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White vs. colored coats: Which reduces dental anxiety better?

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Abstract

Backgrounds To evaluate the effect of colored vs. white coat wear on dental anxiety in children using psychometric, projective, and physiological methods.

Methods The participants were divided into two groups by the pediatric dentist based on the participants' coat color (white vs. colored), and procedures were performed during two separate appointments for both groups: dental examination (DE) and preventive dental treatments (PDT). The blood pressure, pulse rate, and saturation were recorded before and after each appointment. Anxiety was assessed using the Modified Child Dental Anxiety Scale Faces Version ($MCDAS_f$) before and after the appointments and the Child Drawing: Hospital (CD: H). Chi-Square, Mann-Whitney U test, Wilcoxon Signed-Rank test, and t-test were used for analysis. The statistical significance level was evaluated as $P < 0.05$.

Results Compared to the colored coat group, $MCDAS_f$ values recorded before both appointments were higher in the white coat group ($P = 0.019$; $P = 0.034$). Also, it was observed that the CD: H values of the colored coat group were significantly lower after PDT ($P = 0.037$). According to the coat groups, there was a significant difference between pulse rates measured before and after both appointments ($P = 0.026$; $P = 0.017$; $P = 0.008$; $P = 0.004$).

Conclusions The clinician's coat color selection impacts children's dental anxiety. The findings suggest that colored coats are more effective than white coats in relieving dental anxiety.

Keywords Child, Dental anxiety, Drawing, Pediatric dentistry, Vital signs

Background

Dental anxiety is considered a feeling of uncertain worry and exaggerated negative mood independent of any object or situation. Despite modern technological developments in dentistry, it has remained a significant problem for many years [1]. Although it can be seen in every age group, it usually occurs in childhood or adolescence [2]. Dental anxiety can develop multifactorially due to individual factors (e.g., age, gender, and temperament), environmental factors (e.g., family and social factors), or dental factors (e.g., negative dental experiences) [3]. Determining the level of anxiety allows the physician to create an appropriate treatment strategy before the dental procedure and to be prepared for problems that may arise. Many methods have been used from the past to the present to detect dental anxiety and determine its level [4, 5]. Winer divided anxiety assessment methods into four groups: scoring behaviors during treatment, physiological, psychometric, and prospective assessment methods [6]. With anxiety, sympathetic system activation increases, and changes occur in somatic values,

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such as blood pressure, pulse rate, and saturation. Reactions that occur as a result of anxiety and are controlled by the autonomic system can be measured with physiological methods [7, 8]. Studies have shown that physiological measurements are useful in understanding the level of anxiety [9–10]. Due to their ease of application in dentistry practice, psychometric tests are one of the most frequently preferred anxiety determination methods [11]. The Modified Children's Dental Anxiety Scale (MCDAS), developed by Humpris et al., is one of the most frequently used psychometric scales [12]. The Modified Dental Anxiety Scale Faces Version ($MCDAS_f$), was formed by adding a faces rating scale to the numeric form and was developed by Howard et al. to be applied to young age groups and patient groups with low perception levels, who do not have literacy education. This scale is used between the ages of 5–12 [13]. This method includes eight dental procedure questions, and each answer the child gives has a corresponding smiley or sad face. Like the numerical order, the anxiety level increases with the pictures, accordingly [14]. The child responds more easily thanks to the shapes they can perceive more easily [15]. Projective measurement methods consist of scales that aim to determine the anxiety levels of children whose mental development is not yet complete by having them draw situations that will create fear or express their feelings with pictures [16, 17]. One of the projective methods, Child Drawings: Hospital (CD: H), was developed by Clatworthy et al. to measure children's emotional states and anxiety levels in hospitals between the ages of 5 and 11. The child is asked to draw a picture of the doctor performing the procedure and the environment, then dental anxiety is evaluated based on the relevant score on the scoring page [18].

Specialists have reported that children record their physical appearance and behavior before verbally communicating with the dentist, thus developing an impression accordingly [19]. Behaviorist Morris suggests that every article of clothing worn conveys a message and plays a crucial role in forming an impression [20]. The dentist's clothing is the first nonverbal communication. Therefore, the colors and patterns the dentist chooses in his clothing are of great importance [21]. Studies have reported that child-friendly, colorful dental clothing is especially effective in reducing the anxiety of young children [22, 23]. The reduction of anxiety also makes it easier to cope with stressful stimuli, such as aerators and anesthesia. It ensures that they are not afraid of going to the dentist in the future [24].

This study aimed to evaluate the effect of colored and white coat use on dental anxiety in children aged 6–12 who received preventive dental treatments using psychometric, projective, and physiological methods. The null hypothesis was that there would be no difference between the colored coat and white coat groups' levels of dental anxiety in children.

Methods

Ethics approval

This study was approved by the Recep Tayyip Erdoğan University Non-interventional Clinical Research Ethics Committee (Decision no: 2023/34). Because the participants were under 16 years old, detailed information about the research was provided to the children's parents or legal guardians before the study, and informed consent was obtained. According to the principles described in the Declaration of Helsinki, the study protocol included all amendments and revisions.

Sample size

According to the power analysis performed to determine the required number of patients to be included in this study, it was determined that the study should be conducted with at least 126 participants with 95% confidence (1-α), 95% test power (1-β), and w = 0.314 effect size [25]. However, to compensate for missing data, this study was planned to be conduct on a sample of 150 participants.

Study group criteria

Patients who had no previous dental treatment experience, were between the ages of 6 and 12, scored 3 (positive) or 4 (definitely positive) on the Frankl Behavior Scale [26], did not need emergency dental treatment and/or were in pain, had no mental or physical disability, were willing to draw pictures and understood the commands given, and whose parents agreed to participate in this study and signed the consent form were included in this study. A digital software tool (Randomizer, available at www.randomizer.org) was used to randomly select participants for the study groups (accessed on 19 June 2023).

Study procedure

In this study, 75 pediatric patients were welcomed with white coats and 75 pediatric patients were welcomed with colored coats. A two-appointment treatment protocol was created for both groups (Fig. 1). Treatment and evaluations were performed by a single pediatric dentist with 3 + years of experience. Pediatric patients and their parents who applied to the pediatric dentist for a dental examination were informed about the methods to be used for anxiety detection and the procedures to be applied, and written consent was obtained from the parents. The patient's vital signs (blood pressure, pulse rate, haemoglobin oxygen saturation) were recorded in the waiting room during the first visit. The patient was rested in the waiting room for approximately 15 minutes before vital signs were measured, and then the measurements were taken. $MCDAS_f$ was applied before the dental

Total study group (n=150)	
Group 1: White Coat Group (n=75)	**Group 2: Colored Coat Group (n=75)**
1.Appointment Before Dental Examination -Blood pressure, pulse rate, and oxygen saturation measurements were taken. -$MCDAS_f$ was applied.	**1.Appointment** Before Dental Examination -Blood pressure, pulse rate, and oxygen saturation measurements were taken. -$MCDAS_f$ was applied.
During the Examination -The tell-show-do method was applied.	**During the Examination** -The tell-show-do method was applied.
After Dental Examination -Blood pressure, pulse rate, and oxygen saturation measurements were taken. -The child was asked to draw a picture. -Assessment was made using the CD: H.	**After Dental Examination** -Blood pressure, pulse rate, and oxygen saturation measurements were taken. -The child was asked to draw a picture. -Assessment was made using the CD: H.
2. Appointment Before Preventive Dental Treatment Appointment -Blood pressure, pulse rate, and oxygen saturation measurements were taken. -$MCDAS_f$ was applied.	**2. Appointment** Before Preventive Dental Treatment Appointment -Blood pressure, pulse rate, and oxygen saturation measurements were taken. -$MCDAS_f$ was applied.
During Preventive Dental Treatment Appointment - The fluoride varnish and fissure sealant application was performed using the tell-show-do method.	**During Preventive Dental Treatment Appointment** - The fluoride varnish and fissure sealant application was performed using the tell-show-do method.
After Preventive Dental Treatment Appointment -Blood pressure, pulse rate, and oxygen saturation measurements were taken. -The child was asked to draw a picture. -Assessment was made using the CD: H.	**After Preventive Dental Treatment Appointment** -Blood pressure, pulse rate, and oxygen saturation measurements were taken. -The child was asked to draw a picture. -Assessment was made using the CD: H.

Fig. 1 Applied procedures in working groups

examination (DE), and the total score was recorded. The first examination was performed with the "tell-show-do" method and after the examination, vital signs (blood pressure, pulse rate, haemoglobin oxygen saturation) were measured again. The patient was asked to draw the hospital environment and the physician performing the examination. The second appointment was scheduled for seven days later, and it was planned to apply preventive dental treatment (PDT) in this visit. Similarly, vital signs (blood pressure, pulse rate, haemoglobin oxygen saturation), and $MCDAS_f$ values were recorded before the procedure. Fissure sealant and fluoride were applied using the "tell-show-do" method. At the end of the procedure, vital signs (blood pressure, pulse rate, haemoglobin oxygen saturation) were repeated. The patient was asked to draw the hospital environment and the physician who performed the PDT **(**Fig. 2**).**

Outcome measures

Vital signs

Blood pressure, pulse rate, and haemoglobin oxygen saturation were measured in this study (Fig. 3). These measurements were repeated four times in total, before and after the procedure in both appointments.

Blood pressure (BP) Each patient was rested for 15 min before the blood pressure (BP) measurement. BP measurements were performed in the waiting room before the appointment and in the dental unit after the appointment. Measurements were made from the right wrist with the child in an upright position using an automatic wrist blood pressure device (Wohler, Switzerland). Systolic (BPS) and diastolic blood pressure (BPD) values in centimeters of mercury (cmHg) on the monitor were recorded.

Pulse rate (PR) and haemoglobin oxygen saturation (SPO_2) After blood pressure measurement, pulse rate (PR) and haemoglobin oxygen saturation (SPO_2) were measured in a seated position using a finger-type portable pulse oximeter (Oncomed, USA) attached to the child's left finger. PR values on the digital monitor were recorded as beats per minute and SPO_2 as a percentage.

Psychometric assessment

$MCDAS_f$

In both appointments, the children were asked to choose the appropriate faces from the $MCDAS_f$, which is used to measure children's dental anxiety levels, before the procedure, and were asked to choose the appropriate faces from the scale that matched the numbers adapted by Howard [13]. The scores of the eight questions were recorded, with a happy face corresponding to a score of 1 and a very sad face corresponding to a score of 5. The total score was calculated with a minimum of 8 and a maximum of 40, and it was assumed that the anxiety increased as the score increased [27].

Projective assessment

CD: H

After the procedure in both appointments, the children were given the command, "Draw the hospital environment and the person who is treating you, then I will take a photo." They were allowed to be alone in an isolated room to prevent bias in their drawings. A4 paper and crayons of eight colors (black, brown, purple, red, orange, yellow, pink, green) were provided on a table suitable for their height. There was no time limit for the child to complete the drawing. The drawings were evaluated by a pediatric dentist who received training in analyzing

Fig. 2 Examples of 'Child Drawings: Hospital' (CD: H) (a) Picture drawn by an 8-year-old boy. It is seen that the child confines himself to a frame and feels stuck and uncomfortable in the position he is in. Using only black color, not drawing some body parts, drawing himself very small compared to the environment, and hiding his facial expressions are indicators of high anxiety. The child with a CD: H score of 109 was considered to have high anxiety. (b) Picture drawn by an 8-year-old girl. This drawing uses many colors and shapes. The fact that the body parts are compatible with the whole picture, the hair is drawn in color, and the entire paper is used shows that the anxiety level is low. The child with a CD: H score of 17 was considered to have low anxiety

Fig. 3 Measurement of vital signs by a pediatric dentist wearing a white (**a**) and colored (**b**) coat before the appointment, a dental treatment of a pediatric dentist wearing a white (**c**) and colored (**d**) coat, a pediatric dentist wearing a white (**e**) and colored (**f**) coat after the appointment, obtaining 2nd-time vital signs of a child patient

children's drawings. The CD: H scoring table was used to evaluate drawings. Each patient's drawing was numbered and collected, and evaluations were made after all patient drawings were collected. When scoring according to the CD: H scale, the evaluator only knew the patient's number and age and was blind to coat colors. The drawings were scored in three parts (Part A, B, and C) on the CD: H scale. In Part A, 14 items related to the size, positioning, and colors of the drawings were scored between 1 and 10. The items in Section B are considered high anxiety indicators and, therefore, are not expected to be present in every drawing. In the scoring, 5 points were given if a body part was not drawn or was exaggerated; 10 points were given to drawings where there was a disruption in body integrity, more than one body part was forgotten, and it was determined that it was transparent and mixed. If the item was not present, it was recorded as 0 points. Section C is a gestalt degree that scores the child's general condition between 1 and 10; a score of 1 indicates low anxiety and coping, and a score of 10 indicates

high anxiety and discomfort. Accordingly, the appropriate score was given by the rater for each child based on the level of anxiety. According to the total score obtained from the three sections, as the score increases, the anxiety level also increases (Fig. 2) [18, 28].

Clinical applications

In the first appointment of this study, the patient's first examination was carried out using the "tell-show-do" method of using a dental examination set. A second appointment was scheduled for seven days later. In the second appointment, PDT, including fissure sealant and fluoride varnish, was applied. Before the procedure, all patients were informed about the dental procedures to be applied with the "tell-show-do" method. To ensure standardization, the lower permanent first molar tooth was selected as the tooth to be applied with fissure sealant. Polishing was performed with a rotary brush to clean the plaque in the fissures. The teeth were washed and dried. Isolation was provided with cotton rolls and a saliva ejector. The teeth were etched for 20 s according to the manufacturer's instructions (Ruby Etch Acid Gel, Türkiye), washed and dried with air spray for 10 s. Resin-based fissure sealant material (Ruby Dent Fissure Sealant, Türkiye) was applied to the etched enamel surface and spread to the secondary fissures with the help of an applicator. The applied fissure sealant was polymerized for 20 s, and occlusion was checked.

Fluoride varnish was applied after the fissure sealant application. The cleaned tooth surfaces were dried and isolated with cotton rolls and a saliva ejector. Fluoride varnish (Polimo Dental Varnish, Imicryl, Türkiye) was applied to all tooth surfaces and it was left for about one minute. The patient was warned to breathe through his nose and not to swallow excess varnish. In addition, necessary recommendations were made to the patients after the application.

Statistical analysis

The data obtained from this study were evaluated using the SPSS statistical package program (SPSS V23.0, SPSS Inc, Chicago, IL, USA). The categorical data were analyzed with the Chi-Square. The normality distribution of the data was evaluated with the Kolmogorov-Smirnov test. Accordingly, the data of the study groups that were normally distributed were analyzed using the independent sample t-test, and those that were not were analyzed with the Mann-Whitney U. The Wilcoxon Signed Ranks test was applied for the analysis of the data between the examination and PDT appointments. The statistical significance level was determined as $P < 0.05$.

The Kappa test was applied to evaluate intraobserver agreement in scoring the pictures drawn by children according to the CD: H. Accordingly, it was determined that there was a strong level of agreement between the scores made by the researcher at two different times, 10 days apart (Kappa: 0.865) [29].

Results

In this study, 150 pediatric patients were included, 75 of whom were in the white coat group and 75 in the colored coat group, and the mean age was 8.91 ± 2.01. The mean age of the children in the white and colored coat groups was 8.72 ± 1.94 and 9.09 ± 2.08, respectively. There was no statistical difference between age and groups ($P = 0.269$). In this study, 58.7% of the participants were boys and 41.3% were girls. Of the participants in the white coat group, 42 were boys, and 33 were girls, while of those in the colored coat group, 46 were boys and 29 were girls. Also, there was no statistical difference between gender and groups ($p = 0.507$).

The mean values of $MCDAS_f$ applied before the appointment and the mean values of CD: H applied after the appointment are shown in Table 1. When the white vs. colored coat groups were compared, a statistically significant relationship was found in terms of $MCDAS_f$ values in DE and PDT appointments ($P = 0.019$; $P = 0.034$). Accordingly, dental anxiety levels were lower in the colored coat group in both appointments. In the CD: H evaluations made after the appointments, there was no statistically significant difference between the white vs. colored coat groups in CD: H-DE ($P = 0.186$), while

Table 1 Comparison of anxiety scores according to white vs. colored coat groups

		White Coat		Colored Coat		*P*
		Mean ± SD	**M (Min-Max)**	**Mean ± SD**	**M (Min-Max)**	
Before the Appointment Anxiety Scores	**$MCDAS_f$-DE**	18.43 ± 5.75	18 (8–34)	16.21 ± 5.06	16 (8–29)	**0.019[1]***
	$MCDAS_f$-PDT	18.44 ± 6.04	18 (8–34)	16.28 ± 6.49	16 (8–32)	**0.034[1]***
	P	0.952[2]		0.740[2]		
After the Appointment Anxiety Scores	**CD: H-DE**	63.57 ± 22.47	60 (25–125)	58.96 ± 25.03	60 (20–120)	0.186[1]
	CD: H-PDT	66.00 ± 25.12	62 (23–135)	58.23 ± 27.93	48 (21–126)	**0.037[1]***
	P	0.087[2]		0.918[2]		

*: There was a significant difference between groups with the Wilcoxon test (significance set at *P*-values < 0.05); SD: Standard Deviation; M: Median; Min: Minimum; Max: Maximum; $MCDAS_f$-DE: Modified Child Dental Anxiety Scale Faces Version-Dental Examination; $MCDAS_f$-PDT: Modified Child Dental Anxiety Scale Faces Version-Preventive Dental Treatment; CD: H-DE: Child Drawing: Hospital–Dental Examination; CD: H-PDT: Child Drawing- Hospital- Preventive Dental Treatment; [1]Mann-Whitney U Test, [2]Wilcoxon Signed-Ranks Test

Table 2 Comparison of pulse rate (PR), systolic blood pressure (BPS), diastolic blood pressure (BPD), and haemoglobin oxygen saturation (SPO2) vital signs according to white vs. colored coat groups

	White Coat		Colored Coat		*P*
	Mean ± SD	M (Min-Max)	Mean ± SD	M (Min-Max)	
PR-BDE (BPM)	93.45 ± 8.74	93 (70–123)	89.77 ± 10.67	90 (10–101)	**0.026**[1]*
PR-ADE (BPM)	94.24 ± 10.77	94 (74–120)	90.72 ± 6.59	92 (77–104)	**0.017**[3]*
P	0.809[2]		0.786[2]		
PR-BPDT (BPM)	93.65 ± 10.39	91 (63–125)	90 ± 5.51	90 (80–105)	**0.008**[1]*
PR-APDT (BPM)	94.59 ± 10.93	91 (78–122)	88.43 ± 12.05	89 (8–109)	**0.004**[1]*
P	0.308[2]		0.166[2]		
BPS-BDE (cmHg)	9.89 ± 1.37	10 (8–13)	10.14 ± 1.11	10 (8–12)	0.089[1]
BPS-ADE (cmHg)	9.88 ± 0.82	10 (9–12)	10.04 ± 1.06	10 (8–12)	0.464[1]
P	0.227[2]		0.786[2]		
BPS-BPDT (cmHg)	9.89 ± 0.84	10 (9–13)	10.15 ± 1.10	10 (8–12)	0.197[1]
BPS-APDT (cmHg)	9.91 ± 0.80	10 (9–12)	10.16 ± 1.08	10 (8–12)	0.180[1]
P	0.655[2]		0.655[2]		
BPD-BDE (cmHg)	6.59 ± 0.35	7 (6–8)	6.71 ± 0.74	7 (5–8)	0.306[1]
BPD-ADE (cmHg)	6.60 ± 0.61	7 (6–8)	6.53 ± 0.64	7 (5–8)	0.698[1]
P	0.782[2]		**0.003**[2]*		
BPS-BPDT (cmHg)	6.69 ± 0.59	7 (6–8)	6.60 ± 0.67	7 (5–8)	0.301[1]
BPS-APDT (cmHg)	6.69 ± 0.56	7 (6–8)	6.60 ± 0.63	7 (5–8)	0.312[1]
P	1.000[2]		1.000[2]		
SPO_2 -BDE (%)	98.45 ± 0.38	99 (97–99)	98.57 ± 0.24	99 (98–99)	0.322[1]
SPO_2-ADE (%)	98.44 ± 0.66	98 (95–99)	98.65 ± 0.47	99 (98–99)	**0.038**[1]*
P	0.796[2]		0.109[2]		
SPO_2-BPDT (%)	98.47 ± 0.66	99 (96–100)	98.64 ± 0.48	99 (98–99)	0.111[1]
SPO_2-APDT (%)	98.47 ± 0.64	99 (96–100)	98.67 ± 0.47	99 (98–99)	**0.044**[1]*
P	1.000[2]		0.317[2]		

*: There was a significant difference between groups with the Wilcoxon test and T test (significance set at *P*-values < 0.05); SD: Standard Deviation; M: Median; Min: Minimum, Max: Maximum; cmHg: Centimeter of Mercury, BPM: Beats Per Minute, %: Percentage; PR-BDE: Pulse Rate- Before Dental Examination; PR-ADE: Pulse Rate- After Dental Examination; PR-BPDT: Pulse Rate- Before Preventive Dental Treatment; PR-APDT: Pulse Rate- After Preventive Dental Treatment; BPS-BDE: Blood Pressure Systolic- Before Dental Examination; BPS-ADE: Blood Pressure Systolic- After Dental Examination; BPS-BPDT: Blood Pressure Systolic- Before Preventive Dental Treatment; BPS-APDT: Blood Pressure Systolic- After Preventive Dental Treatment; BPD-BDE: Blood Pressure Diastolic- Before Dental Examination; BPD-ADE: Blood Pressure Diastolic- After Dental Examination; BPD-BPDT: Blood Pressure Diastolic- Before Preventive Dental Treatment; BPD-APDT: Blood Pressure Diastolic- After Preventive Dental Treatment; SPO_2-BDE: Haemoglobin Oxygen Saturation- Before Dental Examination; SPO_2-ADE: Haemoglobin Oxygen Saturation- After Dental Examination; SPO_2-BPDT: Haemoglobin Oxygen Saturation- Before Preventive Dental Treatment; SPO_2-APDT: Haemoglobin Oxygen Saturation- After Preventive Dental Treatment; [1]Mann-Whitney U Test, [2]Wilcoxon Signed-Ranks Test, [3]T Test

a significant difference was observed in CD: H-PDT ($P = 0.037$). It was detected that CD: H-PDT values were lower in the colored coat group. No statistically significant difference was found before and after appointment anxiety scores of both coats in intragroup comparisons.

In the vital findings evaluations, the comparison of PR, BPS, BPD, and SPO_2 values recorded before and after both appointments of the white vs. colored coat groups is shown in Table 2. When the white vs. colored coat groups were compared, a statistically significant difference was found in terms of PR-BDE ($P = 0.026$), PR-ADE ($P = 0.017$), PR-BPDT ($P = 0.008$), PR-APDT ($P = 0.004$), SPO_2-ADE ($P = 0.038$), SPO_2-APDT ($P = 0.044$). In intra-group comparisons, a significant relationship was observed between BPD-BDE and BPD-ADE in the colored coat group ($P = 0.003$), while no significant difference was observed in other intra-group comparisons.

Discussion

The null hypothesis was rejected. It was concluded that the pediatric dentist's choice of colored coats could help children feel more comfortable and reduce their dental anxiety levels.

Dental anxiety is a multifactorial concept, and the approach, physical appearance, and communication of the dentist with the patient can have a crucial role in its development. Considering that the color of the coat can affect dental anxiety, pediatric dentists need to pay attention to their appearance [3]. Anxiety can be assessed by behavioral rating scales, physiological, psychometric, and projective methods. Since it is a very complex condition, it is recommended to use more than one method together [5]. In this study, $MCDAS_f$ among the psychometric methods, CD: H among the projective methods, and PR, BPD, BPS, and SPO_2 measurements among the physiological methods were used together to determine anxiety.

The "tell-show-do" method is frequently preferred in studies because it is easy to use, effective, and acceptable to all age groups [30–32]. Consistent with these studies in the literature, the "tell-show-do" technique was used in the DE and PDT in the current study. In addition, patients with dental experience, those in pain, and/or those needing emergency treatment were excluded from this study, considering the possibility of affecting their attitudes when they applied to the clinic. Studies have reported that children aged 6 years and older can express themselves better and respond more accurately to anxiety assessment scales [28, 33, 34]. Therefore, participants aged 6–12 were included in the current study.

Children, unlike adults, exhibit different attitudes and behaviors towards white coats. In some studies in the literature, it has been stated that children are not afraid of white coats; on the contrary, they see them as symbols of recovery and find them reliable [2, 23]. Contrary to these studies, some studies argue that children fear white coats [2, 34]. Ravikumar et al. reported that children with high anxiety levels in the young age group prefer patterned pediatric coats and casual clothes due to their friendly appearance [34]. Arslan and Aydınoğlu reported in their study that patients with dental experience high dental anxiety due to bad experiences and prefer colored coats over white coats [2]. The current study supports studies that argue that children fear white coats and have shown that colored coats reduce children's dental anxiety levels.

In recent years, studies examining the relationship between children's anxiety levels and colors have frequently been included in the literature. Studies conducted over the years have shown that brightly colored uniforms evoke positive emotions in children and are widely preferred [35, 37]. Annamary et al. concluded in their study that children associate pink and blue colors with positive emotions and that it may be beneficial for dentists to use these colors [38]. Also in the same study, it was reported that anxious children preferred pink, whereas non-anxious children preferred blue. A study by Mobaraki et al. found that children in pediatric wards preferred nurses wearing pink uniforms over blue ones [39]. Pakseresht et al. reported in their study that the effect of colored coat preference on anxiety was effective in reducing children's anxiety levels compared to blue [40]. In addition, it was reported that the pink color created a calming and relaxing effect a few minutes after exposure and suppressed aggressive and anxious behaviors [41, 42]. Considering the positive effects of pink on young children's anxiety levels, pink was preferred as the coat color in the study. Similar to Pakseresht et al. [40], they concluded that the anxiety level after dental treatments was lower in the pink coat group compared to the white coat group in the current study.

In the literature, in the studies examining the relationship between anxiety and the appearance of the physician, the $MCDAS_f$ was preferred among the psychometric methods because it is fast and easy to apply, understandable, and has many advantages in measuring anxiety with its questions related to many factors [2, 34]. In the study conducted by Arslan and Aydınoğlu, it was reported that children with high $MCDAS_f$ anxiety scores preferred more colored coats [2]. The current study supports the information in the literature that child-friendly dental appearance strengthens initial communication, especially with children with high anxiety levels, and it was observed that the $MCDAS_f$ scores of the children in the colored coat group were lower in both appointments.

Drawing is considered a suitable projective method for children to express themselves and can be used frequently in the evaluation of anxiety, especially in young children [18]. In the study conducted by Yadav et al., it was reported that children with high CD: H scores also had high anxiety levels [25]. Güner et al. applied one of three different dental treatment procedures, including filling, amputation, and root canal treatment, to patients, and no statistically significant difference was found between the types of dental treatment and CD: H scores [43]. In the current study, no significant difference was observed between the CD: H scores of the colored and white coat groups in the DE. In the PDT of the study, which did not include any painful or invasive procedures, it was observed that the CD: H scores of those in the colored coat group were lower.

In studies examining dental anxiety, it is seen that vital signs are frequently used [25, 43]. However, according to the literature review, to our knowledge, there is no study in which any treatment procedure is applied, the effects of physician-related factors are eliminated, and the physician's appearance on dental anxiety is evaluated with physiological parameters. Studies are reporting that PR values are high in dental treatment steps, such as local anesthesia applications, tooth extraction, and cavity preparation [44, 45]. In their study, Beck et al. found that PR values did not change during examination and polishing procedures; however, PR values reached their highest level after tooth extraction, which is a more complicated treatment, and stated that PR values increased with increasing stress levels [46]. In this study, while no difference was found in PR values taken before and after both DE and PDT appointments in both coat groups, it was found that the PR values taken before and after both DE and PDT appointments of the white coat group were higher than those of colored coat group. It was thought that the white coat upregulated PR values by causing anxiety than colored coats. Contrary to studies reporting that blood pressure values show less variability during dental procedures, such as examination and polishing,

but increase significantly during extraction and local anesthesia applications [47], there are also results indicating that examination and dental treatments do not affect blood pressure values [46]. It is also stated that dental anxiety increases BPS values but does not have a significant effect on BPD values [48]. The current study found a statistically significant difference between the BPD measured before and after DE of patients only in the colored coat group. Although there is no perceptible reason for this difference, it may be due to exposure to different individual or environmental stimuli. No significant difference was found between BPS and BPD values measured before and after other DE and PDT appointments. This situation may be due to the exclusion of treatments that may cause a painful stimulus, such as local anesthesia, tooth extraction, and cavity preparation from this study. In the study conducted by Singh et al., the relationship between anxiety and SPO_2 in patients who underwent tooth extraction was evaluated. Accordingly, no significant difference was found between anxiety and SPO_2 [48]. Similarly, in the results of this study, no difference was found between the SPO_2 values before and after both appointments in both coat groups. This situation is thought to be because SPO_2 values are physiologically within a narrow range (96–98%) and that it is not a parameter that changes in a short time like PR. However, SPO_2 values were significantly higher in the colored coat group both after DE and after PDT than in the white coat group. These results can be evaluated as the colored coat creating a positive communication between the dentist and the child during the treatment, contributing to reducing the child's anxiety and the child feeling relaxed after the appointments.

The limitations of this study include the fact that the sample group consisted only of patients who came to the university hospital, that examination and preventive treatment applications were performed only by a female physician who only wore a pink coat, and that no drawings were made before the appointment. However, the fact that the treatment protocol applied within the scope of the study was conducted in two appointments and that no painful or invasive applications were made during these appointments, allowing the effect of the physician's coat choice on the child's anxiety values to be directly observed, are among the strengths of the study. In addition, the conducted study will make important contributions to the pediatric dentistry literature since it is the first study to evaluate dental anxiety with three different methods. Further studies should be conducted using a wider range of coat colors to evaluate the effect of the physician's appearance on dental anxiety.

Conclusion

Taking control of dental anxiety can help the pediatric dentist establish a friendly relationship with the child. A positive patient-pediatric dentist relationship helps the child develop the habit of going to the dentist regularly, reduces fear, and approaches treatment more positively, resulting in better oral health. At this point, this study achieved its purpose; in other words, the decrease in anxiety levels observed in patients as a result of preventing the development of anxiety due to the differences in treatment or physician is thought to be due to coat color.

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E.K. Design, Data Collection, Literature Review, Writing; S.A. Design, Analysis, Literature Review; D.N.G. Design, Literature Review, Analysis; All authors read, review, editing, and approved the final manuscript.

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Data availability
The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Consent for publication
The informed consent forms obtained from the patients included explanatory text for personal or clinical details and identifying images to be published in this study, and written informed consent was obtained for their use.

Competing interests
The authors declare no competing interests.

Human ethics and consent to participate
Ethical approval was obtained from the Non-invasive Clinical Research Ethics Committee of Recep Tayyip Erdoğan University (Decision no: 2023/34). This study was conducted in accordance with the Declaration of Helsinki of 1975, as revised in 2013. Since the participants were under 16 years old, detailed information about this research was provided to the children's parents or legal guardians before the study, and an informed consent form was obtained.

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