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ORIGINAL RESEARCH

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Evaluation of the relationship between children's dental anxiety levels and their compomer restoration color preferences

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Abstract

Background: Dental anxiety is frequently encountered in children and recognized as an important public health problem. This study aimed to evaluate the relationship between children's dental anxiety levels and their compomer restoration colors preferences. **Methods**: In this study, we evaluated the relationship between anxiety levels and compomer restoration color preferences in 275 children aged between 5 and 10 years who required restorative treatment in their primary molar teeth. The children's dental anxiety levels were determined using the Modified Child Dental Anxiety Scale (MCDAS), face version. Children with identified anxiety levels were asked to choose colors for their fillings. The children were asked about their favorite color, and the obtained data was recorded. **Results**: We observed that children with high anxiety levels predominantly chose pink as the restoration color, while those with low anxiety levels mostly selected white. We also observed that children who chose their favorite color for restoration tended to have higher levels of anxiety ($p < 0.05$). **Conclusions**: Choosing white for compomer restoration colors in children is thought to indicate low or moderate level of anxiety, while choosing pink indicates high anxiety levels. Therefore, compomer restoration color preferences can be used as a measure of dental anxiety and certain emotional states. **Clinical Trial Registration**: ClinicalTrials.gov, ID: NCT06484998, Date: 03 July 2024.

Keywords

Color; Compomer; Dental anxiety; Dental caries; Primary teeth

1. Introduction

Dental fear and anxiety are frequently encountered in children and are recognized as important public health problems in many countries, leading to postponement and eventual neglect of dental treatments [1]. Children with high anxiety levels are less likely to visit the dentist and are more likely to delay dental treatment. Consequently, their oral health is negatively affected. Patients with high levels of dental anxiety avoid appointments and treatments, which results in poor oral hygiene. This, in turn, causes feelings of guilt, shame and inadequacy. This situation is a vicious cycle of both cause and consequence, leading to delayed dental visits and increased dental anxiety levels [2–5]. Dental anxiety is a difficult condition to measure because it exists at different levels in each individual and is a subjective experience; therefore, we determine dental anxiety by using scales [6]. Color preference can reflect specific emotional states, dental anxiety and fear, and can be used to explore children's perceptions of events in clinical settings [7]. Color preference is a well-established aspect of human psychology and can significantly influence individual experiences and perceptions. Coloured compomers attract children's attention, motivating them to take care of their oral hygiene and positively impacting their oral health [8, 9]. By allowing children to choose their preferred colours for their restorations, dentists can increase their sense of control and potentially alleviate the anxiety associated with the dental treatment process [10]. This enables children to participate more in the treatment process and cooperate better. As a result, children feel less anxious and accept dental treatment more easily [11]. While simultaneously preventing loss of clinical time, the ability of dentists to successfully and effectively assess children's dental anxiety levels helps to facilitate treatment requirements and planning [12].

Very few studies have examined the relationship between children's colour preferences and dental anxiety. The study aimed to evaluate the relationship between compomer color preferences and dental anxiety levels. Colored compomers are frequently used in the restorative treatments of pediatric children who need primary molar teeth restorative treatment.

2. Materials and methods

This non-randomized cross-sectional clinical study was carried out in children aged 5–10 years, who were admitted to the Clinic of the Department of Pedodontics, Faculty of Dentistry, Zonguldak Bülent Ecevit University, between 2022 and 2023, and who needed restorative treatment of their deciduous mo-

lars. Ethics committee approval was obtained from Zonguldak Bülent University Clinical Research Ethics Committee (2022/17) and registered to the https://clinicaltrials.gov (Identifier: NCT06484998). Verbal and written informed consent of the children participating in the study was obtained from the parents or legal guardians.

2.1 Sample size and recruitment

Similar studies were reviewed to inform the calculation of the sample size. The calculation yielding the largest sample size according to the statistical methods to be applied in line with the hypotheses was taken into consideration. The sample size was calculated at a 95% confidence level using the G*Power 3.1.9.2 programme (Axel Buchner, Düsseldorf, NRW, Germany). Following the analysis of the comparison of independent groups, alpha was set at 0.05 and the standardized effect size at 0.25, as there were no similar studies. It was determined that the minimum sample size should be 252 with a theoretical power of 0.80. Convenience sampling was used.

2.1.1 Inclusion criteria

- Children with molar teeth requiring restorative treatment;
- Children without any syndrome and/or systemic disorders;
- Children without mental retardation;
- Turkish children were included in the study (same ethnicity).

2.1.2 Exclusion criteria

- Children with a history of allergies to the filling material used and its derivatives;
- Children who refused treatment;
- Children who did not require restorative treatment or who required more advanced treatment than restorative treatment were excluded from the study.

2.2 Measurement tools

The Modified Child Dental Anxiety Scale—Faces Version (MCDAS-f), developed by Howard and Freeman [13], has been adapted to include facial expressions matched with numbers. The MCDAS-f is recognized as a reliable tool for measuring dental anxiety in children, with an age range of 5 to 12 years [14]. Each question is scored using faces ranging from 1 "relaxed" to 5 "extremely anxious", and the scores from 8 questions are added together to obtain a total score. Based on the total score, scores below 19 were classified as low anxiety, scores between 19 and 31 as moderate anxiety, and scores between 32 and 40 as high anxiety [14]. The MCDAS-f version has been reported to be a reliable and valid tool for quickly and efficiently measuring dental anxiety in Turkey [14].

2.3 Procedure

Children without any syndromes or systemic disorders or mental retardation who needed restorative treatment for primary molars were included in the study. The examination forms of 275 children requiring primary teeth restorative treatment were analyzed at the restorative treatment session. The children were taken to a separate room for the treatment. While examining each child, the dentist wore a white apron to prevent the children's color preferences from being influenced by the environment, and each child was examined by the same dentist. To determine the child's anxiety levels, the MCDAS-f version [14] was administered before restorative treatment to the children. While the children were answering the questions in the MCDAS-f, their parents were allowed to make eye contact with them and to be at a distance where they could see their children, but were not allowed to interfere with their answers. The children were asked to choose from a new scale consisting of nine colours (pink, blue, gold, silver, orange, yellow, green, purple, white) by adding white compomer (Dyract XP) to the colored compomer colour scale (Voco Twinky Star) for the compomer restoration color selections. During the color selections, it was ensured that the children saw all the colors at the same time in order not to cause any bias. They were asked what their favourite color was after the compomer restoration color selection so that the previous question would not have any effect on their restoration color selection, and the data obtained were recorded.

2.4 Statistical analysis

We analyzed the data using IBM SPSS 25 software (IBM Corp., Armonk, NY, USA). The descriptive statistics (number, percentage, mean, standard deviation, minimum and maximum) were provided in this study. The Pearson Chi-square test was applied when the cell sample size assumption (expected value >5) was met in testing the relationship between categorical variables, and Fisher's Exact test was applied when the cell sample size assumption was not met. The assumption of normality was tested using the Shapiro-Wilk test, and the assumption of variance homogeneity was tested using the Levene test. The Independent Samples *T*-test was employed to compare two independent groups with normal distribution; when this was not met, the Mann-Whitney U test was applied. In order to compare the means of three or more independent groups with a normal distribution, the analysis of variance (ANOVA) test was performed. In order to compare the means of three or more independent groups for which the data were not normally distributed, the Kruskal-Wallis test was performed. In order to identify the group or groups responsible for the observed differences, the *Post Hoc* Bonferroni test was applied. The significance level was determined as $p < 0.050$.

3. Results

Study results indicate that 5- and 7-year-old girls chose pink as their most preferred compomer restoration and favourite color, while 5-year-old boys chose blue as their most preferred compomer restoration and favourite color. The children aged 6 and 8 years and older chose white as the most preferred compomer restoration color regardless of their favourite colors (Table 1).

The children in the high anxiety group were 5, 6, 7, and 8 years old. Those aged 9 and 10 years were found to have low or moderate anxiety ($p = 0.028$). The children with high anxiety levels were found to be mostly girls ($p = 0.011$) (Table 2). It was found that children with low and moderate anxiety mostly

TABLE 1. Distribution of the most liked color and the most preferred compomer restoration color according to age and gender.

Age (yr)	Gender	The most preferred compomer restoration color Color, n (%)	Most popular color Color, n (%)
5			
	Girl	Pink, 12 (48.0)	Pink, 15 (60.0)
	Male	Blue, 14 (60.9)	Blue, 16 (69.6)
	Total	Blue, 16 (33.3)	Blue, 19 (39.6)
6			
	Girl	White, 10 (43.5)	Pink, 14 (60.9)
	Male	White, 8 (36.4)	Blue, 8 (36.4)
	Total	White, 18 (40.0)	Pink, 14 (31.1)
7			
	Girl	Pink, 9 (40.9)	Pink, 9 (40.9)
	Male	Blue, 9 (40.9)	Blue, 10 (45.5)
	Total	Pink, 10 (22.7)	Pink and Blue, 10 (22.7)
8			
	Girl	White, 11 (47.8)	Pink, 7 (30.4)
	Male	White, 8 (36.4)	Blue, 6 (27.3)
	Total	White, 19 (42.2)	Blue, 8 (17.8)
9			
	Girl	White, 17 (70.8)	Pink, 9 (37.5)
	Male	White, 14 (51.9)	Blue, 12 (44.4)
	Total	White, 31 (60.8)	Blue, 15 (29.4)
10			
	Girl	White, 18 (85.7)	Pink, 7 (33.3)
	Male	White, 18 (85.7)	Blue, 9 (42.9)
	Total	White, 36 (85.7)	Blue, 14 (33.3)
Total			
	Girl	White, 66 (47.8)	Pink, 59 (42.8)
	Male	White, 55 (40.1)	Blue, 61 (44.5)
	Total	White, 121 (44.0)	Blue, 76 (27.6)

TABLE 2. MCDAS-f anxiety levels of children according to their ages.

	Low anxiety		Moderate anxiety		High anxiety		*p*
	n (%)	%M.	n (%)	%M.	n (%)	%M.	
Age (yr)							
5	13 (27.1)	13.5	29 (60.4)	17.9	6 (12.5)	35.3	0.028*
6	13 (28.9)	13.5	29 (64.4)	17.9	3 (6.7)	17.6	
7	12 (27.3)	12.5	27 (61.4)	16.7	5 (11.4)	29.4	
8	20 (44.4)	20.8	22 (48.9)	13.6	3 (6.7)	17.6	
9	17 (33.3)	17.7	34 (66.7)	21.0	0 (0.0)	0.0	
10	21 (50.0)	21.9	21 (50.0)	13.0	0 (0.0)	0.0	
Gender							
Girl	42 (30.4)	43.8	82 (59.4)	50.6	14 (10.1)	82.4	0.011*
Male	54 (39.4)	56.3	80 (58.4)	49.4	3 (2.2)	17.6	

**p < 0.05; %: Row percentage; %M.: Column percentage for MCDAS-f.*
Effect size for Age = 0.186, Effect size for Gender = 0.177.

chose white compomers, and those with high anxiety mostly chose pink compomers ($p < 0.05$) (Table 3). The mean anxiety scores of the children who chose white as the restoration color were significantly lower than those of the children who chose purple ($p = 0.032$) and pink ($p < 0.001$). The mean anxiety scores of the children who chose blue as the restoration color were statistically significantly lower than those of the children who chose pink ($p = 0.029$) (Fig. 1).

It was observed that children who chose white color mostly had low and moderate anxiety levels, while those who chose blue, purple, and yellow colors mostly had moderate anxiety levels. Children who chose pink color mostly had moderate and high anxiety levels ($p < 0.001$). Moreover, girls who chose green color had low anxiety levels, and those who chose blue, purple, pink, and yellow color had moderate anxiety levels. Notably, female children with high anxiety mostly chose pink color ($p < 0.001$) (Table 4).

At the age of 5 years, it was observed that children who chose white colors mostly had low anxiety levels, while those who chose blue, purple, green, yellow, and orange colors mostly had moderate anxiety levels. Those who chose pink color mostly had moderate and high anxiety levels ($p = 0.017$). In 6-year-old girls, it was observed that those who chose white color mostly had low anxiety levels, and those who chose purple and pink color mostly had moderate anxiety levels ($p = 0.003$). At the age of 8 years, children who chose blue and green colors mostly had low anxiety levels, while children who chose silver, pink, and yellow colors mostly had moderate anxiety levels ($p = 0.014$). At the age of 10 years, it was found that children who chose white color mostly had low anxiety levels, and those who chose blue and pink color mostly had moderate anxiety levels ($p = 0.020$) (Table 4).

TABLE 3. Distribution of children's compomer restoration color preferences according to MCDAS-f anxiety groups.

Compomer restoration color	Low anxiety		Moderate anxiety		High anxiety		*p*
	n (%)	%M.	n (%)	%M.	n (%)	%M.	
Gold	2 (40.0)	2.1	3 (60.0)	1.9	0 (0.0)	0.0	<0.001*
White	58 (47.9)	60.4	63 (52.1)	38.9	0 (0.0)	0.0	
Silver	1 (33.3)	1.0	2 (66.7)	1.2	0 (0.0)	0.0	
Blue	13 (27.1)	13.5	34 (70.8)	21.0	1 (2.1)	5.9	
Purple	2 (12.5)	2.1	13 (81.3)	8.0	1 (6.3)	5.9	
Pink	5 (11.6)	5.2	27 (62.8)	16.7	11 (25.6)	64.7	
Yellow	3 (30.0)	3.1	7 (70.0)	4.3	0 (0.0)	0.0	
Orange	4 (36.4)	4.2	5 (45.5)	3.1	2 (18.2)	11.8	
Green	8 (44.4)	8.3	8 (44.4)	4.9	2 (11.1)	11.8	

**Fisher's Exact test, $p < 0.05$; %: Row percentage; %M.: Column percentage for MCDAS-f.*
Effect size: 0.331.

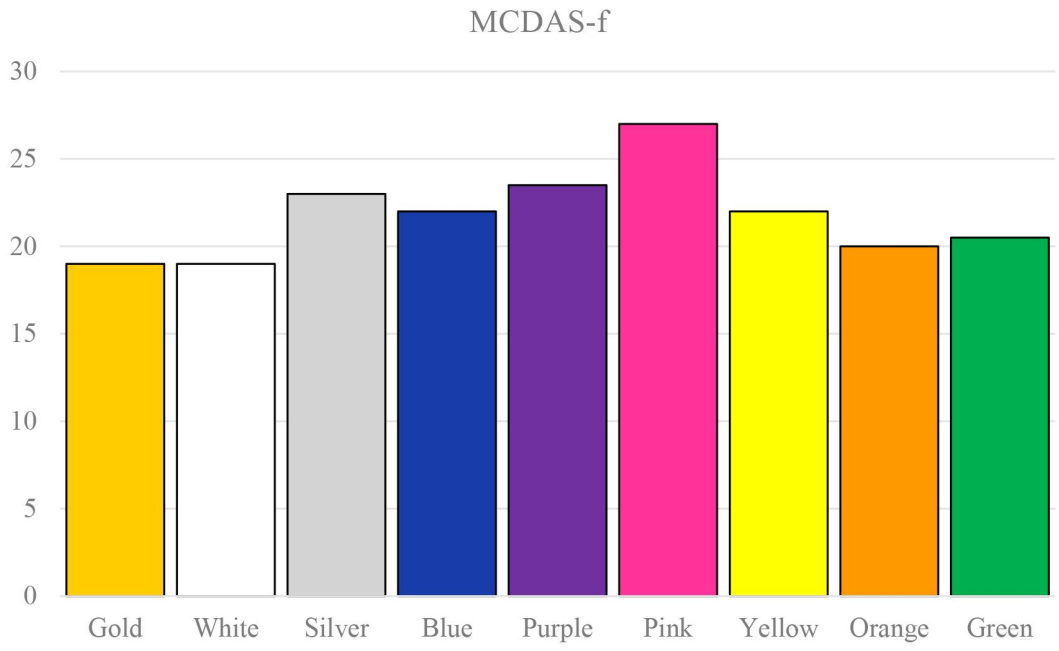

FIGURE 1. Bar graph of the distribution of MCDAS-f scores according to children' compomer restoration color preferences. MCDAS-f: Modified Child Dental Anxiety Scale—Faces Version.

TABLE 4. Table showing the relationships between MCDAS-f anxiety level and compomer restoration color preferences for age and gender.

Age (yr)	Gender	Anxiety	Gold n (%)	White n (%)	Silver n (%)	Blue n (%)	Purple n (%)	Pink n (%)	Yellow n (%)	Orange n (%)	Green n (%)	*p*
5												
		Low	0 (0)	3 (60)	0 (0)	0 (0)	1 (25)	1 (8.3)	0 (0)	0 (0)	0 (0)	0.100
	Girl	Moderate	0 (0)	2 (40)	0 (0)	2 (100)	3 (75)	5 (41.7)	2 (100)	0 (0)	0 (0)	
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (50)	0 (0)	0 (0)	0 (0)	
		Low	0 (0)	2 (66.7)	0 (0)	5 (35.7)	0 (0)	0 (0)	0 (0)	0 (0)	1 (25)	0.854
	Male	Moderate	0 (0)	1 (33.3)	0 (0)	9 (64.3)	0 (0)	0 (0)	1 (100)	1 (100)	3 (75)	
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
		Low	0 (0)	5 (62.5)[a]	0 (0)	5 (31.3)	1 (25)	1 (8.3)	0 (0)	0 (0)	1 (25)	0.017*
	Total	Moderate	0 (0)	3 (37.5)	0 (0)	11 (68.8)[b]	3 (75)[b]	5 (41.7)[b]	3 (100)[b]	1 (100)[b]	3 (75)[b]	**0.534**
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (50)[b]	0 (0)	0 (0)	0 (0)	
6												
		Low	0 (0)	7 (70)[a]	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.003*
	Girl	Moderate	0 (0)	3 (30)	0 (0)	1 (100)	2 (66.7)[b]	7 (77.8)[b]	0 (0)	0 (0)	0 (0)	**0.560**
		High	0 (0)	0 (0)	0 (0)	0 (0)	1 (33.3)	2 (22.2)	0 (0)	0 (0)	0 (0)	
		Low	0 (0)	1 (12.5)	0 (0)	3 (50)	0 (0)	0 (0)	0 (0)	1 (50)	1 (25)	0.442
	Male	Moderate	0 (0)	7 (87.5)	0 (0)	3 (50)	0 (0)	0 (0)	2 (100)	1 (50)	3 (75)	
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
		Low	0 (0)	8 (44.4)	0 (0)	3 (42.9)	0 (0)	0 (0)	0 (0)	1 (50)	1 (25)	0.127
	Total	Moderate	0 (0)	10 (55.6)	0 (0)	4 (57.1)	2 (66.7)	7 (77.8)	2 (100)	1 (50)	3 (75)	
		High	0 (0)	0 (0)	0 (0)	0 (0)	1 (33.3)	2 (22.2)	0 (0)	0 (0)	0 (0)	
7												
		Low	0 (0)	3 (60)	0 (0)	0 (0)	0 (0)	1 (11.1)	1 (50)	0 (0)	1 (50)	0.260
	Girl	Moderate	0 (0)	2 (40)	0 (0)	0 (0)	3 (100)	5 (55.6)	1 (50)	1 (100)	0 (0)	
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (33.3)	0 (0)	0 (0)	1 (50)	
		Low	0 (0)	0 (0)	1 (100)	1 (11.1)	0 (0)	1 (100)	1 (100)	1 (33.3)	1 (50)	0.231
	Male	Moderate	1 (100)	4 (100)	0 (0)	7 (77.8)	0 (0)	0 (0)	0 (0)	2 (66.7)	1 (50)	
		High	0 (0)	0 (0)	0 (0)	1 (11.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
		Low	0 (0)	3 (33.3)	1 (100)	1 (11.1)	0 (0)	2 (20)	2 (66.7)	1 (25)	2 (50)	0.433
	Total	Moderate	1 (100)	6 (66.7)	0 (0)	7 (77.8)	3 (100)	5 (50)	1 (33.3)	3 (75)	1 (25)	
		High	0 (0)	0 (0)	0 (0)	1 (11.1)	0 (0)	3 (30)	0 (0)	0 (0)	1 (25)	

TABLE 4. Continued.

Age (yr)	Gender	Anxiety	Gold n (%)	White n (%)	Silver n (%)	Blue n (%)	Purple n (%)	Pink n (%)	Yellow n (%)	Orange n (%)	Green n (%)	*p*
8												
		Low	0 (0)	5 (45.5)	0 (0)	1 (100)	1 (50)	1 (16.7)	0 (0)	0 (0)	1 (100)	0.141
	Girl	Moderate	0 (0)	6 (54.5)	1 (100)	0 (0)	1 (50)	5 (83.3)	0 (0)	0 (0)	0 (0)	
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	
		Low	1 (50)	3 (37.5)	0 (0)	2 (66.7)	0 (0)	0 (0)	0 (0)	2 (66.7)	3 (75)	0.289
	Male	Moderate	1 (50)	5 (62.5)	1 (100)	1 (33.3)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (33.3)	1 (25)	
		Low	1 (50)	8 (42.1)	0 (0)	3 (75)[a]	1 (50)	1 (16.7)	0 (0)	2 (50)	4 (80)[a]	0.014*
	Total	Moderate	1 (50)	11 (57.9)	2 (100)[b]	1 (25)	1 (50)	5 (83.3)[b]	1 (100)[b]	0 (0)	0 (0)	**0.557**
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (50)	1 (20)	
9												
		Low	0 (0)	5 (29.4)	0 (0)	0 (0)	0 (0)	1 (33.3)	0 (0)	0 (0)	0 (0)	0.606
	Girl	Moderate	0 (0)	12 (70.6)	0 (0)	0 (0)	4 (100)	2 (66.7)	0 (0)	0 (0)	0 (0)	
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
		Low	1 (50)	8 (57.1)	0 (0)	1 (11.1)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	0.054
	Male	Moderate	1 (50)	6 (42.9)	0 (0)	8 (88.9)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
		Low	1 (50)	13 (41.9)	0 (0)	1 (11.1)	0 (0)	1 (33.3)	1 (100)	0 (0)	0 (0)	0.192
	Total	Moderate	1 (50)	18 (58.1)	0 (0)	8 (88.9)	4 (100)	2 (66.7)	0 (0)	0 (0)	1 (100)	
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
10												
		Low	0 (0)	9 (50)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.229
	Girl	Moderate	0 (0)	9 (50)	0 (0)	0 (0)	0 (0)	3 (100)	0 (0)	0 (0)	0 (0)	
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
		Low	0 (0)	12 (66.7)	0 (0)	3 (50)	0 (0)	0 (0)	0 (0)	1 (50)	1 (25)	0.063
	Male	Moderate	0 (0)	6 (33.3)	0 (0)	3 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
		Low	0 (0)	21 (58.3)[a]	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.020*
	Total	Moderate	0 (0)	15 (41.7)	0 (0)	3 (100)[b]	0 (0)	3 (100)[b]	0 (0)	0 (0)	0 (0)	**0.408**
		High	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	

TABLE 4. Continued.

Age (yr)	Gender	Anxiety	Gold n (%)	White n (%)	Silver n (%)	Blue n (%)	Purple n (%)	Pink n (%)	Yellow n (%)	Orange n (%)	Green n (%)	*p*
Total												
		Low	0 (0)	32 (48.5)	0 (0)	1 (25)	2 (12.5)	4 (9.5)	1 (25)	0 (0)	2 (66.7)^{a}	<0.001*
	Girl	Moderate	0 (0)	34 (51.5)	1 (100)	3 (75)^{b}	13 (81.3)^{b}	27 (64.3)	3 (75)^{b}	1 (50)	0 (0)	**0.403**
		High	0 (0)	0 (0)	0 (0)	0 (0)	1 (6.3)	11 (26.2)^{a}	0 (0)	1 (50)	1 (33.3)	
		Low	2 (40)	26 (47.3)	1 (50)	12 (27.3)	0 (0)	1 (100)	2 (33.3)	4 (44.4)	6 (40)	0.314
	Male	Moderate	3 (60)	29 (52.7)	1 (50)	31 (70.5)	0 (0)	0 (0)	4 (66.7)	4 (44.4)	8 (53.3)	
		High	0 (0)	0 (0)	0 (0)	1 (2.3)	0 (0)	0 (0)	0 (0)	1 (11.1)	1 (6.7)	
		Low	2 (40)	58 (47.9)	1 (33.3)	13 (27.1)	2 (12.5)	5 (11.6)	3 (30)	4 (36.4)	8 (44.4)	<0.001*
	Total	Moderate	3 (60)	63 (52.1)	2 (66.7)	34 (70.8)^{a}	13 (81.3)^{a}	27 (62.8)	7 (70)^{a}	5 (45.5)	8 (44.4)	**0.331**
		High	0 (0)	0 (0)	0 (0)	1 (2.1)	1 (6.3)	11 (25.6)	0 (0)	2 (18.2)	2 (11.1)	

**Fisher's Exact test, lettering was performed for categorical data analysis, $p < 0.05$.*

^{a,b}: For each variable, means with same capital letter/s are not significantly different. Bold format means effect size.

Results indicate that the mean MCDAS-f scores of the children who chose their favourite color were statistically significantly higher than those who did not choose their favourite color ($p < 0.001$) (Table 5). Among the total sample, it was observed that the children who chose their favourite color were mostly 5-year-olds, while those who did not choose their favourite color were mostly 10-year-olds ($p = 0.007$, $p = 0.014$, $p < 0.001$) (Table 6).

4. Discussion

Dental caries is one of the most common chronic childhood diseases. Therefore, preventive measures should be taken to prevent caries formation in deciduous and permanent teeth. Today, compomers stand out among the preferred materials for primary teeth treatment [15]. Colored compomers, which are frequently used in primary teeth treatment, are especially designed to attract the attention of children and are preferred in pediatric dentistry applications with their glitter particles [16]. Giving children a choice of colors gives them a greater sense of control over the treatment process [11]. Color awareness usually develops between the ages of 2 and 6 years, and children between the ages of 5 and 6 years are able to distinguish between various colors [17]. For these reasons, children aged 5–10 years who visited the clinic for restorative treatment of primary molars were included in the study.

In our study, it was found that anxiety levels decreased with increasing age and the children with high anxiety were in the age range of 5–8 years. As in the majority of the literature, the possible reasons for this finding may be the increase in children's cognitive capacity with age and also the increased awareness and coping ability for dental treatments [18, 19].

Gender is said to be a natural determinant in the development of dental anxiety. It has been reported that girls can express their emotions more freely, accept their fears, and have a more anxious structure than boys due to cultural factors or related social judgements [19, 20]. On the other hand, there are also studies indicating that there is no relationship between the children's age and gender, and dental anxiety [20, 21]. In this study, the fact that girls had higher dental anxiety scores than boys is thought to be related to the societal upbringing styles of girls and boys, their biological characteristics, and the fact that boys may hesitate to express and show their emotions, such as fear, due to the patriarchal social structure.

In studies evaluating the preference for colored restorative materials in children according to gender and age, it has been reported that color preferences shift more towards aesthetics as age increases [22, 23]. From age 7 to adulthood, it has been reported that the increase in cognitive differentiation may lead to different color preferences [24]. In our study, it was observed that the most preferred compomer restoration color and the most favourite color of the children aged 5 and 7 years were the same. The children's preference for white compomer color from the age of 8 years onwards regardless of their favourite color, is thought to be due to the fact that they have aesthetic awareness with the increase in their cognitive level as they get older.

Gender differences significantly affect color perception. Although this effect stems from the norms imposed by society, children, especially at school age, perceive the difference between them and the opposite sex, and express this situation best through their color preferences [25]. This study supports that the favourite color of female and male children was pink and blue, respectively. In many studies, it has been reported that girls prefer pink-red colors and boys prefer blue [7, 22, 23, 25]. From early infancy, children are exposed to certain colours by their parents, such as stereotypical gender-color relations. As parents raise their baby girls in a pink environment and their baby boys in a blue background with toys, clothes, and room accessories, these may place cultural influences on the colors that children like [26].

In this study, children who chose their favourite color as the restoration color had higher anxiety levels than those who did not. It is known that people's experiences are reflective on their color preferences. It is said that when a person feels bad, he/she will remember the color of the clothes he/she wore on a special day when he/she was happy and will prefer this colour. Although color occupies a small area in a person's memory, it is remembered much quickly when it is associated with an important memory [27]. When individuals face their fears in order to perform an action, they may see this action as outside their comfort zone. The comfort zone is defined as a psychological, emotional, and behavioural space that defines an individual's daily routines and includes trust and safety [28]. It is thought that why children with high anxiety prefer their favourite colors as restoration colors may be related to the fact that children associate their favourite colors with their happy memories, and try to feel safe by choosing these colors when

TABLE 5. Distribution and comparison of MCDAS-f scores according to children choosing their favorite color.

Gender	Choosing your favorite color				*p*
	No		Yes		
	n (%)	MCDAS-f Mean. ± S.D. (M.)	n (%)	MCDAS-f Mean. ± S.D. (M.)[¥]	
Girl[†]	76 (48.7)	20.32 ± 4.88 (21)	62 (52.1)	24.76 ± 5.68 (25)	<0.001*
Male[†]	80 (51.3)	19.39 ± 4.61 (19)	57 (47.9)	21.65 ± 5.29 (22)	0.016*
Total[†]	156 (100)	19.84 ± 4.75 (20)	119 (100)	23.27 ± 5.69 (23)	<0.001*

**p < 0.05, [†]: Mann-Whitney U test; [¥]: Kruskal-Wallis test.*
Effect size for Girls = 0.845, Effect size for Boys = 0.461 , Effect size for Total = 0.662.
S.D.: Standard Deviation; M.: Median; MCDAS-f: Modified Child Dental Anxiety Scale—Faces Version.

TABLE 6. Distribution and comparison of MCDAS-f scores according to age, gender, and color preference.

Age (yr)	Gender	Choosing your favorite color				*p*	Effect Size
		No		Yes			
		n (%)	MCDAS-f Mean. ± S.D. (M.)	n (%)	MCDAS-f Mean. ± S.D. (M.)[¥]		
5							
	Girl[†]	7 (50)	18.71 ± 5.96 (15)	18 (52.9)[a]	27.89 ± 4.98 (28)	0.002*	1.746
	Male	7 (50)	21.00 ± 4.86 (21)	16 (47.1)[a]	21.38 ± 5.82 (22)	0.883	
	Total[†]	14 (100)	19.86 ± 5.36 (21)	34 (100)[a]	24.82 ± 6.25 (27)	0.011*	0.826
6							
	Girl	11 (45.8)	18.45 ± 2.54 (17)	12 (57.1)	26.08 ± 4.19 (25)	<0.001*	2.178
	Male[†]	13 (54.2)	21.31 ± 3.97 (22)	9 (42.9)	21.22 ± 4.58 (19)	0.695	
	Total	24 (100)	20.00 ± 3.62 (21)	21 (100)	24.00 ± 4.91 (23)	0.003*	0.937
7							
	Girl	12 (50)	21.83 ± 6.73 (21.5)	10 (50)	25.1 ± 7.05 (26.5)	0.280	
	Male	12 (50)	19.25 ± 5.45 (19)	10 (50)	23.30 ± 4.88 (23.5)	0.084	
	Total	24 (100)	20.54 ± 6.13 (19.5)	20 (100)	24.20 ± 5.97 (24)	0.053	
8							
	Girl	12 (48)	22.58 ± 5.68 (22.5)	11 (55)	19.36 ± 3.5 (20)	0.121	
	Male[†]	13 (52)	21.00 ± 4.88 (21)	9 (45)	20.44 ± 7.37 (18)	0.695	
	Total[†]	25 (100)	21.76 ± 5.23 (22)	20 (100)	19.85 ± 5.44 (18)	0.192	
9							
	Girl	17 (50)	20.29 ± 3.72 (21)	7 (41.2)	23.57 ± 5.38 (24)	0.099	
	Male[†]	17 (50)	17.71 ± 4.45 (17)	10 (58.8)	21.80 ± 4.39 (23)	0.040*	0.924
	Total	34 (100)	19.00 ± 4.25 (19.5)	17 (100)	22.53 ± 4.74 (23)	0.010*	0.799
10							
	Girl	17 (48.6)[b]	19.53 ± 4.19 (20)	4 (57.1)	22.75 ± 4.79 (24)	0.192	
	Male	18 (51.4)[b]	17.89 ± 3.68 (17)	3 (42.9)	22.00 ± 3.61 (21)	0.088	
	Total	35 (100)[b]	18.69 ± 3.96 (18)	7 (100)	22.43 ± 3.99 (23)	0.028*	0.944
Age—*p*							
	Girl		0.262		0.146	0.007*	0.845
	Male		0.109		0.610	0.014*	0.461
	Total		0.169		0.030*	<0.001*	0.662

**p < 0.05, [†]: Mann-Whitney U test; [¥]: Kruskal-Wallis test, lettering was used for categorical data analysis.*
Effect size for Total (Age) = 0.062.
[a,b]: For each variable, means with same capital letter/s are not significantly different.
S.D.: Standard deviation; M.: Median; MCDAS-f: Modified Child Dental Anxiety Scale—Faces Version.

they are nervous and anxious before dental treatment. These indicate them being wanting to be in a comfort zone without surprises.

Terwogt and Hoeksma [29] asked children in three different age groups to associate colors with emotions and showed that there was a relationship between colors and emotions, especially in the youngest group. It has been reported that color preference may be affected by the presence of dental anxiety and that children's anxiety levels can be determined according to the selected colors instead of different dental anxiety scales [30]. In our study, it was found that children with low and moderate anxiety levels mostly chose white as the compomer restoration color, while those with high anxiety levels mostly chose pink. Kuscu *et al*. [31] found that the anxiety score of children who preferred white apron was lower than that of those who preferred colored apron. Yahyaoğlu *et al*. [32] reported that the dental anxiety scores of children who preferred the dentist to wear a colored apron were higher, and that the pedodontic mask attracted and reduced dental anxiety in the younger age groups. In the study of Yıldırım and Özdemir [33], children were made to choose the color of the dental unit and it was reported that there was no significant relationship between dental anxiety levels and the children's color preferences.

In our study, as the anxiety level decreased, the most preferred colors of the children were white, yellow, gold, green, blue, silver, orange, purple, and pink, respectively. Children who chose white as the restoration color had lower anxiety levels than those who chose purple and pink, and those who chose blue had lower anxiety levels than those who chose pink. In the study conducted by Bubna *et al*. [34] with children, it was observed that the least preferred color for happiness was black and the most preferred color was yellow, while the least preferred color for sadness was green and the most preferred color was red. In a study conducted by Altan *et al*. [35] to determine the color of the presence and absence of pain in children with toothache, it was reported that children chose red to describe severe pain and white, yellow, orange, blue, and green to describe the absence of pain. In the studies, it has been stated that white, blue and green colors represent more positive situations, while colors such as red, purple, and black symbolize negativity [26, 36].

Although dental anxiety can be seen in all age groups, it usually starts to occur in childhood or adolescence [37]. Dental anxiety starting in childhood and continuing into adulthood may adversely affect the oral and dental health of the community [37]. Understanding dental anxiety and fear in young children is important in reducing anxiety and fear before and during treatment, as well as in managing child patient behaviour [38]. Some children may find it difficult to express their feelings or may not want to talk. In this case, colors become a subjective and closed means of expression for children. Children who have difficulty or do not want to express their feelings with words can give meaning to their feelings by expressing them through colors. Therefore, colors can play an important role in emotional expression and communication [25, 26]. Children's compomer restoration color preferences can be used as a scale reflecting their emotional state, dental anxiety, and fear, and can be used to evaluate the way children perceive their dental treatment.

This study has several limitations. Due to its cross-sectional design, only an association between dental anxiety levels and compomer color preferences could be demonstrated, and a causal relationship could not be established. To better understand the nature of this relationship, future studies should employ prospective, longitudinal, and ideally randomized controlled designs. Experimental manipulation of color selection and evaluation of anxiety level changes at multiple time points may help elucidate potential causal mechanisms. In addition, conducting the study in a single clinical setting may limit the generalizability of the findings, whereas multicenter studies with larger sample sizes would enhance both the validity and clinical applicability of the results.

5. Conclusions

It was concluded that there was a relationship between anxiety levels and compomer restoration color preferences in our study. It was seen that children's anxiety decreased with increasing age and the dental anxiety in girls was higher than that in boys. Anxiety scores of children who chose their favourite color as compomer restoration color were higher than those who did not choose their favourite color.

Children with low and moderate anxiety mostly chose white compomers, while those with high anxiety mostly chose pink compomers. Younger children usually choose their favourite colors as the compomer restoration color, whereas as they get older, children choose white regardless of their favourite colors.

6. Clinical significance

Considering the fact that dental anxiety in childhood may persist into adulthood and may adversely affect the oral and dental health of the society, dentists can use compomer restoration color preferences as a subjective scale reflecting emotional states to understand children's perceptions towards dental treatments.

AVAILABILITY OF DATA AND MATERIALS

The data are not publicly available due to privacy or ethical restrictions.

AUTHOR CONTRIBUTIONS

EÇ and MB—conceived the ideas; collected the data; analysed the data; led the writing. Both authors contributed to editorial changes in the manuscript. Both authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethics committee approval was obtained from Zonguldak Bülent Ecevit University Clinical Research Ethics Committee (2022/17). We confirm that all methods were performed in accordance with the relevant guideline and regulations. The experiments were performed in accordance with the Declaration of Helsinki. Informed consent was obtained from the parents or legal guardians of all child participants.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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