

# Oral health status in children undergoing chemotherapy at Erbil city: A case control study

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**Background:** Chemotherapy is a well-known effective treatment for cancer but is associated with many side effects including that of the dental and oral aspects, which have an impact on the overall/general health-related quality of life. This study aimed to assess oral health status

in a specified age group of pediatric patients who were undergoing chemotherapy for acute lymphoblastic leukemia (ALL) at the time of the study as well as identify the factor that indirectly contribute to their OHS and compare the results with healthy children of similar age.

**Methods:** One hundred children who were treated for acute lymphoblastic leukemia (ALL) at Nanakali specialised hospital for hematologic diseases and cancer, in addition to fifty healthy controls at Khanzad teaching hospital were examined. Data on decayed, missing and filled teeth as (DMFT/dmft) scores and simplified plaque index (PI) were collected through and intra oral examination.

**Result:** A high statistically significant difference of a p-value of 0.000 was seen in the dmft caries index for (primary dentition) with the highest mean (5.32) for the controls when compared with the children undergoing chemotherapy (2.84), while no statically significant differences were found in the DMFT for (permanent dentition) and PI. Moreover, among the factors indirectly associated with oral health status (OHS), it turned out that between both groups mother's education, occupation, frequency of child's tooth brushing, and age were the most common contributing factors to the child's OHS.

**Conclusion:** Children affected by hematological diseases showed higher rates of plaque but with no significant differences when compared to the controls. Healthy subjects had significantly higher rates of caries in their primary teeth when compared with leukemic children, while no significant differences were seen in the permanent dentition. And among the factors indirectly associated with oral health status (OHS), it turned out that between both groups mother's education, occupation, frequency of child's tooth brushing and age were the most common contributing factors to the child's OHS.

Keywords: leukemia, child, oral health, dental caries.

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## Introduction

The oral cavity is of central importance to most people as verbal and non-verbal communication is performed through it and its anatomy contributes to a person's appearance. Nutritional intake, essential for survival depends on a well-functioning oral cavity.<sup>1</sup> A healthy mouth enables not only nutrition of the physical body, but also enhances social interaction and promotes self-esteem and feelings of well-being. WHO defines

oral health as a state of being free from mouth and facial pain, oral and throat cancer, oral infection and sores, periodontal (gum) disease, tooth decay, tooth loss, and other diseases and disorders that limit an individual's capacity in biting, chewing, smiling, speaking, and psychosocial well-being.<sup>2</sup>

In modern times, cancer has been widely diagnosed in children even though it is rare-

ly considered as a childhood disease. Cancer is increasingly becoming a cause of death for children aged between 1 and 14 years, but fortunately with accomplished advances in the treatment of childhood cancer, there is an increase in the young population who are successfully cured of their disease with the aid of various therapeutic agents.<sup>3</sup> One of the well-known treatment choices for cancer is chemotherapy which is a systemic treatment used to combat primarily the disease sites, metastatic areas and possibly microscopic spread of disease.<sup>4</sup> Even with the evolution of chemotherapeutic procedures and agents, chemotherapy may cause certain side effects that impair the patient's quality of life.<sup>1</sup> Since along with the cancer cells, many actively dividing normal cells of the body are also destroyed.<sup>4</sup>

The most common treatment-related sequelae in childhood cancer is the orodental aspects that are often overlooked sources of morbidity and impaired health-related quality of life, that with early identification and interventions can optimize health and quality of life.<sup>5</sup> Pieces of evidence from clinical studies state that the presence of oral and dental problems adds to the risk for oral complications from chemotherapy. The oral health issues become so severe that at times there is a need to lower the dose of the chemotherapy, delay to start, or even to discontinue the drug.<sup>6</sup>

Due to the lack of contemporary papers describing oral health status in terms of (prevalence of dental caries and plaque index) in childhood cancer sufferers, more importantly, the correlation of chemotherapy with the oral health status in pediatric patients receiving chemotherapy at Erbil city, this study was suggested to be performed with an aim to:

- Assess oral health status (prevalence of caries and plaque index) in a group of ALL children under therapy.
- Identify the factor that indirectly contribute to OHS of ALL children.
- Compare the results with healthy children of similar age.

### Methods:

This study was approved by the Ethics and Research Committees of Hawler medical

university/college of Dentistry, as well as the general health directorate in the city of Erbil located in Kurdistan region of Iraq.

### Patient Selection

The sample for this case-control design study was composed of patients being treated for (ALL) at the Pediatric Oncology Unit of Nanakaly specialized hospital for blood disease and Cancer over 5 months, matched with healthy children in the control group that were patients visiting pedodontics department at Khanzad teaching hospital to receive dental services on an outpatient base. A number of hundred cases were included if they met the following criteria: a diagnosis with ALL: ages between (2.6 – 15) years old at the time of the study, and absence of other systemic diseases or conditions that might influence on the oral health status. While severely ill, uncooperative, and mentally disabled patients were excluded from the study. Both cases and control groups underwent complete dental assessment.

### Procedures

Clinical intraoral examinations were performed on all participants and were conducted and recorded by the same professional operator (dentist) using the codes and criteria recommended by the World Health Organization (WHO) in 1997. The dental examination was carried out in a dental office and patients were examined from September 2021 to March 2022. The same procedures were followed all through the study by the dentist. Clinical forms previously developed for this purpose were filled out during the examinations. DMFT/dmft scores, PI for oral hygiene assessment were collected for comparison. The DMFT/dmft criteria for (decayed, missing, and filled teeth) was that one suggested by WHO in 1987 where it uses a numerical coding system to record the status of permanent teeth and an alphabetical coding system for primary teeth.<sup>7</sup> This score provides an accurate, objective, and rapid evaluation of caries by visual inspection and evaluation of changes in the dental state.<sup>8</sup>

The plaque index (PI), which measures the amount of plaque to assess the child's oral hygiene, was evaluated using Silness and Loe criteria, a simplified but largely used variation of plaque measurement proce-

dures. A plaque was analyzed as a variable that divides into four branches and assigned a value: 0 – no plaque, 1 – plaque is not seen by the naked eye, only by running the probe. 2 – plaque can be seen with the naked eye, 3 – the abundance of plaque.<sup>9</sup>

Several variables connected with the risk of caries were studied within a questionnaire that was filled throughout a 5-10-minute interview after obtaining informed consent from the child's guardian. The variables were chosen based on an earlier paper and included the following: socioeconomic background, duration of breast and bottle feeding, number of meals per day, frequency of eating sweets, age at the start of brushing teeth, frequency of brushing teeth, age at a first dental visit, frequency of dental visits, and usage of additional preventive aids in everyday oral care.<sup>10</sup> Age when diagnosed with cancer, the onset of chemotherapy, as well as the phase of chemotherapy, were specific variables that must have been taken into consideration as risk associated factors for the cancer group patients only.

#### Statistical analysis

The data collected were entered in a previously developed access data bank containing the items under analysis. After collection, data was subjected to descriptive and comparative statistical analysing's. The Student t-test was used for comparing the means of quantitative variables, while analysis of variance (ANOVA) was used to compare the means of more than two groups of quantitative variables. Moreover, the linear backward regression analysing was used to access the impact of sociodemographic variables, child's oral hygiene and dietary habits and age at cancer diagnosis for the leukemic children on oral health status. Statistical significance was considered for  $p \leq 0.05$ . Statistical Product and Service Solutions (SPSS) version 28 was used.

## Results

Difference between cases and controls with respect to variables:

The independent sample T-test showed highly significant variables with p values ( $P \leq 0.001$ ) for factors like (child's sweets

consuming frequency, child's first dental visit and the frequency of dental visits). While gender showed to be a highly statistically significant variable of a p-value ( $p=0.003$ ). Other variables showed statistically significant (residence quarter, duration of bottle feeding, manner of tooth brushing, the use of additional preventive measures) with p values of (0.029, 0.023, 0.036, and 0.018 respectively) as seen in table 1.

**Table 1. T-test for mean differences between cases and controls for indirect risk factors.**

Groups		N	Mean	Std. Deviation	Std. Error Mean	t-test P-Value	Decision	Mean Differences Case - Control
Age	Case	100	7.7640	3.49815	0.34982	0.635	NS	0.230
	Control	50	7.5340	2.36579	0.33457			
gender	Case	100	1.38	0.488	0.049	0.003	HS	-0.260
	Control	50	1.64	0.485	0.069			
Mother's Education	Case	100	2.59	1.652	0.165	0.559	NS	-0.150
	Control	50	2.74	1.382	0.195			
Mother's Occupation	Case	100	1.89	0.314	0.031	0.062	NS	0.130
	Control	50	1.76	0.431	0.061			
Where do you live?	Case	100	1.20	0.402	0.040	1.000	NS	0.000
	Control	50	1.20	0.404	0.057			
Where do you live? Quarter	Case	87	23.40	14.653	1.571	0.029	S	-9.165
	Control	37	32.57	22.905	3.766			
How long was the duration of breast feeding of your child?	Case	95	12.7211	10.88130	1.11640	0.156	NS	-3.116
	Control	49	15.8367	13.07247	1.86750			
How long was the duration of bottle feeding of your child?	Case	94	25.75	19.652	2.027	0.023	S	6.607
	Control	49	19.14	14.265	2.038			
What are your child's dietary habits?	Case	100	1.48	0.674	0.067	0.319	NS	-0.120
	Control	50	1.60	0.700	0.099			
The frequency your child consumes sweets?	Case	100	2.18	0.702	0.070	0.000	HS	0.760
	Control	50	1.42	0.609	0.086			
At what age your child started tooth brushing?	Case	99	4.0313	2.33700	0.23488	0.307	NS	0.431
	Control	50	3.6000	2.46196	0.34817			
What manner he/she brushes?	Case	99	1.28	0.833	0.084	0.036	S	-0.377
	Control	50	1.66	1.099	0.155			
How often he/she brushes?	Case	100	2.33	1.682	0.168	0.756	NS	0.090
	Control	50	2.24	1.661	0.235			
Do you use other preventive measures for your child's oral care routine?	Case	100	5.80	2.050	0.205	0.018	S	-0.660
	Control	50	6.46	1.297	0.183			
When was your child's first dental visit?	Case	99	1.8434	3.18969	0.32058	0.000	VHS	-3.899
	Control	50	5.7428	3.41016	0.48227			
How often u visit the Dentist?	Case	99	0.31	0.488	0.049	0.000	VHS	-0.547
	Control	50	0.86	0.351	0.050			
Pluque Index	Case	100	1.15	0.744	0.074	0.315	NS	-0.130
	Control	50	1.02	0.742	0.105			
(decayed,missing,filled permanent teeth)	Case	100	0.29	0.808	0.081	0.130	NS	-0.270
	Control	50	0.56	1.110	0.157			
decayed,missing,filled primay	Case	98	2.84	3.436	0.347	0.000	VHS	-2.483
	Control	50	5.32	3.711	0.525			

### Effect of the variables that are indirectly associated to OHS:

#### Plaque index (PI):

ANOVA test results have shown very high significance ( $p < 0.000$ ) of the associating factors on PI, furthermore, the coefficients table showed mothers' education, occupation and frequency of child's tooth brushing in specific to be significant predictors influencing (PI) in cancer patients (cases) of p values (0.032, 0.006 and 0.024 respectively)

with age being the greatest positive (have a directly proportional relationship) and significant predictor to (PI) with a p-value of ( $p < 0,000$ ) while frequency of child's tooth brushing a negative (inversely proportional relationship) but still a significant predictor to (PI) among the mentioned variables as seen in Table 2.

**Table 2. (Backward) linear regression coefficients for (PI) in cases.**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	Age	0.121	0.019	0.753	6.272	0.000
	Mothers education	0.087	0.040	0.195	2.184	0.032
	Mothers occupation	0.335	0.120	0.463	2.792	0.006
	How often he/she brushes?	-0.160	0.041	-0.199	-2.298	0.080

For the controls group, ANOVA test results also showed very high significance ( $p < 0.000$ ), regression coefficients showed only age and gender with p values (0.001 and 0.020 respectively) in specific to be positive significant predictors of (PI) with age being the most significant as seen in Table 3.

When mentioning cases and controls groups together, the ANOVA test shows very high significance ( $p < 0.000$ ), and backward regression coefficients showed child's dietary habits and the duration of bottle feeding specifically to be positive and highly significant contributors to (PI) with p values of (0,001 and 0,051) with age being the strongest positive contributor ( $p < 0,000$ ) and duration of bottle-feeding of a negative significance contribution as shown in Table 4.

DMFT caries index for permanent dentition:

The results of DMFT index by the ANOVA test were very highly significant ( $p < 0.000$ ), then backward regression coefficients table showed that in patients receiving chemotherapy only one variable specifically was very highly significant and positively contributing to DMFT, which is the age at the start of tooth brushing with a p-value ( $p < 0.000$ ) as seen in Table 5.

While in the control group ANOVA test also showed a very high significance of factors on the DMFT caries index, additionally the backward regression coefficients table showed gender, mother's occupation and child's first dental visit to be significant predictors of DMFT scores to p-values (0,044, 0.01 and 0.001 respectively) among those three, mother's occupation exhibited a negative significant contribution as seen in table 6.

**Table 3. (Backward) linear regression coefficients for (PI) in controls.**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
age		0.097	0.026	0.640	3.701	0.001
gender		0.359	0.148	0.511	2.418	0.020

**Table 4. (Backward) linear regression coefficients for (PI) in cases & controls.**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	age	0.121	0.021	0.767	5.792	0.000
	Childs dietary habits	0.221	0.064	0.276	3.451	0.001
	Duration of bottle feeding	-0.005	0.003	-0.120	-1.968	0.051

**Table 5. (Backward) linear regression coefficients for DMFT index in cases.**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	At what age your child started tooth brushing?	0.080	0.017	0.433	4.632	0.000

**Table 6. (Backward) linear regression coefficients for DMFT index in controls.**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	gender	0.489	0.237	0.673	2.067	0.044
Mothers occupation		-0.624	0.255	-0.919	-2.44	0.018
First dental visit		0.145	0.043	0.786	3.378	0.001

When mentioning cases and controls together as a whole study population ANOVA test showed very high significance ( $p < 0.000$ ), in the backward regression coefficients table age, gender, maternal occupation, frequency of child's brushing his/her teeth and history of the first dental visit were significant predictors to DMFT scores with p-values (0.04, 0.02, 0.005, 0.037, and 0.035 respectively), moms occupation and frequency of tooth brushing of a negative contribution as illustrated in Table 7.

(dmft) caries index for primary dentition:

The ANOVA test showed a very high significance ( $p < 0.000$ ) of some variables on the dmft index in cases, moreover, the backward regression coefficients table showed that age, mothers' occupation and frequency of child brushing his/her teeth to be statistically significant predictors with p values (0.016, 0.000, and 0.003) respectively with mothers' occupation to contribute the most and age of negative significant prediction as seen in Table 8.

While for controls ANOVA test also showed the very high significance of the variables on dmft index, but regression coefficients table showed in specific that man-

ner of tooth brushing, the use of additional preventive oral care regimes, child's first dental visit and the frequency of dental visits with p values (0.027, 0.000, 0.012, and 0.012) respectively were significant predictors to dmft with additional preventive measures being the strongest contributor, and not to forget the negative but still significance prediction to dmft by the manner of brushing and child's first dental visit as showed in Table 9.

When talking about cases and controls as a whole population ANOVA test also exhibited very high significance ( $P < 0.000$ ), and backward regression coefficients showed mothers' occupation, frequency of brushing, child's first dental visit, and the frequency of the visits to be the statistically significant contributing factors to dmft ( $< 0.000$ , 0.042, 0.031, and 0.002) respectively with maternal occupation being the strongest and child's dental visit frequencies of negative relation as seen in Table 10.

**Table 7. (Backward) linear regression coefficients for DMFT index in cases & controls.**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	age	0.061	0.030	0.507	2.042	0.043
	Gender	0.300	0.133	0.459	2.263	0.025
	Mothers occupation	-0.386	0.135	-0.724	-2.864	0.005
	How often he/she brushes?	-0.095	0.045	-0.275	-2.109	0.037
	When was your child's first dental visit?	0.044	0.020	0.214	2.132	0.035

**Table 8. (Backward) linear regression coefficients for dmft index in cases.**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Age	-0.250	0.101	-0.477	-2.466	0.016
Mothers occupation	1.589	0.438	0.677	3.629	0.000
How often she/he brushes?	0.596	0.196	0.389	3.034	0.003
How often you visit the dentist for youre child?	1.324	0.716	0.174	1.848	0.068

**Table 9. (Backward) linear regression coefficients for dmft index in controls.**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
What manner she/he brushes?	-0.928	0.405	-0.281	-2.292	0.027
Do you use other preventive measures for youre child's oral care routine?	0.865	0.184	0.878	4.707	0.000
When was youre childs first dental visit?	-0.508	0.193	-0.528	-2.630	0.012
How often youre child visits the dentist?	4.672	1.781	0.676	2.624	0.012



**Table 10. (Backward) linear regression coefficients for dmft index in cases & controls.**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	Mothers occupation	1.813	0.326	0.648	5.564	0.00
	How often he/she brushes?	0.342	0.166	0.187	2.057	0.042
	When was your child's first dental visit?	-0.317	0.146	-0.299	-2.174	0.031
	How often your child visits the dentist?	3.253	1.050	0.450	3.099	0.002

## Discussion

In the present study, a very high statistically significant difference of a p-value of  $\leq 0.001$  was seen in the dmft caries index for primary dentition with the highest mean (5.32) for the controls group when compared with the (ALL) group (2.84). These results opposites Babu and Kavyashrees result in 2015 that found the dmft (46%) to be significantly higher in the ALL group than in the control group dmft (13%) in the age group taken in their study (5–7 years).<sup>11</sup> In accordance to the current study, Kapoor et al in 2019 also found a lower rate of caries in their study on 110 children with (ALL) undergoing treatment and 110 healthy children in the age group of 3-14 years. Their results showed lower caries prevalence in the cases group compared to controls with a mean age of  $7.75 \pm 3.451$  years, the difference was statistically significant ( $P = .0001$ ) in both primary and permanent dentition.<sup>12</sup>

The low rate of caries in the case group

might be because that leukemic children tend to follow an adequate oral and dental preventive regime indirectly as soon as they are diagnosed with leukemia, through diet control as it was noticed that the most depend on natural and homemade food as their nutrition source and parents make sure that they avoid sweets and snacks that are among the cariogenic dietary factors also. While this might not be the same for the controls group, as they are more independent in their dietary choices and tend to consume high amounts of snacks and sweets as parents don't monitor a normal healthy child the way they do for a leukemic child. Another possible justification for this high caries incidence of primary dentition in the control group is the lack of manual abilities for proper brushing in such young ages.<sup>12</sup> Not much supporting literature are found on the same matter. since few studies have examined the state of the deciduous dentition kkk

of cancer children undergoing chemotherapy, as most papers focus on permanent dentition and another justification is that researchers would rather examine a child that has already went through the chemotherapy journey and have experienced all the treatment induced oral changes from the time of diagnosing until time of evaluation. Like Julio et. al did when they evaluated the dental state at age of 11 while the child was at 5 when diagnosed.

While the DMFT permanent dentition results showed mean scores of 0.29 for the cases and 0.56 for the controls with no significant difference seen between the two study groups. In accordance with the current study's results Maciel et al found no significant differences in DMFT scores between leukemic children and the controls. This may have been due to the oral hygiene instructions that the multidisciplinary team gave to these children and to the redoubled care of parents during treatment.<sup>13</sup>

Ninawie in 2021 also conducted a study on a group with an age range of (3-11), in their result only a small number ( 1.7%) ALL children reported poor oral hygiene , and they stated a similar result in a study conducted by Pels and Mielnik-Blaszczak who found that oral hygiene was significantly better in children with ALL than that in healthy children, in the control group. This point indirectly points to the fact that better oral hygiene in turn means lower scores on the caries index.<sup>14</sup>

To assess oral hygiene, the Silness and Løe index was measured – yielding to statistically non-significant results with a mean score of 1.15 in the 100 leukemic patients, and 1.02 in the control group. A similar study to the present one found in the literature was published by Jankovic et al in 1995, where 20 healthy patients were compared with 30 oncological patients before the administration of chemotherapy; in both groups, the age and sex distributions were similar to the current study. Based on the Silness and Løe index, the authors recorded a value of  $1.57 \pm 0.90$  in the 30 oncological patients and  $1.39 \pm 0.65$  in the 20 healthy subjects.<sup>15</sup> Although no significant difference was seen the slight comparable higher rate of plaque in the

cancer group might refer to the fact that some of the children tend to not brush due to the fear of bleeding from their fragile gums due to neutropenia which is a well-known sign and symptom accompanying leukemia or in correctly use the brush on their gums and teeth surfaces also due to the fear of bleeding yielding to plaque and debris build-up.<sup>14</sup>

The current study also examined the influence of other variables not directly connected with cancer treatment like socio-demographic variables and details related to the child's personal oral hygiene habits on the incidence of plaque and caries in leukemic children compared to the healthy children, mothers' education, occupation and frequency of child's tooth brushing were significant predictors influencing (PI) in cancer patients (cases) of p values (0.032, 0.006, and 0.024) respectively. Opposite to the current results, Proc et al in 2019 didn't find a correlation between the frequency of brushing teeth and dental plaque index. This might be in part because respondents might have given inaccurate answers, which they may have seen as more desirable, resulting in a better impression of the quality of their hygienic habits. This problem associated with the reliability of answers in questionnaires has been a matter of many other studies. But still, proc et al confirmed that the education level of the parent influences state of dentition of their children. The level of education is associated with better awareness of health needs and better social and economic status of the family. This might influence the frequency of dental visits by the child, the term of the first dental visit and an appreciation by the parent of the need for introducing proper dental hygienic habits, such as brushing the teeth, as soon as the first tooth appears in the child's mouth.<sup>16</sup>

Moreover, similar to the results of Deise et al in 2020, there was a statistically significant association in this study between kkkkkk

individuals with caries and the number of toothbrushes per day, that is, the fewer brushings, the greater the number of individuals with caries as results showed p values (0.037 for DMFT and 0.042 for dmft).<sup>17</sup>

### Limitations:

The limitation of our study was that, no information existed regarding dental status before anticancer treatment. Therefore, it was not possible to provide direct evidence that dental caries progressed exclusively as a result of anticancer therapy.

### Conclusion

-Healthy subjects had significantly higher rates of caries in their primary teeth when compared with leukemic children, while no significant differences were seen in the permanent dentition.

-Leukemic subjects had higher rates of plaque but with no significant differences when compared to the controls.

-Among the factors indirectly associated with oral health status (OHS), it turned out that between both groups mother's education, occupation, frequency of child's tooth brushing and age were the most common contributing factors to the child's OHS.

### Conflict of interest

The author reported no conflict of interests.

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