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Effects of animal-assisted therapy on anxiety in children undergoing pediatric dental care: a randomized crossover clinical trial

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Abstract

Background: Animal-Assisted Therapy (AAT) can be used as a behavioral management technique in pediatric dentistry; however, this topic lacks rigorous methodological research.

Aim: To investigate the efficacy of AAT during pediatric dental care, compared to a control group, evaluating the outcomes of fear, pain, and behavior.

Design: This randomized crossover trial was conducted with children aged 5 to 12 years treated at the pediatric dentistry. Each participant was exposed to both experimental conditions (AAT and control), with randomization of the order of appointments. The intervention consisted of the presence of an institutional therapy dog during the dental procedure. Outcomes were assessed before and after the appointments using Children's Fear Survey Schedule–Dental Subscale, Visual Analog Scale, and Frankl Behavior Scale. The animal's level of consciousness and well-being were also monitored.

Results: The results demonstrated an improvement in child behavior in the group exposed to AAT ($p < 0.05$). Conversely, no statistically significant differences were observed between groups regarding fear and pain outcomes. Evaluation of the therapy dog indicated maintenance of consciousness level and adequate neurological function throughout all interventions.

Conclusions: It is concluded that AAT represents a promising adjunctive strategy for managing and improving child behavior during pediatric dental care.Parte superior do formulárioParte inferior do formulário

INTRODUCTION

Animal-assisted therapy (AAT) consists of the use of trained animals for the therapeutic, motivational, or educational benefit of patients. It is a directed intervention in which the animal meets specific criteria and is integral to the therapeutic process. AAT uses goals established individually for each participant, and its progress is measured throughout the execution of the method[1,2]. In the medical field, AAT has been applied to a broad profile of patients, encompassing individuals with oncological and cardiovascular pathologies, as well as those affected by psychiatric and neurodevelopmental disorders, constituting a complementary intervention already consolidated in clinical practice[2-4].

In pediatric dentistry, anxiety and fear may trigger uncooperative or problematic behaviors during the dental appointment[5,6]. In this context, there are behavioral guidance methods that range from basic techniques to more advanced approaches, including non-pharmacological and pharmacological strategies, to minimize the manifestation of psychobehavioral disorders. Professional approaches include communication guidance, use of positive imagery before the visit, observation, tell-show-do technique, voice control, nonverbal communication, positive reinforcement, distraction, and desensitization[7]. In addition, sensory-adapted dental environments, including AAT, picture exchange

communication systems, audiovisual adaptations, and nitrous oxide–oxygen inhalation, are sometimes used as auxiliary tools in the care of anxious patients and those with special health care needs[7].

Despite the growing interest in AAT in health care settings, there is still a need to explore its applicability and efficacy in pediatric dentistry. This limitation largely stems from the scarcity of validated methodological protocols for the implementation of AAT, especially in more invasive procedures involving surgical intervention and the use of local anesthesia[8,9]. A systematic review published in 2023 did not identify significant differences in anxiety, behavior, and pain levels among children undergoing AAT, highlighting the need for studies with larger samples and greater methodological rigor[9].

Therefore, this study aimed to investigate the efficacy of Animal-Assisted Therapy (AAT) during pediatric dental care, compared with a control group without intervention, by evaluating the outcomes of fear, pain, and the behavior of the child and the dog. The conceptual hypothesis was that AAT would reduce dental fear and pain and improve patient behavior during dental appointments.

METHODOS

The human study was submitted to and approved by the ATITUS Educação Research Ethics Committee (REC) (Approval No. 7.239.339), and the animal experiments were approved by the ATITUS Educação Ethics Committee on the Use of Animals (CEUA) (Approval No. 03824). Written informed consent was obtained from all parents or legal guardians on behalf of the participating children before data collection. In addition, informed assent was obtained from the children, adapted according to their age and level of understanding, in accordance with the requirements of the REC. All methods were performed in accordance with the relevant guidelines and regulations.

Trail design

A randomized crossover clinical trial was developed to evaluate the efficacy of Animal-Assisted Therapy (AAT) through the assessment of fear, pain, and behavior of the child and the dog during dental appointments. The crossover design was chosen to minimize individual variability among participants.

Patients who met the inclusion criteria, identified through a screening conducted by the pediatric dentistry faculty staff, were invited to participate in the research. Participants were previously scheduled by telephone, and the dental procedures were performed by a qualified and experienced pediatric dentist. The study conducted three patient appointments per shift. Children attended, accompanied by their parents and/or guardians, and it was established that each participant would be exposed to both study conditions (intervention and control). A washout period of 15 days was included between the dental procedures to minimize memory bias related to the questionnaires[10].

There were no changes to the protocol for this study.

Participants, settings, and location

Patients aged between 5 and 12 years who sought pediatric dental care at ATITUS Educação, Dentistry Program, Brazil. The children required at least two restorative procedures and/or extractions under local anesthesia were included. Participants were required to present good general health and no relevant medical conditions that could interfere with participation in the study. Patients with conditions that compromised verbal communication or the understanding of the questions, as well as those with previously manifested phobias, aversions, or respiratory/cutaneous allergies to animals, were excluded.

Interventions

Demographic and socioeconomic data were answered by the parents and/or guardians through a structured questionnaire at the beginning of the study. The questions were monthly household income (in Brazilian reais), maternal education (in years of schooling), children's dental visits (more or less than one year), and the child's behavior during the last visit to the dentist (poor, regular or good).

A previously trained team administered the questionnaires and assisted in the dental procedures. Behavioral management techniques, such as tell-show-do, distraction, positive reinforcement, parental presence, and, if necessary, protective stabilization, were used in both groups[7]. The dental procedures were performed by a dentist specialized in pediatric dentistry to standardize the operative techniques. The procedures were standardized according to the clinical complexities and difficulties in the same patient to maintain similarity between the two groups (AAT and control). A simple randomization of the teeth to be treated during the interventions was performed to reduce the influence of the type of procedure on the outcomes. Extractions and restorations were performed, both in primary teeth and under local anesthesia. The restorations followed the clinical sequence: topical anesthesia with 10% benzocaine, infiltrative anesthesia or regional block with 2% lidocaine and epinephrine 1:100,000, rubber dam isolation, selective removal of carious tissue with manual and rotary instruments, placement of matrix and wedge (in cases involving proximal lesions), conventional adhesive system (37% phosphoric acid and application of 3M™ Single Bond Universal adhesive), restoration with composite resin (3M™ Filtek™ Z350 XT resin), finishing and polishing. The extractions followed the clinical sequence: topical anesthesia with 10% benzocaine, infiltrative anesthesia or regional block with 2% lidocaine and epinephrine 1:100,000, syndesmotomy, luxation, extraction, hemostasis, suture (when necessary), and postoperative instructions.

The canine was permanently owned/maintained by the Atitus institution as a therapy animal. It was an adult, docile, and neutered female of the Collie breed. The animal received health care, including weekly bathing, administration of antiparasitic medications every three months for the control of endoparasites and ectoparasites, an updated immunoprophylaxis record, and hematological and urine tests performed every six months. All the exams present values within the physiological parameters for the species.

The dog was transported to the research site by a veterinarian, inside a motor vehicle, and was subsequently allocated to a ventilated room with a window located in the pediatric dentistry sector of the institution. The animal received water and food throughout its participation in the study and was taken outside to relieve itself between procedures. At the end of each day of appointments, it returned to the

campus, again inside a motor vehicle, where it received training and care from veterinarians from the institution to maintain its well-being.

During the intervention, the animal and the child were allowed to interact for 10 minutes before the dental procedure[11]. Subsequently, the dog remained close to the child during the dental procedure, next to the dental chair, and interaction with the animal (touch and physical contact) was allowed if the patient so desired. In addition, all animal experiments were performed in accordance with the relevant guidelines and regulations.

Outcomes

This study examined secondary outcomes of the randomized crossover clinical trial, such as fear, pain, children's behavior, and animals' level of consciousness.

Children answered the fear and pain questionnaires at two distinct moments: one before the dental procedure and another after the dental procedure. The application of the questionnaires occurred in the same way in both the intervention and the control conditions.

The Children's Fear Survey Schedule – Dental Subscale, validated by Cademartori et al. (2019)[12], was used to measure children's fear levels regarding different aspects of the dental visit, such as fear of dental instruments, procedures, and the clinical environment. The scale consisted of 15 questions in which children responded to each item on a scale from 1 (no fear) to 5 (very afraid). The interpretation of the results was based on the score obtained; therefore, the higher the score, the greater the child's fear regarding the different aspects of the dental visit.

Pain was evaluated using the Visual Analog Scale (VAS), which consisted of a horizontal straight line with two extremes ranging from 0 to 10, representing the limits of the sensation to be measured. The starting point, 0, indicated the complete absence of pain, and the endpoint, 10, represented the greatest possible intensity of pain[13].

For the behavioral evaluation of the child during dental care, the Frankl Scale was used, which classifies behavior into four categories: definitely positive (++), positive (+), negative (−), and definitely negative (−−)[14]. The child's behavior was evaluated after the dental procedures by a professional specialized in pediatric dentistry, who did not participate in the dental treatments or in the administration of the questionnaires.

Finally, the animal's level of consciousness was measured using the Modified Pediatric Glasgow Coma Scale for Dogs, which allows the assessment of the level of consciousness in adult animals. This scale was modified by Andrade et al. (2010)[15], since dogs, like children, have limited verbal responses. The scale was applied by the veterinarian researcher before, during, and after the dental procedure.

There were no changes to the trial outcomes.

Sample size

The sample size calculation was performed using the GPower 3.1.9.4 software, applying the Wilcoxon nonparametric test for paired samples. The adopted parameters were: two-tailed test, significance level of 5% (α = 0.05), test power of 80% (β = 0.20), and effect size of 0.5 (moderate), estimating 35 participants to detect the expected difference between groups.

In addition, a pilot study was conducted before the beginning of the research with 10% of the estimated sample (n = 3 children), with the objective of evaluating the dog's adaptation to the dental environment and the application of the questionnaires. The participants in the pilot study were not included in the final study sample.

Randomization

The randomization of patients was generated using the online program Sealed Envelope[16]. Six blocks were generated, each with six participants, totaling the 36 individuals required for the study. After the first intervention (e.g., AAT), the participant automatically underwent the second intervention (e.g., control) after 15 days (washout).

Allocation

Allocation concealment was maintained in this research. Only on the day of the first procedure did a professional who was not involved in any other stage of the study inform the operator which participant would be allocated to the intervention or control group. This procedure aimed to minimize selection bias and ensure impartiality in the randomization process.

Blinding

Blinding of participants and researchers was not possible due to the nature of the intervention, which involved the presence of an animal during treatment in the intervention group.

Statistical methods

Descriptive statistical analyses were performed using absolute frequencies (n) and percentages (%), mean, and standard deviation (SD). Normality of the data was assessed using the Shapiro–Wilk test. The quantitative outcomes (fear and pain), measured at two time points (before and after the dental procedures), were transformed into variation scores, calculated as the difference between the pre- and post-procedural measurements (delta variation). Comparisons test between interventions (AAT and control) were performed using the paired Student's *t*-test (for normally distributed data) and the Wilcoxon test (for non-normally distributed data), including continuous outcomes. For the outcome of children's behavior (ordinal quantitative variable), the Spearman correlation test was used. The McNemar test was used for the nominal qualitative variable (dental procedure). Statistically significant results were considered at $p < 0.05$. The analyses were performed using the statistical software STATA 18.0.

RESULTS

Figure 1 shows the participant flow. Participants were recruited from March to October 2025. The trial ended when the sample size was reached. The final number of analyses was 72.

Table 1 shows the descriptive analysis of the sample characterization, including 36 children, with a higher frequency of males (n = 23; 63.89%). The mean age of the participating children was 7.8 years (SD 1.43). Regarding family income, a mean value of R$ 2,793 (SD 1,232) was observed, and most mothers had more than 8 years of schooling (66.67%; n = 16). Considering dental visits, more than half of the children (57.14%; n = 20) had had a dental appointment more than one year earlier, whereas 42.86% (n = 15) had visited the dentist within the previous year. Regarding behavior before dental care, most children presented behavior identified as good (74.29%; n = 26), followed by poor behavior (14.29%; n = 5), and finally regular behavior (11.43%; n = 4).

The results presented in Table 2 show the comparative analysis of psychobehavioral measurements between the group submitted to the AAT intervention (dog) and the control group, measured before and after the dental procedures. Regarding the outcome of fear and pain, no statistically significant difference was identified between the groups after the dental procedures ($p = 0.690$ and 0.190, respectively). Children's behavior, assessed using the Frankl Scale, showed a statistically significant difference between the groups ($p < 0.001$), with a higher proportion of children classified as having definitely positive behavior in the intervention group (65.71%) compared with the control group (61.11%).

No statistically significant differences were observed between the groups regarding the duration of the dental procedure [mean 31.55 minutes (SD 11.22) for the dog group and 35.64 minutes (SD 15.94) for the control group; $p = 0.090$], the number of anesthetic tubes used [1.21 (SD 0.42) in the dog group and 1.14 (SD 0.39) in the control group; $p = 0.343$], and the dental procedure performed between the groups (extraction or restauration, $p = 0.125$) (data not shown in tables).

The behavior of the dog showed that the animal achieved the maximum score on all measured parameters (level of consciousness assessed by eye opening, response to vocalization, and motor response) before, during, and after the 36 dental procedures. In contrast, during two procedures, the dog exhibited polypnea and attempted to escape while the high-speed handpiece was in operation (data not shown in tables).

DISCUSSION

This study evaluates AAT as an intervention to reduce fear and pain and improve behavior in children requiring dental procedures, such as restorations or tooth extractions. The results demonstrated better behavior in children aged 5 to 12 years who underwent AAT compared to the control group. Other outcomes, such as fear and pain, did not show statistically significant differences.

These findings suggest that the presence of a therapy dog may act as a modulator of negative emotional responses during dental care, even in clinical contexts characterized by greater anxiogenic potential, corroborating previous clinical trials[17]. It is also important to highlight that the present clinical trial included restorative procedures and dental extractions performed under local anesthesia, which broadens the discussion regarding the applicability of AAT in clinical contexts of greater complexity.

In the present study, no statistically significant reduction in fear was observed when comparing the group submitted to AAT with the control group. Similar results have been described in previous studies[6,18]. In the first study, the authors suggest that AAT may exert a greater influence on physiological and immediate stress responses than on the conscious and subjective perception of dental fear[18]. Dental fear is a complex, multifactorial phenomenon influenced by prior dental experiences, characteristics of the clinical environment, family-related factors, and aspects of children's emotional development[19,20]. Given this complexity, although the assessment instrument used in this research to evaluate this outcome is validated[12], some questionnaire items may encompass broader dimensions related to the medical–hospital context rather than exclusively to the dental environment. This characteristic may have reduced the sensitivity of the instrument to detect specific changes attributable to the intervention, constituting a possible explanatory factor for the absence of a statistically significant difference observed in this result[21].

Regarding pain, no statistically significant difference was identified between the evaluated groups. However, an increase in pain perception after the dental procedures was observed in both groups, possibly due to the invasive nature of the interventions performed in the study. This response may be attributed to factors inherent to the treatment itself, including the use of local anesthesia, the occurrence of postoperative sensitivity at the procedure site, and the subsequent tissue inflammatory response[22]. Furthermore, it should be considered that part of the participants, although they had a history of previous dental visits, had not previously undergone procedures involving local anesthesia and extractions, which may have influenced the subjective perception of pain when faced with a clinical experience that was previously unknown.

Systematic reviews and clinical trials indicate that animal-assisted therapy (AAT) tends to exert a greater influence on the emotional and behavioral components of stress than on the direct modulation of nociceptive pain, especially when it results from acute peripheral stimuli[23,24]. In contrast, when evaluating children undergoing invasive dental procedures and comparing a group submitted to AAT with a control group, a statistically significant reduction in the pain perceived by patients in the intervention group[25]. These findings indicate the potential of AAT as an adjunctive strategy in pain management in pediatric dentistry, reinforcing the need for further studies with robust designs and greater sample power to deepen the understanding of its clinical effects.

Regarding children's behavior, a statistically significant difference was identified between the group submitted to AAT and the control group, demonstrating a higher proportion of children classified with

definitely positive behavior in the intervention group when compared with conventional management. Physiological evidence indicates that interaction with therapy dogs can activate neuroendocrine and autonomic mechanisms favorable to stress reduction and the promotion of more adaptive behaviors and is associated with increased oxytocin levels and stabilization of heart rate, concomitant with the reduction of cortisol, suggesting activation of the parasympathetic nervous system in contexts of contact with therapy animals[26].

Meta-analyses also report that dog-assisted interventions can reduce cortisol levels in children and adolescents in stressful situations, with the possibility of more positive behavioral responses[27]. In addition, highlight the role of oxytocin, stimulated by physical and affective interaction with dogs, in the modulation of psychosocial and emotional responses, positively impacting human behavior in clinical contexts[28].

Although research on animal-assisted therapy (AAT) in dentistry is still limited regarding clinical trials that adopt children's behavior as an outcome, available studies point to a potential positive effect of the intervention on cooperation and behavioral responses during dental care. In the study by Pinheiro et al. (2023)[18], although the primary outcomes were anxiety and heart rate, the authors reported observational improvement in behavior, such as greater cooperation and less agitation during dental care in the presence of the therapy dog, suggesting a potential effect of AAT on behavioral aspects.

In the present study, the evaluation of the therapy dog's behavior through the Modified Pediatric Glasgow Coma Scale for Dogs[15] showed the maximum score in all measured parameters before, during, and after the dental visits, indicating maintenance of the level of consciousness and adequate neurological function throughout the entire intervention. These results suggest that the participation of the animal in the AAT sessions did not promote clinically relevant changes in its behavioral or neurological status, even with repeated exposure to the dental environment. Occasional episodes of polypnea and escape attempts, observed during the operation of the high-speed dental handpiece, were also seen in our research and were interpreted as transient responses to aversive sound stimuli, without sustained repercussions on the general state of the animal[2,29].

Among the limitations of the present study, the impossibility of blinding participants and researchers stands out due to the nature of the intervention, which may introduce observation bias. Furthermore, the instruments used to measure fear and pain, although validated, are based on self-report and may be influenced by subjective factors, such as previous experiences, individual expectations, and misunderstanding of the applied questions.

Our findings apply to children aged 5 to 12 who like dogs and do not have a diagnosis of neurodivergence. Additionally, further research is needed in pediatric dentistry, with rigorous methodological designs and the adoption of standardized and validated protocols for the evaluation of AAT. Such investigations should include clearly defined criteria for the selection and training of animals, as well as the standardization of the duration and form of intervention, in addition to the use of

consistent and reproducible outcome measures, in order to strengthen the scientific evidence and comparability among studies.

In summary, this research simultaneously evaluated emotional variables (fear), sensory variables (pain), behavioral variables (children's behavior), and behavioral parameters of the therapy animal, providing an integrated view of the effects of AAT in the pediatric dentistry context. In contrast to most previously published studies, which predominantly evaluate AAT in routine consultations or preventive procedures, the present study included restorative procedures and dental extractions performed under local anesthesia. This approach broadens the discussion regarding the applicability of AAT in clinical contexts of greater complexity and potential stress, contributing to the understanding of its effects in more invasive dental situations. Additionally, the systematic evaluation of the therapy dog's behavior showed maintenance of the level of consciousness and adequate neurological function throughout the entire intervention, suggesting that the participation of the animal in the AAT sessions occurred without clinically relevant impairment of its well-being

The findings of the present study indicate that animal-assisted therapy (AAT) improved children's cooperative behavior during dental procedures performed under local anesthesia. In contrast, no statistically significant differences were observed regarding fear and pain. These results reinforce the potential of AAT as an adjunct strategy for behavioral management in pediatric dentistry, especially in clinical contexts characterized by greater complexity and stress potential.

Registration and protocol

This study is part of a larger project entitled "Animal-Assisted Therapy in Pediatric Dentistry: an intervention study with dogs," registered in 24/03/2025 in the Brazilian Registry of Clinical Trials (Rebec – U1111-1317-6771; https://ensaiosclinicos.gov.br/rg/RBR-39v9n67).

The final report of this study was based on the Consolidated Standards of Reporting Trials (crossover trials)[30].

Declarations

Funding Information

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions

FRO and BAA planned this study. JCT, JGS, and BRB collected the data. FRO and BAA analyzed the statistical results. JCT and FRO wrote the paper. All authors reviewed and corrected the final version of the paper.

Conflict of Interest

The authors have no conflicts of interest to declare.

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Tables

Table 1. Descriptive analysis of sample characteristics.

	AAT	**Control**
	n (%)	**n (%)**
Sex		
Female	13 (36.11)	13 (36.11)
Male	23 (63.89)	23 (63.89)
Age *	7.8 (1.43)	7.8 (1.43)
Monthly family income *	2,793 (1,232)	2,793 (1,232)
Maternal education		
≤ 8 years	8 (33.33)	8 (33.33)
> 8 years	16 (66.67)	16 (66.67)
Dental visit		
Less than 1 year	15 (42.86)	15 (42.86)
More than 1 year	20 (57.14)	20 (57.14)
Previous behavior		
Poor	5 (14.29)	5 (14.29)
Regular	4 (11.43)	4 (11.43)
Good	26 (74.29)	26 (74.29)

* mean (standard deviation). AAT: animal-assisted therapy.

Table 2. Comparative analysis of psychobehavioral measurements between the intervention (dog) and control.

	AAT	Control	P value
	Mean variation (SD)		
Fear	-1,33 (7,13)	-0,88 (3,97)	0,690*
Pain	0,97 (2,42)	1,83 (2,74)	0,190*
	n (%)		
Frankl Behavior			
1	1 (2.86)	1 (2.78)	<0,001**
2	3 (8.57)	3 (8.33)	
3	8 (22.86)	10 (27.78)	
4	23 (65.71)	22 (61.11)	

AAT: animal-assisted therapy; SD: standard deviation; * Wilcoxon test; **Spearman correlation; Variation (Δ): after the procedure − before the procedure.

Figures

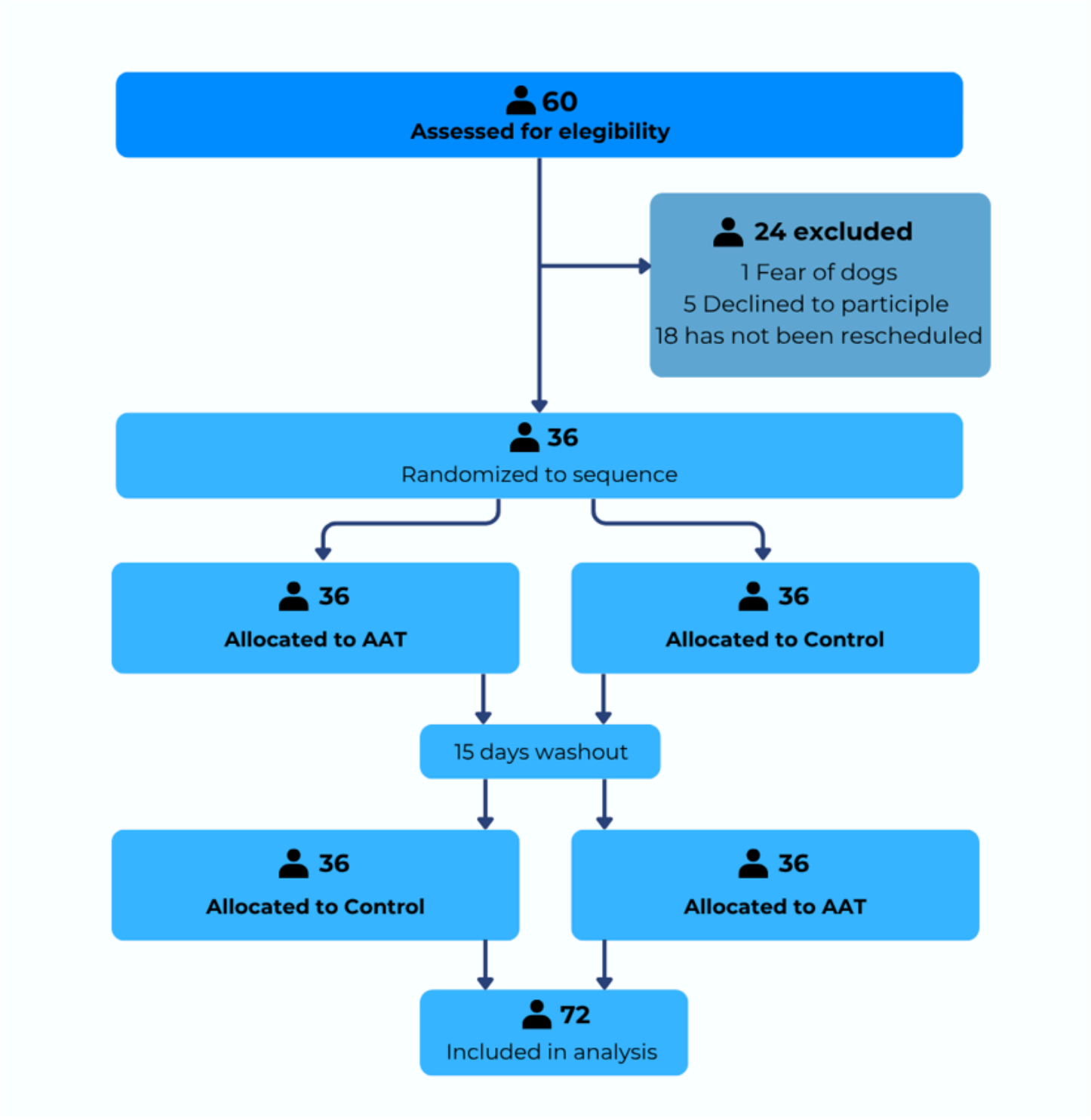


Figure 1

Flow diagram of the crossover study.