

Investigation of Oral Health-Related Quality of Life and Effectiveness of Oral Health Training Given in Children Treated in the Pediatric Hematology Clinic

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ABSTRACT

Objective: Treatment of childhood cancers causes many oral complications in children. In addition, oral health is often neglected in these patients. This study aimed to investigate the OHRQoL and the effectiveness of oral health training (OHT) in pediatric patients with cancer treated in the pediatric hematology clinic.

Methods: Twenty-nine patients and their parents participated in this study. The patients were divided into two groups, the outpatient treatment group (group-1) and the inpatient treatment group (group-2). A questionnaire was administered to the parents about the families' sociodemographic and medical status and children's oral health behavior. In addition, the OHRQoL with Early Childhood Oral Health Impact Scale and Dental Neglect Scale were evaluated for each patient. Oral examination findings of gingival (GI, PI, OHI-S) and dental (dmft, dmfs, ds, pufa, CAST) health were recorded. OHT was given to the patients together with their parents. All patients' C-reactive protein values were recorded before and after OHT.

Results: The mean dmft score was 5.52 ± 4.58 . None of the patients had not the necessary dental treatment before chemotherapy and had not been given OHT before. There was no statistical difference between the groups in terms of oral findings. The mean OHI-S score decreased significantly after OHT ($p < 0.01$).

Conclusions: Oral and gingival health can be regained in pediatric patients with cancer undergoing chemotherapy with OHT. Providing information about oral and dental care to these patients and their parents should be a part of the treatment process and the necessary training should be given to the pediatric hemato-oncologists to direct these patients to dentists before administration of chemotherapy.

Key words: Dental caries, Oral hygiene, Chemotherapy, Cancer, Children, Quality of life

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INTRODUCTION

Cancer is a chronic disease caused by the uncontrolled proliferation and spread of misdifferentiated cells [1]. Lymph hematopoietic cancers constitute 40% of all childhood cancers. Hematopoietic malignancies comprise leukemia, lymphoma, and histiocytic malignancies. Leukemia is a malignant disease characterized by the clonal proliferation of neoplastic cells in a certain

stage of myeloid or lymphoid hematopoiesis, with the spread of neoplastic cells to the bone marrow and other tissues and their accumulation in the peripheral blood. Leukemia's constitute 25-30% of childhood cancers [2].

Chemotherapy, radiotherapy, surgical interventions, and the use of biologic agents are the preferred primary treatment methods in childhood cancers [3]. Chemotherapy, which is frequently preferred in childhood cancers, also forms the basis of leukemia treatment. Chemotherapy aims to destroy cancer cells that multiply uncontrollably and prevent their growth and proliferation with chemotherapeutic agents; however, these drugs affect healthy cells as well as cancer cells. Oral mucosa epithelium is also among the most affected tissues by chemotherapy due to its high mitotic activity. The development of cytotoxicity is affected by the type of chemotherapeutic drugs, the total dose of the

drug used, the frequency of drug administration, and the use of other treatment methods [4].

Oral complications such as oral mucositis, intraoral infection, dry mouth, salivary gland inflammation, and intraoral bleeding are seen due to chemotherapy. Factors influencing the severity of complications include the child's age, type of malignancy, the condition of the oral cavity before the treatment, and the state of oral care during cancer treatment [4,5]. It has been reported that the risk of developing oral complications after treatment in pediatric patients is three times higher than in adults [6]. The oral cavity is highly sensitive to the effects of chemotherapy and is the most common source of sepsis in patients with cancer with compromised immune systems [7]. All these complications may lead to temporary or permanent discontinuation of the patients' treatment, leading to decreased response to treatment and the development of life-threatening conditions [8].

It is known that most pediatric patients with cancer do not go to the dentist until the age of diagnosis and they do not have any dental experience. Most families do not see dental treatment as a primary problem after their child is diagnosed as having cancer [9]. When this situation is combined with the oral complications of chemotherapy, it can negatively affect the oral health-related quality of life (OHRQoL) of patients, which is affected by many factors, including a personal assessment of an individual's oral health and expectation of physical, psychological, and emotional well-being [10]. Evaluating the oral health of patients before starting cancer treatment and performing the necessary dental treatments will reduce oral complications and increase their OHRQoL.

In this study, it was aimed to investigate the OHRQoL of pediatric patients with cancer in the pediatric hematology inpatient and outpatient clinics and the effectiveness of the oral health training (OHT) given to the patients.

The null hypothesis (H₀) of this study was that (i) The level of caries affected the OHRQoL of patients treated in the pediatric hematology clinic and (ii) The OHT they received would cause a decrease in OHI-S scores.

MATERIALS AND METHODS

This study is a prospective cross-sectional study. Ethics committee approval was obtained from the Malatya Clinical Research Ethics Committee (2021/137).

The minimum sample size required to detect a significant difference in the change in OHI-S values before and after the training between groups should be at least 10 in each group (20 in total), considering type I error (alpha) of 0.05, power (1-beta) of 0.9, an effect size of 1.3, and two-sided alternative hypothesis (H₁) [11].

A total of 29 patients (15 outpatients and 14 inpatients) receiving chemotherapy aged under 6 years were included in the study between June 2021 and September 2021 in X University XX Medical Center Pediatric

Hematology Department. Their parents also participated in the study. The patients were divided into two groups according to their treatment status, the outpatient treatment group (group 1) and the inpatient treatment group (group 2).

A 23-item questionnaire was prepared, including the children's and their families' sociodemographic status, medical conditions, and oral care habits. The 7-question section that determines a child's oral health habits was scored as "correct" or "false" according to the guidelines of the American Academy of Pediatric Dentistry (AAPD) [12,13]. The correct answer score was determined by giving 1 point for ideal answers and 0 points for incorrect answers. Thus, the theoretical range was from 0 "poor oral health habits" to 7 "excellent oral health habits."

The content of the questionnaire was evaluated by four experienced pedodontist for validity evaluation. The experts did not need any changes in the questionnaire and approved the current version of the questionnaire. To measure the reliability of the questionnaire, test-retest was performed using Cohen's kappa measure and it was administered to seven outpatients and their families twice at a 2-week interval. These children were not included in the study. The researcher (X) conducted face-to-face interviews with parents to gather data from the questionnaire. The questionnaire was read aloud to the parents, and their answers were recorded. Even if the parents were together during conducting the survey, all the questions were answered by the mothers. The Early Childhood Oral Health Impact Scale (ECOHIS) for determining OHRQoL and Dental Neglect Scale (DNS) were also added to the questionnaire.

The ECOHIS, which has proven validity and reliability for Turkish children [14], comprises a 13-item questionnaire with the Child Impact Section (CIS; nine items) and the Family Impact Section (FIS; four items). The items of the scale were scored according to the answers from 0 to 5 (0: "never", 1: "hardly ever", 2: "occasionally", 3: "often", 4: "very often", 5: "don't know"). The score ranges for the total ECOHIS, CIS, and FIS are from 0 to 52, from 0 to 36, and from 0 to 16, respectively. A higher ECOHIS data score indicates greater impact and/or more problems for OHRQoL.

The DNS, developed by Thomson, et al. [15] is an oral health index objectifying dental neglect. The DNS is composed of seven statements, using a Likert scale ranging from 1 (definitely no) to 5 (definitely yes). The items were: "Your child maintains their home dental care," "Your child receives the dental care they should," "Your child needs dental care, but you put it off," "Your child needs dental care, but they put it off," "Your child brushes as well as they should," "Your child controls snacking between meals as well as they should," and "Your child considers their dental health to be important," The total DNS score can range from 7 to 35, with higher scores representing greater dental neglect.

Before starting the study, the researcher (X) was trained

and calibrated in terms of the intraoral examination parameters of the study such as plaque index (PI), gingival index (GI), oral hygiene index simplified (OHI-S), dmft, dmfs, ds, pufa, and caries assessment spectrum and treatment (CAST) by an experienced trainer (XX) with at least 10 years of experience in the field. The researcher performed intraoral examinations of 15 children who were randomly selected among the children who came to the X University Faculty of Dentistry Pedodontics Clinic for oral examinations through these parameters and repeated the oral examinations of the same patients with the same parameters after 2 weeks. The intra-rater reliability was evaluated using Cohen's kappa measures for each parameter, and the kappa values showed a range from 0.97 to 0.99. These values showed that the researcher had a very good agreement in scoring all parameters ($\kappa > 0.75$; a good agreement).

Intraoral examinations of the children were performed in the pediatric hematology clinic, using a mouth mirror, a ball-tipped periodontal probe as recommended by the World Health Organization (WHO), and a headlamp for illumination. The children's dmft, dmfs, ds, pufa, and CAST indexes for the detection of dental caries and GI, PI, and OHI-S values for evaluation of the oral hygiene level were recorded.

The CAST index scoring system, a visual guide containing information on the CAST index and coding developed by Frencken, et al. [16] is as follows: "0: sound," "1: sealant," "2: restoration," "3: enamel lesions," "4, 5: dentine lesions," "6: pulp involvement," "7: abscess/fistula," and "8: tooth loss." If a situation did not match any codes from 0 to 8, code 9 was assigned. According to the CAST manual, the severity score is obtained by first selecting the maximum CAST score per tooth (the highest code among the codes of all surfaces of an examined tooth). This information is then applied to formula F1, as shown below:

$$F1 = 0.25 \times \text{CAST } 3 + 1 \times \text{CAST } 4 + 2 \times \text{CAST } 5 + 4 \times \text{CAST } 6 + 5 \times \text{CAST } 7 + 6 \times \text{CAST } 8 \text{ [17].}$$

After using formula F1, the CAST severity score was calculated. The score was categorized as mild (CAST severity score of 0-1.25), moderate (CAST severity score of 1.25-6.75), and severe (CAST severity score of >6.75).

The pufa index recorded the presence of visible pulp involvement (p), mucosal ulceration due to root fragments (u), fistulae (f), and/or abscesses (a) [18]. Only one score was given to each tooth and pufa scores were assessed as the total number of teeth with any pufa criteria.

In addition, complete blood count and C-reactive protein (CRP) values, which were checked for follow-up purposes as a part of their medical treatment, were also recorded on the day of the oral examination.

The OHT was given to the patients on the same day. Tooth brushing was explained practically to the patients and their parents on an artificial teeth jaw model with a toothbrush. The roll technique as the tooth brushing

style was preferred. The children were advised to brush their teeth twice a day, morning and evening, with a soft-bristled toothbrush suitable for their age. Patients were encouraged to continue brushing if they could tolerate it and unless otherwise directed by their physician. In case of difficulties in tooth brushing, it was recommended to remove the plaque on the tooth surface with gauze and use mouthwash. Patients and their parents were informed about the importance of oral hygiene to reduce oral complications that might occur after chemotherapy. The education brochure on toothbrushing, tooth brushing chart, and a soft toothbrush was given to each patient.

Two weeks later, PI, GI, and OHI-S values were re-recorded after oral examination to measure the effectiveness of the OHT given to the patients. The complete blood count and CRP values, which were repeated 2 weeks later for the medical follow-up of the patients, were recorded.

Statistical analysis

The IBM SPSS Statistics for Windows, V22, (SPSS Inc., Chicago, IL, USA) software package was used for the statistical analyses. Test-retest reliability using Cohen's Kappa was conducted to measure the reliability of the questionnaire. The data were firstly analyzed for the normality of distribution using the Shapiro-Wilk test. Mann-Whitney U and Kruskal-Wallis tests were used in intergroup comparisons, and Wilcoxon signed-rank and paired sample t-tests were used for within-group comparisons before-and-after OHT. The powers of the independent variables, which are among the findings of this model, to predict the dependent variable, are given percentages (%). The correlations between variables were analyzed using the Spearman correlation test. The results are presented as frequencies and percentages for categorical data, and descriptive statistics for continuous variables are expressed as mean, standard deviation, median, minimum and maximum values. $P < 0.05$ values were considered significant.

RESULTS

In this study, 29 pediatric patients who were treated for leukemia or lymphoma in X University XX Medical Center Pediatric Hematology Clinic were evaluated. Of the 29 patients, 10 (%) were girls and 19 (%) were boys, the mean age was 5.22 ± 1.04 (range, 2 to 6) years. After the OHT was given, there was no decrease in the number of participants in the second evaluation (participation rate 100%). Table 1 presents the sociodemographic, medical, and dental status of the patients and their parents.

The children's oral health behavior findings are presented in Table 2. There is no statistically significant difference between the groups in terms of the children's oral health behavior ($p = 0.652$).

When the patients were evaluated for within-group comparisons and overall without group discrimination, a statistically significant decrease was observed in GI, PI, and OHI-S scores after OHT ($p < 0.01$), and no statistically

Table 1: Socio-demographic and medical status.

	Group 1	Group2	Total
Age	Mean ± SD (min-max) 4.93 ± 1.31 (2-6) n (%)	Mean ± SD (min-max) 5.50 ± 0.63 (4-6) n (%)	Mean ± SD (min-max) 5.22 ± 1.04 (2-6) n (%)
Sex			
Girl	6 (60.0)	4 (28.6)	10 (34.5)
Boy	9 (40.0)	10 (71.4)	19 (65.5)
Number of siblings	Group 1 Mean ± SD (min-max) 2.71 ± 1.3 (0-5) n (%)	Group 2 Mean ± SD (min-max) 2.73 ± 0.9 (2-4) n (%)	Total Mean ± SD (min-max) 2.72 ± 1.13 (0-5) n (%)
Does the child has any siblings?			
Yes	15 (100)	13 (92.9)	28 (96.6)
No	0 (0.0)	1 (7.1)	1 (3.4)
Maternal education			
illitarete	2 (13.3)	2 (14.3)	4 (13.8)
Primary school	4 (26.7)	4 (28.6)	8 (27.6)
Secondary school	3 (20.0)	6 (42.9)	9 (31.0)
High school	3 (20.0)	2 (14.3)	5 (17.2)
University	3 (20.0)	0 (0.0)	3 (10.3)
Paternal education			
illitarete	1 (6.7)	0 (0.0)	1 (3.4)
Primary school	3 (20.0)	1 (7.1)	4 (13.8)
Secondary school	1 (6.7)	7 (50.0)	8 (27.6)
High school	6 (40.0)	5 (35.7)	11 (37.9)
University	4 (26.7)	1 (7.1)	5 (17.2)
Maternal Age			
20-30	4 (26.7)	9 (64.3)	13 (44.8)
31-40	8 (53.3)	3 (21.4)	11 (37.9)
41-50	3 (20.0)	2 (14.3)	5 (17.2)
Paternal Age			
20-30	2 (13.3)	4 (28.6)	6 (20.7)
31-40	7 (46.7)	8 (57.1)	15 (51.7)
41-50	6 (40.0)	1 (7.1)	7 (24.1)
Death	0 (0.0)	0 (0.0)	1 (3.4)
Family Monthly Income			
1000-2400 TRY	8 (53.3)	14(100)	22 (75.9)
2500-4000 TRY	2 (13.3)	0 (0.0)	2 (6.9)
4000-6000 TRY	1(6.7)	0 (0.0)	1 (3.4)
6000< TRY	4 (26.7)	0 (0.0)	4 (13.8)
Does the mother brush her teeth regularly?			
Yes*	12 (80.0)	6 (42.9)	18 (62.1)
No	3 (20.0)	8 (57.1)	11 (37.9)
Does the father brush his teeth regularly?			
Yes*	13 (86.7)	7 (50.0)	20 (71.4)
No	2 (13.3)	6 (42.9)	8 (27.6)
Child's medical status			
Leukemia	14 (93.3)	14 (100)	28 (96.6)
Lymphoma	1 (6.7)	0 (0.0)	1 (3.4)
Is there any medical problem other than leukemia/lymphoma?			
Yes	1 (6.7)	1 (7.1)	2 (6.9)
No	14 (93.3)	13 (92.9)	27 (93.1)
Anyone else in the family with leukemia/lymphoma?			
Yes	2 (13.3)	4 (28.6)	6 (20.7)
No	13 (86.6)	10 (71.4)	23 (79.3)

significant difference was observed in CRP values (p>0.05) (Table 3).

The mean dmft, dmfs, ds, pufa, and CAST severity score

values of the patients were 5.52±4.58, 11.97±11.05, 8.62±9.02, 0.21±0.49, and 11.50±10.84, respectively. All teeth were caries-free in eight patients, four in group 1 and four in group 2 (dmft=0). There was no statistically

Table 2: Child's oral health behavior.

	Group 1		Group 2		Total	
	Mean ± SD (min-max)		Mean ± SD (min-max)		Mean ± SD (min-max)	
Age at which the child starts brushing teeth	4.83 ± 0.75 (4-6)		3.68 ± 1.53 (2-6)		4.18 ± 1.35 (2-6)	
	n (%)		n (%)		n (%)	
1. Does the child brush her/his teeth?						
Yes*	8 (53.3)		6 (42.9)		14 (48.3)	
No	7 (46.7)		8 (57.1)		15 (51.7)	
2. When was your child's first dental appointment?						
After the eruption of first primary tooth*	0 (0.0)		0 (0.0)		0 (0.0)	
Never	6 (40.0)		9 (64.3)		15 (51.7)	
When child has a dental problem	8 (53.3)		4 (28.6)		12 (41.4)	
Directed by the doctor	1 (6.7)		1 (7.1)		2 (6.9)	
3. How often do your child go to the dentist?						
Never	6 (40.0)		9 (64.3)		15 (51.7)	
When he/she has a dental problem	9 (60.0)		5 (35.7)		14 (48.3)	
Every six months*	0 (0.0)		0 (0.0)		0 (0.0)	
One per year	0 (0.0)		0 (0.0)		0 (0.0)	
4. Did your child go to the dentist before starting chemotherapy?						
Yes*	1 (6.7)		0 (0.0)		1(3.4)	
No	14 (93.3)		14 (100)		28(96.6)	
5. Has your child had dental treatment before starting chemotherapy?						
Yes*	0 (0.0)		0 (0.0)		0 (0.0)	
No	15 (100)		14 (100)		29(100)	
6. Did your child need to go to the dentist because of dental complaints during the chemotherapy process?						
Yes	6 (40.0)		2 (14.3)		8(27.6)	
No	9 (60.0)		12 (85.7)		21(72.4)	
7. Has your child ever been given OHT?						
Yes*	0 (0.0)		0 (0.0)		0 (0.0)	
No	15 (100)		14 (100)		29(100)	
The mean ± SD and Median (min-max) values of child's oral health behavior (range 0 to 7)	Mean ± SD	Median (min-max)	Mean ± SD	Median (min-max)	Mean ± SD	Median (min-max)
	0.53 ± 0.52	1 (0-1)	0.43 ± 0.51	0 (0-1)	0.48 ± 0.51	0 (0-1)

Ideal answers are marked with *

Table 3: The mean and median values associated with the parameters of oral hygiene and CRP values.

	Before OHT			After OHT		p-values
	Mean (SD)	Median (min-max)	Mean (SD)	Median (min-max)		
Group 1	GI	0.29 (0.28)	0.25 (0-0.87)	0.02 (0.06)	0 (0-0.20)	0.005*
	PI	0.50 (0.38)	0.54 (0-1.30)	0.07 (0.01)	0 (0-0.25)	0.002*
	OHI-S	0.68 (0.50)	0.79 (0-1.50)	0.12 (0.20)	0 (0-0.66)	0.002*
	CRP	0.40 (0.95)	0.32 (0.32-3.4)	0.32 (0.32)	0.32 (0.32-0.32)	0.141**
Group 2	GI	0.34 (0.35)	0.33 (0-0.95)	0.05 (0.07)	0 (0-0.15)	0.012*
	PI	0.64 (0.50)	0.62 (0-1.40)	0.13 (0.14)	0.1 (0-0.35)	0.001*
	OHI-S	0.72 (0.62)	0.72 (0-1.58)	0.18 (0.19)	0.15 (0-0.50)	0.001*
	CRP	0.19 (0.39)	0.32 (0.32-1.03)	1.42 (3.33)	0.32 (0.32-9.44)	0.173**
Total	GI	0.32 (0.31)	0.25 (0-0.95)	0.04 (0.06)	0 (0-0.20)	<0.001*
	PI	0.57 (0.44)	0.54 (0-1.40)	0.10 (0.12)	0 (0-0.35)	<0.001*
	OHI-S	0.70 (0.54)	0.79 (0-1.58)	0.15 (0.20)	0 (0-0.66)	<0.001*
	CRP	0.30 (0.73)	0.32 (0.32-3.4)	0.68 (2.38)	0.32 (0.32-9.44)	0.357**

*Wilcoxon Signed Rank Test; **Paired Sample t-test

significant difference between the groups in terms of dmft, dmfs, ds, pufa, and CAST values (p>0.05) (Table 4).

Strong positive correlations were found between the PI, GI, and OHI-S values and the CAST severity score (r=0.771, p<0.001; r=0.839, p<0.001; r=0.800, p<0.001;

respectively). In ECOHIS CIS, the situations in which the children were most uncomfortable were "difficulty eating some foods" and "pain in the teeth, mouth or jaws" (Table 5).

The ECOHIS scores of all patients, who were divided into

Table 4: The mean and median values associated with the parameters of dental caries.

	Group 1		Group 2		*p-values	Total	
	Mean (SD)	Median (min-max)	Mean (SD)	Median (min-max)		Mean (SD)	Median (min-max)
dmft	4.67 (3.80)	4 (0-10)	6.43 (5.28)	7 (0-13)	0.31	5.52 (4.58)	5 (0-13)
dmfs	10.4 (10.65)	8 (0-39)	13.64 (11.61)	14.5 (0-30)	0.425	11.97 (11.05)	10 (0-39)
ds	6.53 (6.60)	7 (0-18)	10.86 (10.87)	8.5 (0-30)	0.331	8.62 (9.02)	7 (0-30)
pufa	0.20 (0.56)	0 (0-2)	0.21 (0.43)	0 (0-1)	0.78	0.21 (0.49)	0 (0-2)
CAST	10.57 (11.12)	8 (0-42)	12.50 (10.85)	18 (0-26)	0.533	11.50 (10.84)	11 (0-42)

*Mann-Whitney U test

Table 5: The percentage frequency distribution of the responses to total and subscale ECOHIS.

	Never	Hardly never	Occasionally	Often	Very Often	Don't know
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
1. pain in the teeth, mouth or jaws	15 (51.7)	4 (13.8)	8 (27.6)	1(3.4)	1 (3.4)	0 (0.0)
2.difficulty drinking hot or cold beverages	23 (79.3)	2 (6.9)	3 (10.3)	1 (3.4)	0 (0.0)	0 (0.0)
3.difficulty eating some foods	14 (48.3)	2 (6.9)	10 (34.5)	1 (3.4)	2 (6.9)	0 (0.0)
4.difficulty pronouncing any words	29 (100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
5.missed preschool, daycare or school	29 (100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
6.trouble sleeping	24 (82.8)	2 (6.9)	3 (10.3)	0 (0.0)	0 (0.0)	0 (0.0)
7.irritable or frustrated	25 (86.2)	2 (6.9)	2 (6.9)	0 (0.0)	0(0.0)	0 (0.0)
8.avoided smiling or laughing	29 (100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
9.avoided talking	29 (100)	0 (0,0)	0 (0,0)	0 (0,0)	0 (0,0)	0 (0,0)
10.been upset	21 (72.4)	3 (10.3)	5 (17.2)	0(0.0)	0 (0.0)	0 (0.0)
11.felt guilty	25 (86.2)	0 (0.0)	3 (10.3)	1 (3.4)	0 (0.0)	0 (0.0)
12.taken time off from work	29 (100)	0 (0.0)	0 (0.0)	0 (0.0)	0(0.0)	0 (0.0)
13.financial impact	29 (100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Table 6: Mean total and subscale ECOHIS scores according to the CAST severity score.

CAST	Mild (n=9) (31%)		Moderate (n=4) (13.8%)		Severe (n=16) (55.2%)		*p-values	Total (n=29) (100%)	
	Mean (SD)	Median (min-max)	Mean (SD)	Median (min-max)	Mean (SD)	Median (min-max)		Mean (SD)	Median (min-max)
Child symptoms (1)	0.66 (1.32)	0 (0-4)	0.5 (1)	0 (0-2)	1.18 (1.04)	1.5 (0-3)	0.234	0.93 (1.13)	0 (0-4)
Child function (2-5)	0.77 (1.2)	0 (0-3)	1 (1.15)	1 (0-2)	2.06 (2.11)	2 (0-6)	0.284	1.52 (1.82)	1 (0-6)
Child psychology (6,7)	0 (0.0)	0 (0-0)	0 (0.0)	0 (0-0)	0.87 (1.5)	0 (0-4)	0.096	0.48 (1.18)	0 (0-4)
Self image and social interaction (8,9)	0 (0.0)	0 (0-0)	0 (0.0)	0 (0-0)	0 (0.0)	0 (0-0)	-	0 (0.0)	0 (0-0)
Child impact section (1-9)	1.44 (1.67)	1 (0-4)	1.5 (1.92)	1 (0-4)	4.13 (4.26)	3.5 (0-12)	0.31	2.93 (3.56)	2 (0-12)
Parental distress (10,11)	0 (0.0)a	0 (0-0)	0 (0.0)ab	0 (0-0)	1.37 (1.82) b	0.5 (0-5)	0.015	0.76 (1.50)	0 (0-5)
Family function (12,13)	0 (0.0)	0 (0-0)	0 (0.0)	0 (0-0)	0 (0.0)	0 (0-0)	-	0 (0.0)	0 (0-0)
Family impact section (10-13)	0 (0.0) a	0 (0-0)	0 (0.0) ab	0 (0-0)	1.38 (1.82) b	0.5 (0-5)	0.015	0.76 (1.50)	0 (0-5)
ECOHIS	1.44 (1.66)	1 (0-4)	1.5 (1.91)	1 (0-4)	5.5 (5.14)	5.5 (0-16)	0.095	3.69 (4.42)	2 (0-16)

*Kruskal-Wallis Test
a,b Different letters have statistically significant difference in the same row.

three groups according to the CAST severity score, as mild, moderate, and severe, were examined. The mean scores of FIS were found to be statistically significant among these three groups ($p < 0.05$) (Table 6).

A positive correlations were found between the PI, GI, OHI-S values, and ds and ECOHIS scores ($r = 0.432$, $p = 0.019$; $r = 0.381$, $p = 0.041$; $r = 0.483$, $p = 0.008$; $r = 0.393$, $p = 0.035$, respectively). A positive correlation was found between DNS and the children's oral health habit scores ($r = 0.449$, $p = 0.015$).

The variables (outpatient/inpatient treatment, OHI-S,

GI, PI, CRP, dmft, dmfs, ds, pufa score, CAST score, DNS) associated with the ECOHIS dependent variable were determined primarily using the variable selection method based on Pearson statistics. Then, the support vector machine for the regression model was used to determine the factors associated with ECOHIS. Based on the model findings, the most important variables are presented. According to the analysis, OHI-S, GI, ds, PI, and pufa scores from largest to smallest have the predictive power of 37%, 19.5%, 18.8%, 18.6%, and 6%, respectively, on the dependent variable "ECOHIS."

DISCUSSION

Treatment of hematologic malignancies, which constitute the majority of childhood cancers, requires a long process. During the treatment process, the daily care needs of pediatric patients become more important in this period. Oral care should not be neglected, especially because the oral cavity can be a source of infection for patients with cancer.⁷ Before chemotherapy, it is recommended that pediatric patients undergo a comprehensive oral examination by a dentist, the caries teeth should be treated as soon as possible, and these patients and their parents should be given information about oral care and OHT during the chemotherapy process [19].

In this study, 41.4% of the patients had their first dental visit due to dental problems and 48.3% stated that they presented to the dentist when they had any dental issues. Previous studies also reported that the reason to visit to the dentist was mostly due to dental problems [20,21].

Among the patients, there was only one (3.4%) patient who went to the dentist before starting chemotherapy, and none of the patients underwent dental treatment before receiving chemotherapy. The lack of necessary dental treatments in all of the patients may have been because the patients were not referred to the dentist by their physicians before starting chemotherapy. It is a common reason not to refer these patients to dentists before chemotherapy because initiating treatment for hematologic malignancies often requires urgency and waiting for dental treatments may delay chemotherapy. Consequently, 27.6% of the patients needed to go to the dentist during the chemotherapy period. Duruk, ET AL. [22]. in their study conducted on 130 Turkish pediatricians, reported that 67.7% of pediatricians did not receive any training on children's oral and dental health.

Shaghaghian, ET AL. [23] reported that 75% of 396 children aged 3-6 years brushed their teeth once or more than once per day. In this study, 55.2% of the patients did not brush their teeth. The reason why the number of those who do not brush their teeth is so high is that the physician may have requested the postponement of tooth brushing because it could cause gingival bleeding and septicemia in patients receiving chemotherapy. In a study conducted on children with epilepsy, it was mentioned that it could be difficult and arduous to provide oral care due to the constant use of drugs and hospital admissions [24]. We think that a similar situation may be a major reason for neglecting oral care for children undergoing chemotherapy.

The AAPD states that oral hygiene measures should be started with the eruption of the first primary tooth [13]. The mean age of starting tooth brushing was 4.18 ± 1.35 years in this study, which is quite late. In addition, the average score of children's oral health habits was 0.48 ± 0.51 on a scale of 0 to 7. These data are an indication of the level of neglect of the oral health of children.

There are many studies in the literature that oral care application reduces oral mucositis in patients undergoing chemotherapy [25,26]. It has been stated that the percentage of septicemia that may occur as a result of oral care, which is a controversial issue, is not high and that the reservations about tooth brushing during aplasia can be removed in the study by Borowski, et al. [25].

Studies have reported that the PI, GI, and OHI-S scores of children treated for leukemia are higher than those of healthy children [27,28]. Djuric, et al. [11] in their study on adult patients with leukemia receiving chemotherapy, applied a protocol that included the treatment of teeth and oral hygiene measures before chemotherapy to some of the patients. The OHI-S score in the group receiving oral care was significantly lower than in the other patients. Although it was noted that there was a difference between the groups in the OHI-S score, it continued to increase throughout the study period in all patients. The GI score increased in all patients during the study period, to a lesser extent in the oral care group.

In a study conducted on healthy children [29], it was noted that after OHT, there were decreases in GI, PI, and OHI-S scores, as well as in the concentrations of IL-1 β and vascular endothelial growth factor (VEGF), which are markers of inflammation, in the gingival crevicular fluid. In this study, the decrease in GI, PI, and OHI-S scores shows that tooth brushing is effective on clinical parameters. In this study, the decrease in the OHI-S score in patients with cancer was in parallel with the study of Djuric, et al. [11] and a decrease was also noted in the GI score. This difference may be because periodontal diseases are less common in pediatric patients and recovery is faster than in adults.

Kashiwazaki, et al. [30] studied adult patients with bone marrow transplantation and stated that a group of patients performed the necessary dental treatments before transplantation as much as possible. In the group receiving oral care, there was a decrease in the incidence of oral mucositis, as well as a decrease in the incidence of febrile neutropenia and the maximum CRP levels. In our study, although there was no statistically significant difference in CRP values before and after OHT, an increase in CRP values of four patients was observed in the 2nd week after OHT due to the focus on extraoral infection. The high CRP values in these four patients who were receiving immunosuppressive therapy and were neutropenic have been associated with the fact that these patients had infections.

In this study, similar to Permatasari, et al. study [31], the children's problems were mostly "difficulty eating some foods" and "pain in the teeth, mouth or jaws." Toothache in young children is mostly caused by food impaction, which is occlusal force wedging of food into interproximal periodontal tissue, due to interproximal contact loss caused by interproximal caries. This discomfort causes difficulty in eating in children. In addition, a positive correlation was found between ECOHIS and ds score. This result shows that as the number of decayed tooth surfaces of the patients increases, so does their OHRQoL.

Studies have shown that as dental caries increases, the OHRQoL decreases [32,33]. In this study, the FIS scores of families of children with severe CAST severity scores was higher than the FIS scores of families of children with mild and moderate CAST severity scores. In addition, there was a statistically significant relationship between ECOHIS and pufa scores. This result is an indication that caries lesions with pulp involvement adversely affect OHRQoL.

In their study on 150 mentally handicapped children aged 3-5 years, Aggarwal, et al. [34] stated that according to ECOHIS, parents of disabled children were more stressed and needed more support. In Jaggi et al.'s study [35] the percentage of parents who answered "never" in the FIS section of ECOHIS was found to be high. In this study, the majority of parents answered "never," and these percentages are quite high compared with other studies [36,37]. It can be thought that the reason why parents are less affected by oral health-related problems of their children is that they see the cancer treatment as more vital and ignore oral health.

There is a limited number of studies in the literature on dental neglect, especially in children. Aydınoglu, et al. [38] stated that the number of caries increased with the increase in dental neglect in children aged 6-12 years. Thomson, et al. [39] reported that individuals with increased dental neglect had more dental plaque on their teeth and brushed their teeth less frequently. In this study, a positive correlation was found between children's oral health habits and DNS. These children aged less than 6 years are dependent on their parents for oral care. It can be thought that families, who have to take care of these children during the difficult treatment process for an extended period, neglect the oral care of their children and even themselves, as heavy responsibilities fall on them.

The small number of patients and the short follow-up period are the limitations of this study. While the study was being designed, follow-up appointments were determined as 2 weeks to be able to conduct oral hygiene status follow-ups of the patients simultaneously with blood draws and thus not to lose participants in the follow-up sessions. In addition, the fact that the dental caries of the patients were not treated is among the limitations of this study. However, because the patients received chemotherapy during our study period, their treatment was compulsorily postponed. However, all patients who needed dental treatment have been invited to our pediatric dental clinic during periods when their medical conditions allow for dental treatment. Despite all these limitations, the strength of the study is that it is the first to investigate OHRQoL and dental neglect in patients receiving chemotherapy.

CONCLUSION

Based on the results of the study, it can be said that healthy gingiva can be achieved by removing dental plaque in patients undergoing chemotherapy. This study

emphasizes the need to take precautions about oral health by providing information about the OHRQoL and dental neglect of patients undergoing chemotherapy. There is a need for studies with larger sample sizes and extended follow-up sessions on oral health in children receiving chemotherapy.

AUTHORS' CONTRIBUTIONS

X prepared the questionnaire, collected data, wrote the initial framework, and drafted the manuscript. XX conceived the idea for the research, prepared the questionnaire, performed the statistical analyses, wrote the initial framework, and drafted the manuscript. XXX identified patients to be included in the study, collected data, and revised the manuscript. The manuscript has been read and approved by all the named authors.

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