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Validation of child drawing hospital (CD: H) scale and the role of drawing in the evaluation of Dental anxiety

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Abstract

Background Child Drawing: Hospital (CD: H) was developed as a tool to measure the emotional state of hospitalized school-age children. This scale consists of sections A, B and C, which allow understanding of anxiety through children's drawings. The CD: H Scale, which is widely used in medicine, has only been validated in two different cultures. The adaptation and validation of the scale in the field of dentistry has recently started to take place in the literature. In our study, we aimed to conduct a Turkish validation study of the Child Drawing: Hospital (CD: H) Scale and to evaluate dental anxiety and pain experienced during treatment through drawing.

Methods Pediatric patients between the ages of 5–12 who attended the Pediatric Dentistry Department between 2018 and 2020 were included in the study. Following the translation of the CD: H Scale into Turkish and linguistic-cultural validation, the behaviors of pediatric patients during treatment were evaluated with the Frankl Behavior Rating Scale, the pain they experienced during treatment with the Wong- Baker Face Rating Scale, and their anxiety levels were evaluated with the pictures drawn by the patients at the end of the treatment. The data were analyzed with IBM SPSS v23, and the significance level was taken as $p < 0.05$.

Results Within the scope of the scale's reliability-validity study, the Intra-Class Correlation Coefficient (ICC) was evaluated with test-retest consistency. For section A, B,C and total score reliability was found to be positive and strong level correlation.

Conclusions The Turkish version of the CD: H Scale is a reliable and valid scale that can be used to evaluate the dental anxiety of Turkish pediatric patients.

Trial registration ClinicalTrials (NCT05236101/11.02.2022), 'retrospectively registered'.

Keywords Child drawing Hospital Scale (CD:H), Dental anxiety, Dental pain, Validation

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Background

Anxiety is the unconscious reaction to unknown dangers [1]. Dental anxiety can arise due to multiple factors, such as previous negative or traumatic experience, especially in childhood (conditioning experiences), indirect learning from anxious family members or peers, individual personality characteristics such as neuroticism and self-consciousness, lack of under-standing, exposure to frightening portrayals of dentists in the media, the coping style of the person, perception of body image and the vulnerable position of lying back in a dental chair [2]. The effects of anxiety continue into adulthood, resulting in avoidance of dentists and deterioration of individuals' oral health [3]. It is important to evaluate the dental anxiety level of the individual before treatment so that the dentist can be prepared for negative reactions. Thus, some scales can be taken to reduce the patient's dental anxiety level [4]. It is difficult to measure dental anxiety in children for several reasons. These include the inability to assess the extent of the emotional response, inappropriate discrimination between emotions, and difficulty understanding the situation due to immaturity of both emotional and cognitive development [5]. Assessing children's subjective reactions to dental anxiety is difficult, especially at very young ages.

Today, different techniques, including behavior rating, psychometric measurements, and physiological and projective techniques, determine children's dental anxiety. Self-report methods are reported to be the most reliable and valid tools for measuring dental anxiety [6]. Children's Fear Survey Schedule–Dental Subscale are mostly used questionnaire. However, it has various drawbacks such as the inability to read and comprehend the questionnaire by young children as well as inadequate response rating by children because of developmental immaturity [7]. Projective techniques aim to determine the level of anxiety and fear by making up a story of some purposefully drawn pictures or by painting objects or creatures that may be the object of fear [8]. This method provides an advantage to the physician in helping the child reveal feelings that are not expressed verbally. Drawings are a well-established tool in assessing children's psychological and emotional states. Drawings reveal the child's wishes, dreams and fears. Self-report tests based on drawings are inexpensive, easily applicable, and delightful experiences for children. In many studies, children's drawings and color choices have been used to evaluate children's emotional states [9]. The Child Drawing: Hospital (CD: H) Scale, which has also been used to evaluate dental anxiety in dentistry in recent years, was developed to measure the emotional states of hospitalized school-age children. The CD: H Scale obtains an anxiety score by scoring the drawings in three different sections, A, B and C. Section A contains 14 items: position, action, length, width, and size of person; eyes and facial expression; color predominance; numbers of colors used; use of paper; placement on the paper; stroke quality; inclusion and size of hospital equipment; and developmental level. Each item is scored on a scale of 1 to 10, with 1 indicating the lowest level of anxiety and 10 the highest. Section B consists of eight items presumed to be pathological indices. The omission, exaggeration, and deemphasis of a body part receive 5 points. Distortion, omission of two or more body parts, transparency, mixed profile, and shading receive 10 points. If the item is not present, a score of 0 is recorded. Section C is a gestalt rating that calls for an overall response by the scorer to the child's anxiety as expressed in the picture on a 1 to 10 scale using the specific identifiers provided. A score of 1 indicates coping or low anxiety, and a score of 10 indicates disturbance or high anxiety (6). However, validation of this method in different cultures has recently gained popularity [10–12]. This study aims to ensure that the CD: H Scale is adopted by validating its Turkish version and adaptation to dentistry and evaluating children's anxiety levels during dental treatments using this scale.

Material and method

Ethical approval

The Clinical Research Ethics Committee of the Faculty of Medicine at Gaziosmanpaşa University approved our study (17-KAEK-195).

Sample size calculation

Power analysis of the study

To adapt a scale to another culture, it is necessary to reach a group with a size that is at least 5–10 times the number of items on the scale [13]. For validation of the CD: H Scale, it was aimed to ensure a minimum of 115 pediatric patients. For this purpose, 123 patients were initially included in the study to validate the scale." In the evaluation of dental anxiety, representing the second step of the study, the power of the study was calculated as 80% (5% error margin), requiring at least 102 pediatric patients (G-Power 3.1.9.2). According to the power analysis, considering potential losses of the sample, 132 patients were initially included in the study to evaluate dental anxiety. Ultimately, 233 pediatric patients were included in the study, including 115 for the CD: H Scale validation and 118 for the evaluation of dental anxiety.

Patient selection criteria

Initially, the clinical and radiographic examinations of the pediatric patients who attended the Department of Pediatric Dentistry were screened, those in need of dental restorations and root canal treatment were identified. ICDAS (International Caries Detection and Assessment System) was used for caries classification. Before the

study, written informed consent was obtained from the each parent of the children included in the study stating that they accepted the treatment. Finally, patients who had these treatments completed were included in the study (Fig. 1).

Translation and adaptation of the CD: H scale to the Turkish language

The CD: H Scale was translated into the Turkish language in line with the guidelines of the World Health Organization (http://www.who.int/substance_abuse/research_tools/translation/tr/index.html). (Fig. 2)

Content validity in adaptation of the scale

Upon completion of the translation process, the scale items were submitted to the opinion of 3 specialist dentists for content validity. Specialists examined the comprehensibility of the scale items and their suitability for Turkish culture. In line with the opinions of the specialists, the *"bed"* expressions in section A, Item 1, Item 3, and Item 4 were adapted to dentistry and hence turned into *"dental unit"*, and the expression *"distortion"* in item 18 of section B was changed to *"deterioration"*.

Evaluation of the reliability and validity of the scale

To measure the reliability and validity of the CD: H Scale, a sample group of 115 was formed by children patients. The patients were asked to draw a picture that includes the dentist and themselves, considering their feelings during the treatment. The pictures drawn were evaluated by a psychologist and a dentist, who was trained in interpretation of drawings, using the CD: H Scale, and the levels of dental anxiety were measured. The drawings made by the patients after dental treatment were evaluated twice by the dentist and psychologist at an interval of 4 weeks using the CD: H Scale, which was translated and created in Turkish.

Treatment protocol

Treatments for patients requiring dental restoration and root canal treatment were performed in a single session under local anesthesia. In our study, all children were treated by the same clinician. The behavior and attitudes of the patients during the treatment were measured with the Frankl Behavior Rating Scale (FBRS), and the degree of pain felt by the patients during the treatment was measured with the "Wong-Baker Faces Pain Rating Scale" after the treatment. The patients were asked to draw a picture that includes the dentist and themselves, considering their feelings during the treatment. The pictures drawn were evaluated by a psychologist and a dentist.

Inclusion Criteria

- Children between the ages of 5-12
- Patients with deep dentin caries who need local anesthesia (ICDAS 4-5-6)
- Patients who have toothache and require dental treatment (dental restoration and root canal treatment).
- Patients who will have dental treatment for the first time
- Patients who are willing to paint and understand commands
- Patients without any mental or physical disability
- Patients whose parents agreed to participate in the study and signed their consent

Exclusion Criteria

- Children not aged 5-12
- Patients with mild to moderate caries who do not need local anesthesia (ICDAS 0-1-2-3)
- Patients who need treatment under general anesthesia
- Patients with inadequate hand coordination
- Patients with motor dysfunction
- Children with any systemic illness
- Patients who are not willing to paint
- Patients with any syndrome
- Patients with mental or physical disabilities
- Patients with color blindness
- Children whose native language is not Turkish
- Patients whose parents refused to participate in the study

Fig. 1 Inclusion and exclusion criteria from the study

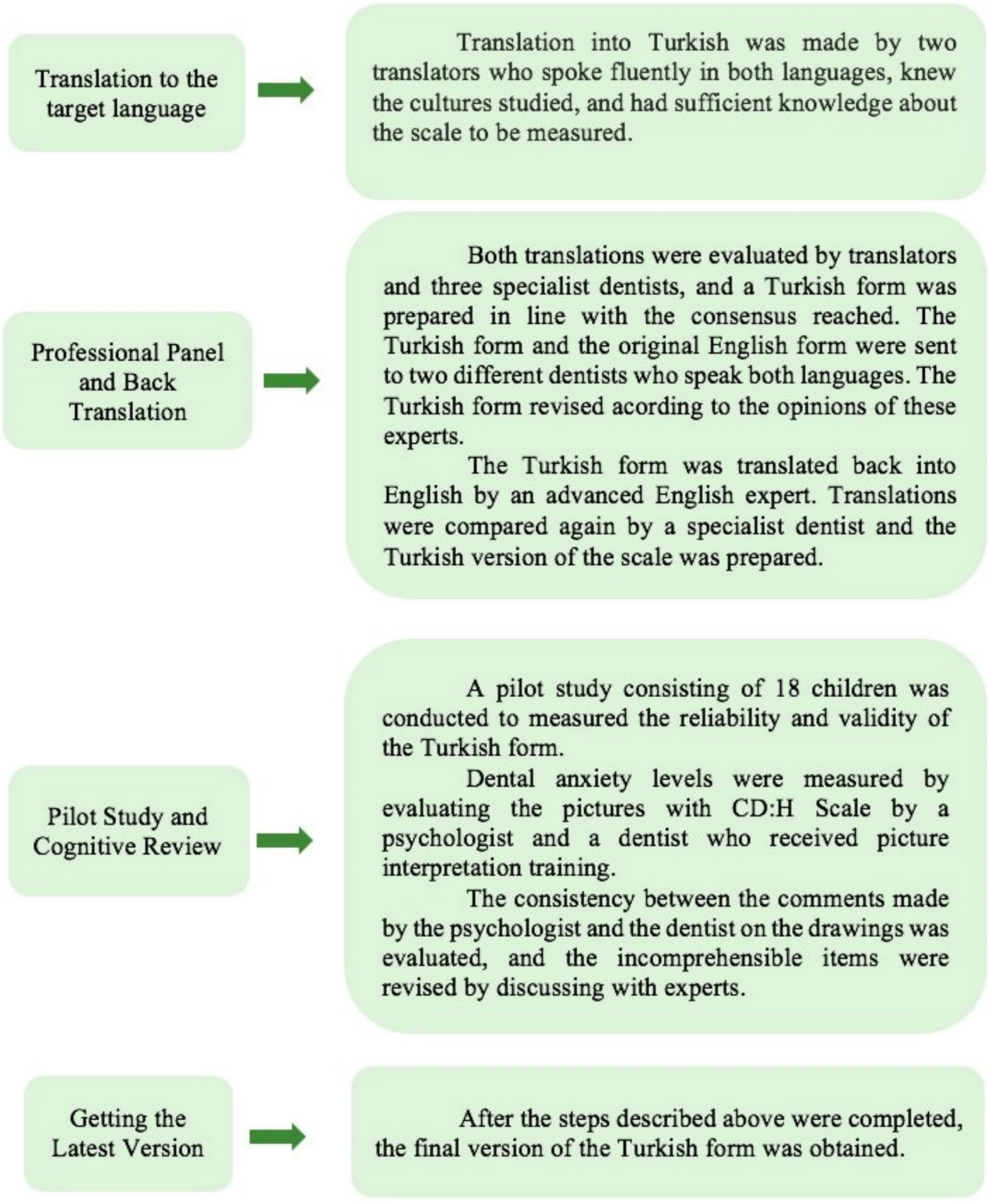

Fig. 2 Scale adaptation stages

Drawing protocol

Parents were informed about the study and were told not to intervene in the drawings even if the child asked for help and to wait outside the clinic until the drawing process was completed. A particular, isolated area was created in the clinic for children to prevent them from being affected by the environment. A white Table (70 × 70) was specially made for children to draw comfortably. A4 paper and 8 colors (Crayola, Switzerland) crayons were used in the study [14]. The child was not given a pencil and eraser to scribble or sketch. No time limit was set, waiting until the drawings were finished. Scoring was performed for three separate sections of the CD: H Scale (Sections A, B, and C) and recorded on the CD: H Scale score sheet. The anxiety level based on the total score obtained in the CD: H Scale is as follows: ≤43: very low anxiety, 44–83: low anxiety, 84–129: average anxiety, 130–167: above average anxiety; 168 and above: very high anxiety.

Statistical analysis

The data was analyzed with IBM SPSS V23. Section A, B, and C scores and the total scores were obtained by two different observers, and the consistency between the obtained values was evaluated with the intraclass correlation coefficient. Analysis results are presented with ICC and 95% confidence interval. Correlation between scale scores was evaluated with Pearson's correlation coefficient. Descriptive statistics of the scores were presented as mean, standard deviation, median, minimum and maximum values. Compliance with normal distribution was examined using the Kolmogorov - Smirnov test. Mann-Whitney U test was used to compare FBRS, Wong Baker and CD: H scores which were not normally distributed according to age and treatment. Spearman's Rho correlation coefficient was used to examine the relationship between the age, FBRS, Wong-Baker, and CD: H Scale scores that were not normally distributed. Kappa statistics were used to study the consistency between the CD: H Scale scores evaluated by the dentist and psychologist. The analysis results were presented in the form of mean ± standard deviation and median (minimum-maximum) for quantitative data and the form of frequency (percent) for categorical data. The significance level was taken as $p < 0.05$.

Results

Reliability-validity results of the CD: H scale

For the reliability-validity measurement, 115 patients aged 5–12 years received. When each section was examined within itself according to the raters, it was observed that the average values were obtained close to each other.

The consistency between raters for the total scores of sections A, B, and C was assessed using the ICC of which a strong, positive, and statistically significant correlation were found for all sections (ICCA = 0.946 ($p < 0.001$), ICCB = 0.844 ($p < 0.001$), and ICCC = 0.845 ($p < 0.001$) respectively). For each of the 14 items in section A, the consistency between dentist and psychologist was evaluated using ICC. The highest correlation was seen in item 9, "number of colors used." While item 7, "personal adaptation to the environment," was statistically significant, it showed a moderate correlation. No low correlations were found in section A (Table 1).

For each of the 8 items in section B, the consistency between dentist and psychologist was evaluated using ICC. The highest correlation was found in item 22, "shading." The lowest correlation was seen in item 20 "transparency," and the second-lowest correlation was found in item 16 "exaggerating a part of the body." The correlation of item 17 "not emphasizing a part of the body," and item 21, "mixed profile," was moderate, and the correlation values were high in the other items.

Evaluation of dental anxiety

There is a statistically significant difference between the distributions of the Frankl scale according to age groups ($p = 0.001$). The median score of the age groups was 4 (Definitely positive). This difference is due to the difference in rank averages. The CD: H score of the 5–8 age group and the 9–12 age group was obtained as "low stress". There is no difference between other score medians according to age groups ($p > 0.05$) (Table 2).

There is a weak, statistically significant negative relationship between Wong Baker Scale score and Frankl score (r=-0.229; $p = 0.012$). There is a very high statistically significant positive correlation between the CD: H Scale score evaluated by the dentist and the CD: H Scale score evaluated by the psychologist ($r = 0.924$; $p < 0.001$;). There is no statistically significant relationship between other parameters ($p > 0.050$).

Table 1 Descriptive statistics and inter-rater reliability of sections A-B-C and total score

Item	Evulator	Mean	Standard deviation	Median	Min.	Max.	ICC (%95CI)	*p*
Section A	Dentist Psychologist	54,53	15,17	54,00	22,00	90,00	0,946 (0,922–0,962)	< 0,001
Section B	Dentist Psychologist	54,30	15,24	53,00	19,00	99,00	0.844 (0.782–0.889)	< 0.001
Section C	Dentist Psychologist	17,26	9,28	20,00	0,00	50,00	0,845 (0,783–0,89)	< 0,001
Total Score	Dentist Psychologist	17,26	9,58	20,00	0,00	50,00	0.936 (0.908–0.955)	< 0.001

ICC: Intraclass Correlation Coefficient, Min: Minimum, Max: Maximum

The significance level was taken as $p < 0.05$

Table 2 Scale comparison by age

		Age Groups		Total	Test statistics	p
		5–8	9–12			
Frankl Scale	Mean. ± SD	3,36 ± 0,90	3,79 ± 0,62	3,53 ± 0,82	U = 1163,5	0,001
	Median (Min - Max)	4 (1–4)	4(1–4)	4 (1–4)		
Wong Baker	Mean. ± SD	1,43 ± 1,99	1,25 ± 1,92	1,36 ± 1,96	U = 1597,5	0,614
	Median (Min - Max)	0 (0–10)	0 (0–10)	0 (0–10)		
CD: H Score of Dentist	Mean. ± SD	2,41 ± 0,55	2,31 ± 0,59	2,37 ± 0,57	U = 1558,5	0,444
	Median (Min - Max)	2 (1–4)	2 (1–3)	2(1–4)		
CD: H Score of Psychologist	Mean. ± SD	2,41 ± 0,55	2,25 ± 0,57	2,35 ± 0,56	U = 1456,5	0,155
	Median (Min - Max)	2(1–4)	2 (1–3)	2 (1–4)		

Min: Minimum. Max: Maximum. CD: H: Child Drawing Hospital Scale

U: Mann-Whitney U test istatistiği

The significance level was taken as $p < 0.05$

Table 3 Comparison of scale scores by treatment

Parameter		Root canal treatment	Dental restoration	Total	Test statistics	*p*
Frankl Scale	Mean. ± SD	3,33 ± 0,98	3,67 ± 0,68	3,53 ± 0,82	U = 1365,5	0,035
	Median (Min - Max)	4 (1–4)	4 (1–4)	4 (1–4)		
Wong Baker Scale	Mean. ± SD	1,79 ± 2,48	1,06 ± 1,43	1,36 ± 1,96	U = 1468,5	0,196
	Median (Min - Max)	0 (0–10)	0 (0–6)	0 (0–10)		
CD: H Score of Dentist	Mean. ± SD	2,54 ± 0,54	2,26 ± 0,56	2,37 ± 0,57	U = 1276	0,011
	Median (Min - Max)	3 (2–4)	2 (1–3)	2 (1–4)		
CD: H Score of Psychologist	Mean. ± SD	2,48 ± 0,55	2,26 ± 0,56	2,35 ± 0,56	U = 1375	0,053
	Median (Min - Max)	2 (2–4)	2 (1–3)	2 (1–4)		

Min: Minimum. Max: Maximum. SD: Standard Deviation. CD: H: Child Drawing Hospital Scale

U: Mann-Whitney U test statistic

The significance level was taken as $p < 0.05$

According to treatment, there is a significant difference between the distributions of the FBRS ($p = 0.035$). The median score of those undergoing root canal treatment and dental restoration was "definitely positive". This difference is due to the difference in mean rank (Table 3).

There is a significant difference ($p = 0.011$), according to treatment, between the medians of the CD: H Scale scores evaluated by the dentist. The median of the CD: H Scale score of those having undergone root canal treatment was "average stress", while the median of the CD: H Scale score of those having undergone dental restoration was "low stress". This difference is due to the fact that the median score of those with root canal treatment is higher than the median of those with dental restoration (Table 3).

There is a statistically significant very good level of consistency between the CD: H Scale scores evaluated by the dentist and psychologist ($p < 0.001$).

Discussion

Children's drawings in dental settings can gather a wide variety of information. Drawing increases the amount of information children share about their experiences and helps them organize their narratives, allowing them to tell a better story. The shortcomings of the current methods (physiological, psychometric, and projective techniques) emphasize the need to use new subjective approaches to distinguish between anxiety and pain.

On the CD: H scale, the lowest correlation value was found in section B, item 16, "exaggerating a part of the body," and item 20, "transparency." The transparency item is scored if organs that are not visible from the outside (such as the heart, bones, etc.) are shown in the drawing. Since the teeth are not internal organs, their presence in the drawings is not related to the transparency item. Since this item is open to interpretation, the ICC of item 20 was low. This effect was thought to result from the following situations encountered by the children: not receiving an eraser while drawing, making perspective errors, and not being able to frame their drawing on the page. For these reasons, it was found that in addition to anxiety, the reasons the drawings were exaggerated were related to problems encountered while drawing. For this reason, we believe that the low correlation values for item 16 do not fully reflect the truth. Since the total ICC for section B was high, we did not consider removing items 16 and 20 from the scale.

In the validation of the Swedish version of the CD: H scale by Wennström et al. [10], the authors found high inter-rater reliability correlations, especially for sections A and B and the total score. For section C, inter-rater reliability was slightly lower than for sections A and B,

but still significant. As in the study by Wennström et al. [10], Fernandes and Barbosa [11] found that correlations tended to be strong for section A and the total score but weak for sections B and C, although moderate and strong correlation coefficients were observed. In a validation study of the CD: H Scale in dentistry, Custódio et al. [12] they evaluated the intra-examiner agreement coefficients with kappa statistics and reported strong values in the total score, although lower for section C than for sections A and B. In our study, the reliability between the raters for sections A, B, and C and the total score was found to be positive and strongly correlated.

The test-retest method applies a measurement tool twice to the same subject group, under the same conditions, and at a certain time interval. In our study, we applied four weeks, the preferred period for a test-retest [15]. The Pearson correlation coefficient was calculated as a result of the evaluations made by the psychologist and dentist at an interval of 4 weeks, and it was found to be 0.96.

Inter-rater reliability (psychologist and dentist) was high at our study's CD: H scale validation step. In addition to sections A, B, and C, the CD: H scale total score significantly differentiated anxiety between the two by comparing children who had dental restoration and root canal treatment under local anesthesia and demonstrated sufficient validity.

FBRS is a widely used scale in dentistry for evaluating dental anxiety, and it is popular due to its ease of learning and use. The literature indicates that the correlation between the CD: H scale and FBRS is negative [16]. For example, Güner et al. [17] showed a statistically significant negative correlation between the CD: H scale scores and the FBRS. However, Aminabadi et al. [16] identified a statistically insignificant negative correlation between the CD: H scale scores and the FBRS, while Pala et al. [18] found a statistically insignificant positive correlation between these same scores. In our study, similar to the literature, there was a negative correlation between FBRS and CD: H scale scores, although there was no statistically significant difference.

Pala et al. [18] examined the relationship between pain and dental anxiety by comparing the Faces Pain Scale-Revised (FPS-R) score and the scores obtained from the CD: H scale to measure pain levels and found an insignificant positive correlation between pain and dental anxiety. In our study, the pain levels felt by the patients who underwent dental restoration and root canal treatment under local anesthesia were measured using the Wong-Baker Pain Rating Scale, and the anxiety levels were assessed by both the dentist and the psychologist using the CD: H scale were compared. Similar to Pala et al. [18], an insignificant positive correlation was found between pain and dental anxiety.

When the dominant colors in the drawings were evaluated on the CD: H scale, the highest anxiety score was 10 points (black) and 9 points (red). It has been previously reported that children made drawings in which these colors were dominant with higher anxiety levels [6]. In a study on color and pain in children.

of Arab origin in a school in the USA, children defined black and blue as the colors of pain [19]. The Color.

Circle Pain Scale (CCPS), which consists of six colors (white, green, gold, blue, red, black), was also applied postoperatively in adult patients in Ghana [20]. In this study, Aziato et al. [20] found that patients associated unbearable and severe pain with black and red. Moreover, using the Visual Analog Scale, Altan et al. [14] measured children's pain levels in a study that examined the relationship between toothache and color. The authors reported that children with high pain levels predominantly preferred black and red, while children without pain chose yellow. Based on these studies, we can conclude that black and red are high pain and anxiety indicators. As pain and anxiety are interrelated, children with high pain levels may also have higher anxiety levels. Since the number of children with a Wong-Baker score of 6 (hurts even more), 8 (hurts whole lot), and 10 (hurts worst) was low in our study, more sample groups are needed to support this view.

Other limitations of this study are that the children made drawings only after dental treatment sessions. Therefore, the drawings may have reflected the momentary dental feelings and fears the children experienced during treatment and not their general level of anxiety. Further studies should evaluate multiple drawings made by children over time and after different dental treatment sessions.

It is seen in the literature that there are studies in which drawing is used in children with special needs, especially to evaluate the cognitive characteristics of these children [21–23]. In this respect, we think that the CD: H scale will help clinicians in measuring dental anxiety in individuals with special needs.

Conclusion

The Turkish version of the CD: H Scale is safe and valid for assessing dental anxiety in children aged 5–12 years, and the drawing allows the dentist to comment on pain and dental anxiety. We think that upon introducing the CD: H Scale into the Turkish language, the number of studies to be conducted with the scales measuring psychometric dental anxiety should be increased.

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Author contributions
DSÖÇ, study design, data collection, preliminary analysis, and first draft of the article. ED made significant contributions to the psychological analysis of children's drawings, OD, data management and data analysis, HA, study design and writing of the article. All authors have read and approved the final article.

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

Declarations

Ethics approval and consent to participate
The study was approved by the ethics committee of Gaziosmanpaşa University, Faculty of Medicine (Protocol no:17-KAEK-195) and ClinicalTrials (NCT05236101/11.02.2022). Before the study, written informed consent was obtained from the each parent of the children included in the study stating that they accepted the treatment. This study was performed in accordance with the ethical standards of the Declaration of Helsinki (1964) and its subsequent amendments.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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