has ended, or both. It does not independently demonstrate less procedural pain, improved cooperation, or a persistent benefit at later visits [10,11]. The single-visit design therefore limits the interpretation to immediate anxiety responses. Future evaluations should distinguish anxiety during treatment from feelings after completion and consider complementary behavioral measures.

The study had several limitations. Convenience recruitment at a single university clinic and exclusion of uncooperative children restricted generalizability. Nonrandomized allocation allowed differences in baseline anxiety, previous dental experiences, and family or clinical circumstances to influence the observed associations. Small age strata and music-genre groups limited precision, and the exploratory age comparisons involved multiple testing. The single-visit design addressed immediate responses and could not establish persistence at subsequent visits. These design and contextual factors should guide interpretation and the planning of larger controlled studies.

Family preferences and previous experiences remain relevant when choosing a guidance strategy. Evidence on parental acceptance shows that behavior guidance methods are not uniformly acceptable to families [25]. Music should therefore be discussed as an optional adjunct within individualized care. Its use should preserve communication between the child and clinician and should not replace appropriate analgesia or other indicated behavior support. The present findings do not establish safety or effectiveness for uncooperative children or for populations excluded from the study.

The wider literature is encouraging but not uniform. The nonsignificant pediatric subgroup in the 2024 meta-analysis contrasts with the favorable pediatric-specific synthesis published in 2025 [8,9]. Differences in

included populations and protocols help explain why recommendations require context. Current pediatric behavior guidance likewise emphasizes individualized decisions [5]. More definitive evaluation of music listening should use prospective registration, clear allocation procedures, standardized exposure, and an analysis that accounts for repeated measurements and baseline anxiety [12,13].

Conclusions

Children receiving music showed lower anxiety categories after dental treatment, with a within-group $p = 0.0015$; the corresponding comparison without music yielded $p = 0.862$. The age-specific comparison at age 5 yielded an exploratory $p = 0.0357$. Classical music was associated with a more favorable anxiety distribution than children's music ($p = 0.0098$). These findings support further evaluation of music listening as an adjunct to pediatric dental care. The nonrandomized design does not establish causal efficacy or a differential treatment effect by age.

Author Contributions Statement (CrediT)

VMT: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Visualization, Project administration, Writing – original draft, Writing – review and editing.

Acknowledgments

The author thanks the children and their parents or guardians for participating, and the clinical teaching and support staff for facilitating study visits within the pediatric dental services.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. No external funding supported its preparation or reporting.

Conflict of Interest

The author declares no financial or nonfinancial conflicts of interest related to this work.

Data Availability

The aggregate data underlying the reported analyses are presented in Tables 1–3. Reasonable requests for access to de-identified study records should be addressed to the corresponding author and are subject to institutional authorization and applicable ethical and confidentiality restrictions. Records containing personal identifiers will not be shared.

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