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ORIGINAL SCIENTIFIC ARTICLE

Dog-assisted therapy in paediatric dentistry: physiological, psychological, and family-centred benefits in managing child dental anxiety

Ana Freifrau von Rotenhan[1] · Sabine Weiland[1] · Aneta M. Kochanowicz[1] · Renata Cserjesi[2]

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Abstract

Purpose Dental anxiety in children is a major challenge affecting treatment quality and family well-being. This study examined the effectiveness of dog-assisted therapy (DAT) in modulating physiological indicators of dental anxiety in paediatric patients and assessed its relevance for family-centred dental care.

Methods Sixty children aged 5 to 12 years were allocated to a therapy dog group ($n = 30$) or a control group receiving standard care ($n = 30$). Heart rate (HR) was measured before (T0), during (T1), and after treatment (T2). In the DAT group, Corah's dental anxiety scale (CS) and oxygen saturation (SpO_2) were additionally assessed. Parents and children provided qualitative feedback on their experiences.

Results In the DAT group, HR decreased significantly from 96.53 bpm (T0) to 91.53 bpm (T2) (−5.00 bpm; $t(29) = 2.71$, $p = 0.011$, $d = 0.49$), while HR in the control group increased slightly (+3.33 bpm; $p = 0.028$). Between-group differences were significant during treatment ($p \approx 0.015$, $d \approx 0.65$) and after treatment ($p < 0.001$, $d \approx 0.96$). SpO_2 remained stable throughout. Parents frequently reported feeling calmer and perceived their children as more cooperative in the presence of the dog.

Conclusions DAT was associated with lower heart rates and more efficient post-procedural physiological recovery compared to standard care. Conclusions regarding subjective anxiety should be interpreted cautiously due to the absence of a control-group CS assessment. Nevertheless, DAT may contribute to a more positive emotional climate during dental appointments, supporting both children and families in coping with dental procedures.

Keywords Dog-assisted therapy · Dental anxiety · Physiological response · Family · Child well-being

Introduction

Dental anxiety is a significant barrier to effective paediatric dental care, often leading to behavioural management challenges, delayed treatment, and long-term avoidance of dental services. Parental acceptance of animal-assisted approaches is generally high, with studies showing that most parents believe that animals help reduce their child's dental anxiety and enhance cooperation during visits (Nalini & Srinivaskumar 2022; Roa et al. 2026). The consequences extend beyond the child, as parents frequently experience heightened stress when accompanying an anxious child, influencing the overall emotional climate of the dental visit. Accordingly, contemporary paediatric dentistry increasingly values approaches that not only support the child but also foster a calmer, more secure environment for the family as a whole. Family-centred perspectives highlight the importance of relational, emotional, and contextual factors in shaping children's responses to clinical procedures, making non-pharmacological anxiety-reduction strategies especially relevant (Almarzouq et al. 2024; Murphy et al. 1984). Children report positive experiences

✉ Aneta M. Kochanowicz
akochanowicz@wsb.edu.pl

Ana Freifrau von Rotenhan
anat@gmx.net

Sabine Weiland
weiland.s@gmx.de

Renata Cserjesi
cserjesi.renata@ppk.elte.hu

1 WSB University, Dąbrowa Górnicza, Poland

2 Eötvös Loránd University, Budapest, Hungary

with animal-assisted interventions in paediatric healthcare settings (Lindström Nilsson et al. 2019).

Animal-assisted interventions (AAI), including dog-assisted therapy (DAT), have gained attention as supportive tools in healthcare settings. DAT involves structured interactions between a trained therapy dog, its handler, and the patient, with the aim of reducing stress, enhancing emotional regulation, and promoting a sense of safety. In children, the presence of a friendly dog has been associated with decreased anxiety, improved cooperation, and increased willingness to engage in medical or therapeutic procedures (Vincent et al. 2020). These effects are believed to stem from multiple mechanisms, including distraction, activation of positive affect, and enhanced feelings of companionship. Physiological responses linked to oxytocin-mediated stress regulation may also contribute. Similar psychophysiological mechanisms have been proposed in paediatric contexts, where animal-assisted therapy has been shown to reduce pain and promote parasympathetic relaxation responses, even during stressful medical procedures (Braun et al. 2009). This calming effect has been demonstrated consistently across paediatric studies of animal-assisted interventions (Pinheiro et al. 2023; Cruz-Fierro et al. 2019), including work showing that dog-assisted therapy can reduce anxiety and promote relaxation during medical and dental procedures (Wu & Wei 2023). A cross-sectional survey study found that both orthodontic patients and caregivers largely perceived animal-assisted activity as beneficial, anticipating reduced anxiety and more enjoyable dental experiences, with minimal concerns regarding safety, hygiene, or allergies (Cass et al. 2022).

Within paediatric dentistry, DAT is a relatively new and promising approach. Early studies suggest that therapy dogs can improve children's procedural cooperation, reduce anticipatory fear, and contribute to a more welcoming treatment environment. The presence of a dog may also support dental teams by facilitating rapport with children and helping them tolerate challenging moments such as local anaesthesia or prolonged chair time. Importantly, parents frequently report that the presence of a therapy dog reassures them as well, contributing to a more positive family experience of dental care (Gussgard et al. 2023). These observations align with recommendations from the American Academy of Paediatric Dentistry supporting non-pharmacological, child-friendly anxiety-reduction methods (Goyal et al. 2023). Ensuring safety and welfare is essential when implementing dog-assisted therapy in dental clinics (Gussgard et al. 2019).

Previous studies in paediatric dentistry have emphasized the importance of combining objective physiological measures with subjective self-reported outcomes when evaluating the effects of animal-assisted interventions (Massouda et al. 2025; Kapov et al. 2025). This multimodal approach allows for a more comprehensive assessment of both physiological stress responses and perceived emotional experience.

Although the effectiveness of dog-assisted therapy in reducing anxiety has been documented in multiple paediatric studies (Gussgard et al. 2023; Cruz-Fierro et al. 2019), most of this work has relied primarily on self-report measures and has not systematically incorporated physiological indicators or direct comparison groups.

Kapov et al. (2025) emphasise that identifying optimal outcome measures is essential for accurately assessing the impact of animal-assisted therapy (AAT) on dental anxiety and behavioural responses in paediatric patients. Establishing the effectiveness of AAT may contribute to the development of safe, non-pharmacological approaches to anxiety and behaviour management, with strong translational potential across clinical settings.

Beyond patient-centred outcomes, animal-assisted interventions have also been associated with reduced stress and improved well-being among healthcare professionals, including nurses working in high-demand environments. These findings underscore the broader regulatory and supportive role of human–animal interactions within healthcare systems. In paediatric dentistry, prior research highlights the importance of integrating objective physiological indicators with subjective self-report measures when evaluating intervention effects (Massouda et al. 2025; Kapov et al. 2025). Such multimodal assessment enables a more comprehensive understanding of both physiological stress responses and perceived emotional experience.

Although the anxiolytic effects of dog-assisted therapy have been demoxinstrated in several paediatric studies (Gussgard et al. 2023; Cruz-Fierro et al.2019), existing research has largely relied on self-reported outcomes and has seldom incorporated physiological measures or controlled comparative designs.

The present study aims to determine whether dog-assisted therapy facilitates a calmer and more cooperative clinical experience, and to evaluate its potential within a broader family-centred model of paediatric dental care.

Materials and methods

The present study employed a mixed-methods, pre–post comparison design with two parallel groups: a dog-assisted therapy (DAT) intervention group and a control group receiving standard paediatric dental care. Quantitative measures included heart rate (HR), in the DAT group these measurements were complemented with the Corah's Dental Anxiety Scale (CS) and oxygen saturation (SpO_2), Qualitative feedback from parents and children was collected to contextualize the quantitative findings and to explore the broader family experience of the intervention.

The study was non-randomised. Due to the clinical nature of the intervention and the allocation procedure, randomisation and binding of clinicians were not feasible Fig. 1.

All procedures were conducted during routine paediatric dental appointments. The primary systematic difference between groups was the presence versus absence of a certified therapy dog in the treatment room; however, groups also differed in baseline anxiety characteristics due to the non-randomised allocation procedure.

Participants

A total of 60 children, aged 5 to 12 years, were recruited from a paediatric dental clinic and allocated into two groups. The children presenting moderate to high dental anxiety assigned to the DAT group and children without extreme dental fear assigned to the control group.

The DAT group ($n = 30$) included children treated in the presence of a certified therapy dog, whereas the control group ($n = 30$) consisted of children treated without a dog, matched to the DAT group by age and type of dental procedure. This matching procedure was applied to reduce potential confounding effects related to age and treatment characteristics.

All children had attended at least three prior appointments with the same paediatric dentist, ensuring familiarity with the clinical setting. Parents frequently reported that their child typically experienced stress, fear, or behavioural challenges during dental treatment, making the sample appropriate for evaluating anxiety-reducing interventions. A total of 60 children participated in the study and were equally allocated to the DAT group ($n = 30$) and the control group ($n = 30$). The mean age of participants in the DAT group was 11.2 years, while in the control group it was 11.13 years. The age range was comparable between the two groups. In the DAT group, there were 17 males and 13 females, whereas the control group consisted of 14 males and 16 females. Participant characteristics are summarized in Table 1.

Participants in the DAT group had a median of three previous dental visits, compared to a median of seven visits in the control group. At baseline, the severity of dental anxiety in the DAT group was characterized by a minimum recorded score of 13. In all cases, a standardized desensitization procedure was applied prior to the dental intervention. This procedure involved familiarizing the children with the dental environment and instruments used during treatment, with the aim of reducing anxiety and increasing cooperation.

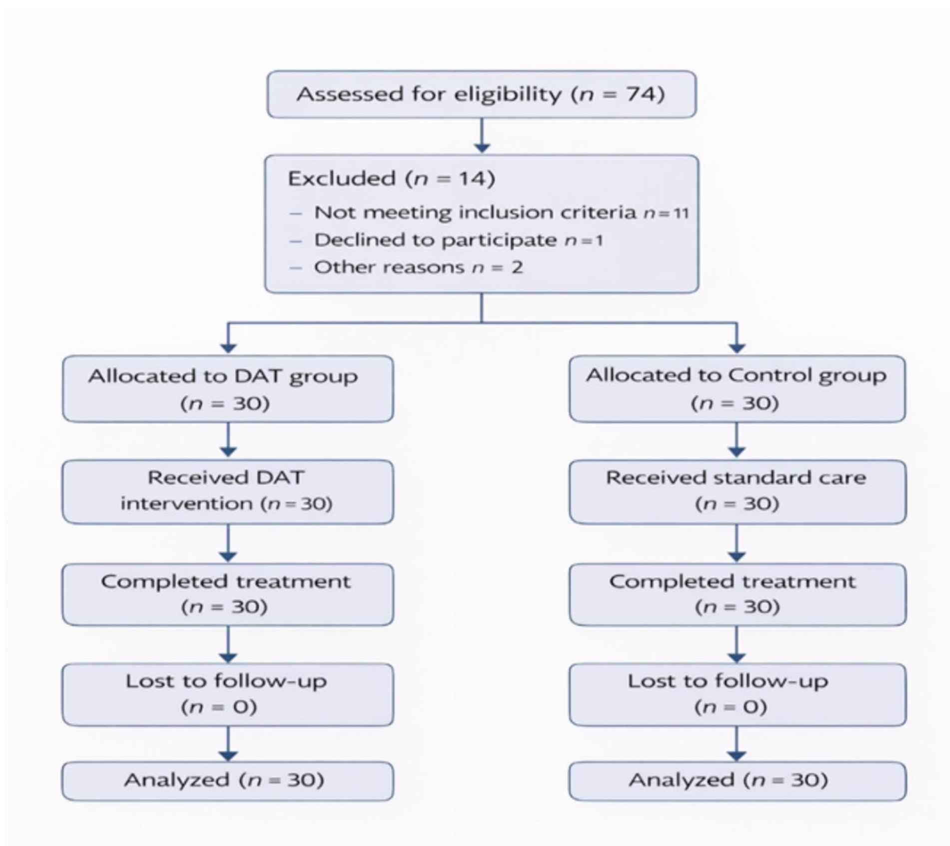

Fig. 1 CONSORT-style flow diagram of participant recruitment, allocation, follow-up, and analysis (non-randomised design)

Table 1 Participant characteristics

Characteristic	DAT Group ($n = 30$)	Control Group ($n = 30$)
Age, mean (years)	11.20	11.13
Age range (years)	5 to 12	5 to 12
Sex, n (male/female)	17 / 13	14 / 16
Previous dental visits, median	3	7
Dental anxiety level at baseline	Moderate to high (CS $\geq$ 13)	no data
Type of dental procedures	Simple procedures*	Simple procedures*

*Simple procedures included restorations, prophylaxis, and uncomplicated extractions

Inclusion and exclusion criteria

For the dog-assisted therapy (DAT) group, inclusion criteria comprised children aged 5 to 12 years were scheduled to undergo routine dental procedures (e.g., restorations, prophylaxis, or uncomplicated extractions). Exclusion criteria included asthma, known allergies to dogs, fear of dogs, any medical condition that could pose a risk during interaction with a therapy dog (e.g., severe immunodeficiency, uncontrolled epilepsy, acute respiratory infections, or cardiovascular instability).

For the control group, inclusion criteria included children aged 5 to 12 years and scheduled to undergo comparable dental procedures to those in the DAT group.

In both groups intellectual or developmental disabilities that could interfere with communication or participation, or physical disabilities that could interfere with treatment were exclusion criteria.

Written informed consent was obtained from all parents or legal guardians prior to participation. A sample informed consent form is provided in the Supplementary Material. The study complied with the Declaration of Helsinki and received institutional ethical approval.

Dog-assisted therapy (DAT) protocol

The therapy dog, Rosi, was a 6 year-old female Golden Retriever and a certified therapy animal trained in accordance with Austrian animal-assisted intervention (AAI) standards. She completed a structured training program, including supervised practical work and formal behavioural assessment, and was certified by the Messerli Research Institute (University of Veterinary Medicine Vienna), the national coordinating authority for therapy dog certification in Austria (Austrian Federal Law for Disabled People 2015; Federal Ministry of Labour, Social Affairs, Health, Care and Consumer Protection 2026).

Training began at approximately 8 months-of-age and included documented supervised sessions. Certification was obtained after successful completion of all required training components, including supervised practical work and behavioural assessment, and in accordance with national eligibility criteria defined under §39a of the Austrian Federal Disability Act. Certification was granted only after the dog reached the minimum required age of approximately 24 months; accordingly, Rosi was certified in September 2022.

All sessions followed a standardised protocol applied consistently across participants. Before treatment, each child was introduced to the dog in a separate room (approximately 5 min) to ensure comfort and willingness to engage. During the dental procedure, the dog remained continuously present in the treatment room.

The dog was positioned next to the dental chair on a designated surface, allowing continuous visual contact with the child. The dog remained in a fixed position and did not move freely within the room. Rosi worked off-leash, in accordance with certification standards ensuring behavioural stability and controllability.

Interaction during treatment was not actively guided and occurred only if initiated by the child and compatible with the procedure. When appropriate and safe, children were allowed to pet the dog. The dog's role was to provide a calm and reassuring presence, supporting emotional regulation through passive mechanisms such as distraction and positive affect.

After completion of the procedure, a brief closing interaction (approximately 3–6 min) allowed the child to re-engage with the dog in a relaxed context. The dog was accompanied by a trained handler whose role was limited to supervision and safety. Following the introduction phase, the handler did not interact with the child, did not guide interaction, and did not provide emotional or verbal support. The handler remained passive and intervened only when necessary.

Animal welfare was closely monitored throughout the study. The dog's workload was adjusted to ensure adequate rest, and behaviour was observed for signs of stress or fatigue. The dog was free to disengage from interaction at any time, and no signs of distress were observed.

Strict hygiene and infection control protocols were implemented due to the paediatric clinical setting:

- Regular veterinary examinations
- Routine screening for *Giardia*, *Cryptosporidium*, and *Escherichia coli*

- Bathing of the dog before and after clinical sessions
- Hand hygiene procedures for dental staff before and after contact
- Positioning of the dog away from sterile zones and dental instruments

Parents were informed about all safety, hygiene, and animal welfare procedures prior to participation, contributing to increased trust and perceived comfort.

Standard behavioural management techniques (tell–show–do, positive reinforcement) were applied equally in both groups.**Measures.**

Heart rate (HR)

HR served as a physiological marker of situational anxiety. Measurements were taken using an automated upper-arm device (Boso Medicus X, Bosch + Sohn) at three standardized time points:

- T0: Before the dental procedure
- T1: Midway through treatment
- T2: Immediately after treatment

Dental procedures typically lasted between 10 and 20 min, with a mean duration of approximately 15 min. Only a small number of visits (2–3 cases) were substantially shorter than 5 min. Given this relatively brief and clinically variable duration, heart rate during treatment (T1) was assessed as a mid-procedure measure intended to capture overall physiological arousal during the intervention rather than short-lived fluctuations. Further subdivision of the treatment period into shorter segments (e.g., beginning, middle, and end of the procedure) was not performed, as this would have resulted in very short measurement windows and potentially unstable estimates of heart rate. The chosen approach was therefore considered the most appropriate compromise between ecological validity and physiological sensitivity in the context of routine paediatric dental care.

To further characterize post-procedural physiological regulation, heart rate recovery (HRR) was calculated. HRR was operationalized as the difference between heart rate measured during treatment and immediately after treatment (HRR_T1–T2 = HR_T1 – HR_T2), (Balasubramaniyan et al. 2016) higher positive values indicating faster recovery following the dental procedure.

HR was collected in both groups.

Corah's dental anxiety scale (CS)

In the DAT group, dental anxiety was assessed using Corah's Dental Anxiety Scale, a four-item measure (range 4–20) with strong evidence of reliability in paediatric populations. The CS was administered verbally at three time points: before treatment (T0), during treatment (T1), and after treatment (T2). The sequence of the dental visit and the timing of all data collection points are illustrated in Fig. 2.

The control group did not receive CS assessments in order to avoid disrupting standard care and to maintain consistent procedures across study groups.

The control group did not undergo CS assessments to preserve the natural course of standard dental care and to avoid introducing additional stimuli that could influence children's stress responses and behaviour. Incorporating such measures in the control condition might have introduced measurement-related bias and reduced the ecological validity of the comparison between groups.

Oxygen saturation (SpO_2)

SpO_2 was monitored uniquely in the DAT group using a Nellcor PM10N pulse oximeter (Medtronic, Minneapolis, MN, USA) at the same time points as HR (T0, T1, T2). The measure served to verify physiological safety and detect any respiratory fluctuations linked to anxiety or emotional arousal.

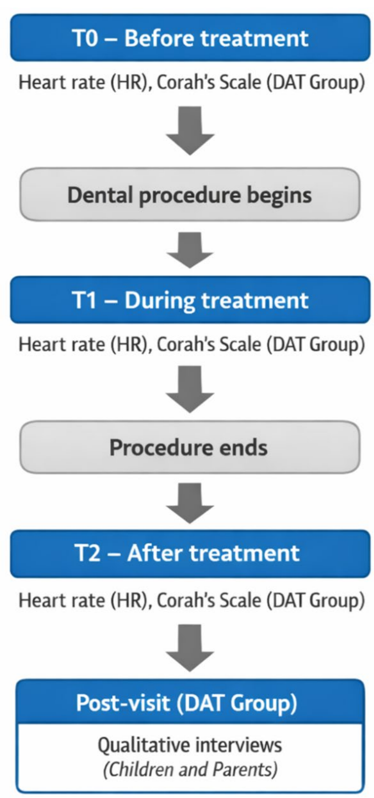

Fig. 2 Timeline of data collection during the dental visit

Qualitative feedback

Open-ended interviews with parents and children in the DAT group were conducted immediately after the appointment. Parents were asked to describe their child's emotional state, level of cooperation, the perceived impact of the therapy dog, and the family's overall experience of the dental visit. Children were asked simple, age-appropriate questions about their feelings, sense of comfort, and interactions with the dog. Responses were analysed using thematic analysis.

Statistical analysis

Descriptive statistics (mean, SD) were calculated for HR at each time point for both groups. To examine changes in heart rate across the three measurement time points and to compare response trajectories between groups, a mixed repeated-measures analysis of variance (RM-ANOVA) was conducted. Time (T0, T1, T2) was included as a within-subject factor, and Group (dog-assisted therapy vs control) as a between-subject factor. The primary effect of interest was the Time × Group interaction, indicating whether heart rate changes over time differed between groups.

Where assumptions of sphericity were violated, Greenhouse–Geisser corrections were applied. In addition, to account for inter-individual variability and to ensure robustness of the findings, a linear mixed-effects model with participant-level random intercepts was fitted as a complementary analysis.

Post hoc comparisons were performed to explore between-group differences at each time point and within-group changes over time. Effect sizes are reported as partial eta squared (ηp^2) for RM-ANOVA effects and Cohen's d for pairwise comparisons. Statistical significance was set at $p < 0.05$ (two-tailed).

Complementary paired and independent-samples t-tests were conducted to facilitate interpretation of the main repeated-measures effects. Paired t-tests were used to examine within-group changes from T0 to T2, and Welch-corrected independent-samples t-tests were used to compare groups at each time point (Ruíz-Mora et al. 2021). For Corah's Dental Anxiety Scale and SpO_2, paired t-tests compared T0 and T2 values within the dog-assisted therapy group. Qualitative data were coded inductively to identify recurring themes related to emotional comfort, cooperation, and family perceptions of the therapy dog. A significance threshold of $p < 0.05$ (two-tailed) was applied.

Results

Heart rate (HR)

Descriptive statistics

Mean heart rate (HR) values for both groups at all three time points are presented in Fig. 3A. Children in the therapy dog (DAT) group consistently demonstrated lower heart rates than children in the control group.

Between-group differences in heart rate were significant during treatment (T1) and after treatment (T2), with lower HR values observed in the DAT group. The two groups showed opposing trends across the procedure: HR in the DAT group decreased from T0 to T2, whereas HR in the control group increased. Analyses examining heart rate patterns across the three measurement points indicated divergent trajectories between groups, with consistently lower heart rate values observed in the dog-assisted therapy group during and after treatment.

Within-group comparisons

Paired *t*-tests were performed to examine change in HR from T0 to T2 within each group. HR decreased by 5.00 bpm (from 96.53 to 91.53), and this reduction was statistically significant: $t(29) = 2.71$, $p = 0.011$, Cohen's d ≈ 0.49 (small-to-moderate). HR increased slightly by 3.33 bpm (from 105.27 to 108.60), and this increase was statistically significant: $t(29) = -2.31$, $p = 0.028$, Cohen's d ≈ 0.42 (small-to-moderate). These within-group changes indicate opposite

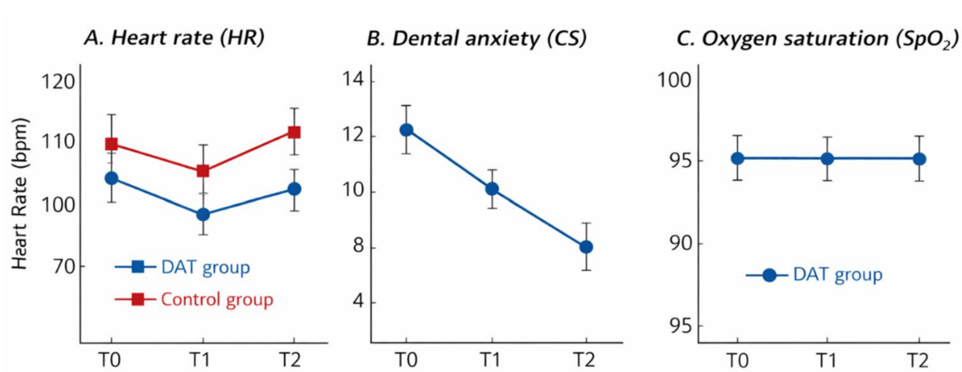

Fig. 3 Physiological and psychological responses across time points in the dog-assisted therapy (DAT) and control groups. **A** Heart rate (HR) across time (T0, T1, T2) in DAT and control groups. **B** Corah's dental anxiety scale (CS) scores across time in the DAT group. **C** Oxygen saturation (SpO_2) across time in the DAT group. Error bars represent standard deviations

directions of physiological response across the two groups, with a decrease in HR in the DAT group and an increase in the control group.

Between-group comparisons

Independent-samples *t*-tests (Welch-corrected) showed meaningful differences between groups:

- T0 (baseline): a modest but statistically significant difference was observed, with lower HR in the DAT group ($p = 0.044$, $d = 0.53$).
- T1 (during treatment): Significantly lower HR in the DAT group
- ($p \approx 0.015$, $d \approx 0.65$).
- T2 (after treatment): Highly significant difference
- ($p < 0.001$, $d \approx 0.96$), with the DAT group showing markedly lower HR.

To facilitate interpretation of this interaction, complementary within- and between-group comparisons are reported below.

Heart rate recovery (HRR)

To further examine post-procedural physiological regulation, heart rate recovery (HRR_T1–T2) was compared between groups. Children in the dog-assisted therapy (DAT) group showed a larger reduction in heart rate from mid-procedure to post-procedure than children in the control group, indicating faster physiological recovery following the dental intervention. Between-group comparison of HRR_T1–T2 indicated a larger, though non-significant, reduction in heart rate in the DAT group compared with controls, with a small effect size. This finding complements the between-group differences observed during and after treatment and suggests that the DAT group not only exhibited lower heart rates but also a more efficient post-stressor downregulation.

The divergence of HR trajectories between groups is illustrated in Fig. 3A.

Corah's dental anxiety scale (CS)

In the DAT group, children's self-reported dental anxiety showed a consistent decrease over time within the DAT group.

Within-group analysis (DAT group only): Paired t-test T0 vs T2: $t(29) = 4.18$, $p < 0.01$, Cohen's d ≈ 1.25.

These findings should be interpreted with caution, as no comparable CS data were collected in the control group; therefore, they cannot be interpreted as evidence of a differential effect of DAT relative to standard care.

The relationship between HR and CS is shown in Fig. 4.

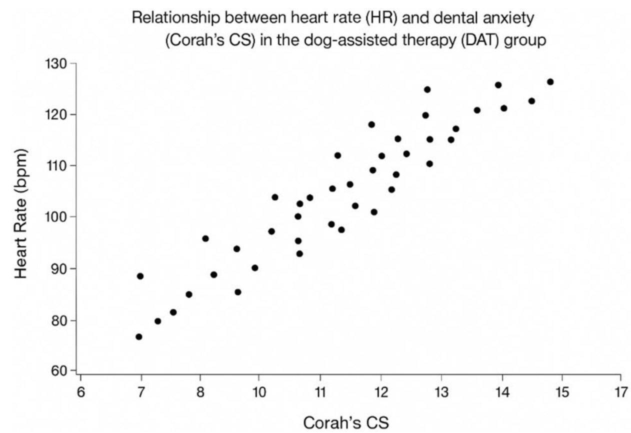

Fig. 4 Relationship between heart rate (HR) and dental anxiety (Corah's CS) in the dog-assisted therapy (DAT) group. Each point represents one participant. A positive association is visible: higher HR tends to coincide with higher CS scores

A paired *t*-test comparing T0 and T2 revealed a statistically significant reduction in self-reported anxiety:

- $t(29) = 4.18$, $p < 0.01$
- Cohen's $d \approx 1.25$, indicating a large effect size

Changes in CS scores across the three time points correspond to the values are illustrated in Fig. 3B. The figure illustrates a steady decline in self-reported anxiety from T0 to T2. CS scores were intentionally collected only in the DAT group to avoid disrupting standard care procedures in the control group. As a result, direct statistical comparison of subjective anxiety across groups was not possible; however, the strong within-group decrease indicates a substantial within-group reduction in self-reported anxiety over time in the DAT group.

Oxygen saturation(SpO_2)

Oxygen saturation (SpO_2) was monitored in the DAT group to ensure physiological stability and to examine whether emotional arousal during treatment had any measurable respiratory effects. As shown in Fig. 3C, SpO_2 values remained highly stable and consistently within the normal physiological range at all three time points:

- *T0 (before treatment)* 97.10% (SD = 1.17)
- *T1 (during treatment)* 97.03% (SD = 1.05)
- *T2 (after treatment)* 98.30% (SD = 0.86)

Paired t-test (T0 vs T2): $t(29) = 0.46$, $p = 0.65$.

Qualitative feedback

Qualitative reports from children and their parents in the DAT group provided additional insight into the emotional and behavioural effects of dog-assisted therapy during dental treatment. These accounts consistently aligned with the quantitative findings, highlighting improved comfort, cooperation, and overall family experience.

Children's experiences

Children frequently described the presence of the therapy dog as calming and reassuring. Typical responses included statements such as “I felt less scared when Rosi was here,” “I just looked at the dog and didn't think about the dentist,” and “She made me brave.”

Several children noted that petting the dog helped them remain still and relaxed during moments they typically found stressful, such as injections or prolonged mouth opening. Even children who were initially hesitant to approach the dog reported becoming more at ease as the appointment progressed.

Parental perspectives

Parents expressed high satisfaction with the therapy dog intervention, often describing benefits not only for the child but for the family as a whole. Comments emphasized reduced stress, increased cooperation, and an improved emotional climate. Typical responses included statements such as “My child was calm the entire time — much more than usual,” “Rosi helped us both. I felt more relaxed, too,” and “This was the first appointment where we didn't have a struggle.”

Parents also appreciated the structured and hygienic implementation of the intervention, noting that the professionalism of the handler and dental team contributed to their sense of safety and trust.

Themes identified

Across comments, three recurring themes emerged:

1. *Emotional Regulation and Comfort* Children frequently reported feeling safer, calmer, and less focused on dental fear.
2. *Improved Cooperation and Treatment Flow* Parents and clinicians observed smoother procedures, reduced resistance, and increased willingness to follow instructions.
3. *Positive Family Experience and Atmosphere* The therapy dog contributed to a more supportive and reassuring environment, reducing stress for both children and accompanying parents.

Discussion

The present study examined the effects of dog-assisted therapy (DAT) on physiological and psychological indicators of dental anxiety in children undergoing routine paediatric dental treatment. By integrating objective measures (heart rate, oxygen saturation), subjective assessments (Corah's Dental Anxiety Scale), and qualitative reports from families, the study provides a multifaceted picture of how the presence of a therapy dog may influence children's emotional and behavioural responses in the dental setting.

This approach is consistent with previous research in paediatric dentistry, which highlights the importance of integrating both objective physiological indicators and subjective self-reported measures when evaluating animal-assisted interventions (Massouda et al. 2025; Kapov et al. 2025).

Children in the control group were not exposed to the therapy dog; however, as in routine clinical settings, it cannot be fully excluded that some children or parents were aware that a therapy dog was present in the clinic at other times.

Effect of DAT on physiological stress responses

Although within-group changes in heart rate (HR) were statistically significant, their magnitude was modest. Children treated in the presence of the therapy dog demonstrated consistently lower mean HR at all time points, a modest downward trend from before to after treatment (−5 bpm), and significantly lower HR than controls during ($p \approx 0.015$) and after ($p < 0.001$) treatment, with medium to large effect sizes.

In contrast, HR in the control group showed only a slight increase (+3.33 bpm).

Importantly, the direction of change differed between groups, with a reduction in HR in the DAT group and a slight increase in the control group, supporting the interpretation of a stabilising effect of DAT on physiological stress responses. In addition to lower heart rate levels during and after treatment, children in the dog-assisted therapy group demonstrated faster heart rate recovery following the dental procedure. Heart rate recovery is widely considered an index of autonomic regulation, reflecting the reactivation of parasympathetic processes and the downregulation of stress-related arousal after a challenging event.

Although HRR is most commonly discussed in the context of physical exercise, the same principle applies to psychophysiological stress responses in clinical settings. Faster recovery following a stressor is associated with more adaptive emotional regulation and greater physiological flexibility. In the present study, the more pronounced post-procedural decline in heart rate observed in the DAT group suggests that the presence of the therapy dog may facilitate not only reduced arousal during treatment but also more efficient recovery once the procedure has ended.

These findings can be further interpreted in terms of emotional and physiological regulation. In stressful clinical environments such as dental treatment, the ability of children to regulate their emotional and physiological responses is crucial for maintaining cooperation and reducing distress. Improved regulation is reflected not only in lower levels of arousal but also in the capacity to recover more quickly following a stressor. In this context, the presence of the therapy dog may function as a regulatory support, helping children modulate their emotional responses and maintain a more stable physiological state during and after the procedure. This pattern aligns with theoretical models of stress buffering in human–animal interaction, which propose that supportive social stimuli—such as the presence of a calm and affiliative animal—can promote parasympathetic activation and accelerate return to baseline following stress exposure.

This interpretation aligns with established literature on animal-assisted interventions, which highlights mechanisms such as distraction, positive affect induction, and oxytocin-mediated modulation of stress reactivity (Beetz et al. 2012). Similar reductions in state anxiety following brief dog-assisted interventions have also been reported in clinical populations outside dentistry, underscoring the general anxiolytic potential of AAT (Barker & Dawson 1998). Such effects may be especially important in paediatric dentistry, where even small reductions in physiological arousal can lead to improved cooperation and treatment flow (Vincent et al. 2020).

Subjective anxiety and emotional experience

Subjective anxiety, measured via Corah's dental anxiety scale (CS), decreased markedly in the DAT group, with a large effect size (Cohen's $d \approx 1.25$). Children reported feeling safer, calmer, and more in control during the procedure. The steady decline from T0 to T2 indicates that the presence of the dog continued to exert a calming influence throughout the appointment.

These findings highlight an important distinction: while HR reflects immediate autonomic arousal, CS captures children's perceived emotional state, which may respond more strongly to the comforting and relational aspects of DAT. In this regard, subjective improvements may be just as clinically relevant as physiological changes, particularly in shaping children's long-term dental attitudes and reducing avoidance behaviours. These results are also consistent with findings from randomized controlled studies that evaluated therapy dogs in paediatric dental settings (Thakkar et al. 2020).

Qualitative insights and family experience

Qualitative reports from children and parents strengthened and contextualized the quantitative results. Children often described the therapy dog as a source of courage and comfort, helping them remain calmer during procedures that typically evoke fear. Parents similarly reported feeling more relaxed themselves, noting that the dog contributed to a less stressful and more supportive treatment environment.

These findings underscore the potential of DAT to positively influence not only the child but also the broader family experience of dental care. Family-centred models emphasize that children's emotional regulation is deeply embedded in relational contexts; thus, interventions that lower parental stress may indirectly support the child's coping and cooperation. The positive atmosphere created by the dog may therefore help families develop more trusting and less fearful associations with dental visits.

Beyond patient and family outcomes, previous research has also shown that animal-assisted interventions may reduce stress and improve well-being among healthcare professionals, including nursing staff working in demanding clinical environments. This suggests that the benefits of such interventions may extend beyond patients and families, contributing to a more supportive and less stressful clinical setting overall.

The observed baseline imbalance in physiological measures may have led to an underestimation of the calming effect of DAT; therefore, future randomised studies with matched baseline anxiety levels are warranted to strengthen causal inference.

Clinical relevance

The findings have several implications for clinical practice:

1. *Improved treatment conditions* Lower HR and reduced anxiety in the DAT group were accompanied by reports of smoother treatment flow and improved cooperation—elements frequently highlighted in the qualitative feedback.
2. *Non-pharmacological alternative* DAT may serve as a useful adjunct to traditional behavioural management techniques, potentially reducing reliance on pharmacological sedation in anxious but otherwise healthy children.
3. *Enhancement of family-centred care* By alleviating parental stress and fostering a more positive emotional climate, DAT aligns with contemporary standards

emphasizing the involvement and well-being of the whole family.

4 *Feasibility and safety* Stable SpO_2 values within normal ranges in the DAT group indicate that the intervention is physiologically safe. Adherence to strict hygiene and handling protocols ensures that therapy dogs can be integrated into dental settings without compromising infection control.

Strengths and limitations

The study possesses several notable strengths. By incorporating both physiological and subjective measures, it provides a more comprehensive understanding of children's anxiety responses than would be possible with either indicator alone. The inclusion of a comparison group strengthens the interpretability of the findings, allowing clear distinctions between changes observed in the presence of a therapy dog and those occurring under standard clinical care. Importantly, all procedures were carried out in real dental conditions rather than controlled laboratory environments, enhancing ecological validity and capturing the practical realities of paediatric dental treatment. The integration of qualitative feedback from children and their parents further enriches the dataset, offering insight into lived experiences and the broader emotional context surrounding the dental visit.

At the same time, several limitations should be acknowledged. Although heart rate was assessed at three standardised time points, the relatively short duration of most dental procedures (typically around 15 min) limited the feasibility of finer-grained temporal segmentation of physiological responses during treatment.

The present study employed a non-randomised design, which raises the possibility of selection bias and limits causal inference. In addition, the control group did not receive an active control intervention (e.g., alternative distraction or supportive activity), which further limits the ability to isolate the specific effects of dog-assisted therapy from general contextual or attentional influences. Future studies should include control groups with comparable baseline anxiety levels and collect the full range of outcome measures across all groups to allow for more robust and internally valid comparisons.

Although each group included 30 participants, this sample size may have been insufficient to detect small within-group changes in heart rate, particularly given the high variability typically observed in paediatric physiological responses. The research was also conducted in a single clinical setting with one therapy dog team, which may limit generalisability to other clinics or contexts.

A major limitation is that baseline anxiety levels were not comparable between groups, as children in the DAT group were selected based on moderate to high dental anxiety, whereas the control group included children without extreme dental fear. Consequently, the groups were not directly comparable, and observed between-group differences cannot be conclusively attributed to the intervention.

An important limitation of this study is that Corah's Dental Anxiety Scale (CS) was assessed only in the DAT group and not in the control group, which prevents direct between-group comparison of subjective anxiety. This asymmetry in outcome assessment limits the strength of conclusions regarding the effect of DAT on self-reported anxiety.

Another limitation of this study is the absence of a formal a priori sample size or power calculation, as the convenience sample size was determined pragmatically based on patient availability. This may limit the statistical power to detect small or moderate effects.

Parental outcomes were based solely on qualitative self-reports, and no objective measures of parental stress or anxiety were included, which should be taken into account when interpreting these findings.

Finally, the study captured only a single dental appointment, leaving open the question of whether the benefits of dog-assisted therapy persist across multiple visits or influence longer-term dental attendance and anxiety trajectories.

Future studies should include randomised or quasi-experimental designs and comparable outcome assessment across groups to strengthen causal interpretation.

Conclusion

Dog-assisted therapy appears to be a safe, promising, and family-supportive adjunct in paediatric dental care. Although within-session physiological changes were statistically significant but modest, children treated in the presence of a therapy dog consistently showed lower heart rates than those receiving standard care, and they reported substantial reductions in subjective anxiety. These outcomes, complemented by positive family feedback regarding emotional comfort and cooperation, suggest that the presence of a therapy dog can meaningfully enhance the overall experience of dental visits for anxious children.

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Data availability The data presented in this study are available on request from the corresponding author. The data are not publicly available due to the continuation of the research and the preparation of a summary report.

Declarations

Conflict of interest The authors declare no competing interests.

Declaration of generative AI use On behalf of all authors, and with their consent, we used **ChatGPT** to assist with language editing and readability. All content was carefully reviewed, edited, and remains the authors' own work.

Informed consent Informed consent was obtained from all subjects involved in the study.

Institutional review board statement The study was conducted in accordance with the Declaration of Helsinki, and approved by the WSB University' Ethic Committee (protocol code AWSB/KE/07/2025).

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