

# Oral hygiene in children suffering from acute lymphoblastic leukemia living in rural and urban regions

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## Abstract

**Introduction and objective.** During acute lymphoblastic leukemia treatment, oral *mucositis* is a hugely important dental problem. In order to lower the risk of such complications, patients should take special care of their oral hygiene. The aim of this study was to assess the oral hygiene status in children with ALL during anti-cancer treatment protocols.

**Materials and methods.** 78 children with ALL who were examined in 3 stages, and 78 generally healthy children, who constituted the control group, participated in the study. In the group of patients were 55 children from the rural environment and 23 children living in towns. Oral hygiene status was assessed with the use of the Oral Hygiene Simplified Index, Plaque Index, and Gingival Index.

**Results.** The average value of OHI-S index in children with ALL before the chemotherapy was  $0.64 \pm 0.85$ , the value of the PI.I index was  $0.59 \pm 0.74$ , GI index value was  $0.08 \pm 0.34$ . In the period from 0.5 – 1.5 years, the anti-cancer therapy value indicators of oral hygiene in children with ALL developed as follows: OHI-S –  $0.49 \pm 0.69$ , PI.I –  $0.49 \pm 0.67$ , GI –  $0.02 \pm 0.13$ .

**Conclusions.** Oral hygiene was significantly better in children with ALL than in children in the control group. The better condition of oral hygiene in children with ALL than children in the control group is the result of the oral hygiene regime that the children were following during cancer treatment protocols. Significantly higher GI in children with ALL, compared to children from the control group, was observed despite the better oral hygiene.

## Key words

acute lymphoblastic leukemia, children, oral hygiene, dental plaque

## INTRODUCTION

Acute lymphoblastic leukemia (ALL) results from the suppression of cell maturation in the early stages of lymphoblastic system development. Cell clones prevail in blood and marrow, and infiltrate various organs. The etiopathogenesis of leukemia is not entirely clear, but its development is related to the coexistence of several etiological factors: changes to genes; viruses, mainly retroviruses (C-RNA), individual predisposition connected with the abnormal functioning of immunological control systems; and external environmental factors that can directly trigger leukemic transformation or weaken antineoplastic control. These include ionizing radiation, chemicals, abnormal composition of the environment, and additional infections [1, 2, 3]. Attempts to determine either the influence of environment conditions or exposure to pesticides have not evidenced the significance of this factor in the prevalence of acute lymphoblastic leukemia in children or adults [4, 5, 6]. Leukemia, mainly acute lymphoblastic leukemia, are the prevailing type of neoplasms (constituting about 28% of all types of neoplasms) in children in Poland [7] and in other countries [1, 8, 9].

Both the disease and its treatment radically change the environmental conditions in the oral cavity.

Immunoregulatory mechanisms engaged in inflammation, infectious and immunological diseases in the oral cavity play a special role in defending the host, and in sustaining homeostasis in the oral cavity. Therefore, ALL patients should be under regular dental review [10, 11, 12, 13], particularly because cancer treatment during childhood is not associated with an increased risk of dental anxiety [14].

Dental plaque, also called bacterial biological biofilm, forms on the surface of the hard tissue of teeth and on the mucous membrane of the oral cavity, and is one of the etiological factors for the forming of caries and diseases of the periodontitis. The mechanism of inflammation of the periodontal tissue is faster when there is a direct contact of the bacterial plaque with the gum in the area of the gingival pocket, or through the gingival pocket fluid of saliva. Knowledge of the principles of proper oral hygiene and, more importantly, the propagation of this knowledge, is very important in preventing diseases of the oral cavity during cancer treatment. During intensive multi-drug chemotherapy, oral *mucositis* is a hugely important dental problem. In order to lower the risk of such complications, patients should take special care of their oral hygiene [15, 16, 17, 18]. Oral complications may influence the modifications of chemotherapy; it increases the probability of prolonged in-patient treatment, and substantially increases the financial resources required for treatment in paediatric cancer patients [19]. Children and parents throughout the process of treatment should be subject to special care of the interdisciplinary treatment team. Transfer of full information

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on leukemia and the requirements of treatment and hygiene can reduce stress in both children as well as parents. The multidisciplinary and psychosocial approach to a child with cancer is an important factor in obtaining complete success of the anticancer therapy [20].

Bearing in mind the complexity of processes occurring in children with acute lymphoblastic leukemia, ensuing from the same illness, as well as the complexity of the treatment and possible therapeutic prognoses in the future [19], it seems purposeful to make an assessment of oral hygiene in this group of children during chemotherapy [21, 22].

The aim of the study was to assess the oral hygiene of children from rural and urban regions with acute lymphoblastic leukemia during cancer treatment protocols.

## MATERIAL AND METHODS

The study included 78 children, aged 2-18, with acute lymphoblastic leukemia (ALL) and 78 children in good general health condition chosen using the analogue method, who comprised the control group. In the study group, the majority of patients were children from the rural environment. There were 55 children living in rural regions (70.51%), while 23 children came from towns (29.49%). In the study group, 5 children had leukaemia recurrence in the cerebrospinal fluid, 2 had recurrence in the bone marrow, 7 had their CNS affected, and 3 had Down's syndrome. Children suffering from acute lymphoblastic leukemia were haematologically treated according to the Programme ALLIC BFM 2002 as a therapeutic protocol for risk groups: standard (SR), intermediate (IR) and high (HR) [23]. In children with ALL, due to the reaction of the oral mucosa to chemotherapy, the use of mouthwash medicinal products of chlorhexidine (Corsodyl) or benzydamine hydrochloride (Tantum verde) were recommended, as well as the herbal mixture (Dentosept).

Children with ALL were examined in 3 stages: examination 1 – before chemotherapy, examination 2 – during the period of 1-5 months from the beginning of treatment of the cancer disease, examination 3 – during the period of 6-18 months of cancer treatment.

**Clinical examinations.** In the clinical study, oral hygiene was assessed using the Oral Hygiene Index, Simplified (OHI-S), according to Greene and Vermillion, with the use of the Plaque Test. In the clinical study regarding the marginal periodontium, the incidence of dental plaque was assessed using the Plaque Index (Pl. I.) according to Silness and Loe and Gingival Index (GI), according to Loe and Silness.

**Statistical analysis.** The characteristics of the measurable study parameters were presented using mean, median and standard deviation. MannWhitney U test was used to compare 2 independent groups. To evaluate the presence of relationship between 2 quantitative variables, the Spearman R correlation coefficient significance test was used. A 5% conclusion bias and the related significance level of  $p < 0.05$  were assumed; the database and the statistical analyses were performed using STATISTICA 8.0 software (StatSoft, Poland).

## RESULTS

In each risk group, the following proportion of children with acute lymphoblastic leukemia occurred: 25.4% in the standard risk group, 50.8% in the intermediate risk group, and 23.8% in the high risk group.

Oral hygiene condition was assessed with the use of the OHI-S, the value of which in children with acute lymphoblastic leukemia, on average, was  $0.64 \pm 0.85$  before chemotherapy (examination 1), slightly higher at  $0.68 \pm 0.74$  in the period of 1-5 months from the beginning of treatment of the cancer disease (examination 2), and lowest at  $0.49 \pm 0.69$  in the period of 6-18 months of cancer treatment (examination 3). In healthy children, the value of OHI-S index was the highest and the average  $0.98 \pm 0.70$ . Differences in values of OHI-S between children with ALL and children in the control group were statistically significant (Tab. 1). Analysing the place of resident of children with ALL, higher values of OHI-S index were observed in rural children compared to children living in towns. The average value of OHI-S in examination 1 in children from rural areas was  $0.66 \pm 0.87$ , while in the children from towns –  $0.59 \pm 0.82$ . OHI-S index in examination 2 in children from rural areas was  $0.70 \pm 0.81$ , in children from towns –  $0.65 \pm 0.53$ , in the examination 3 –  $0.52 \pm 0.75$  and  $0.41 \pm 0.53$ , respectively.

**Table 1.** Oral hygiene status (OHI-S) in children suffering from acute lymphoblastic leukemia, and in children in good general health

Studied group of children	Index	Mean value	Me <sup>b</sup>	SD <sup>c</sup>	Z <sup>d</sup>	P <sup>e</sup>
with ALL examination 1	OHI-S <sup>a</sup>	0.64	0.4	0.85	3.4274	0.0006*
with ALL examination 2		0.68	0.5	0.74	2.6520	0.008*
with ALL examination 3		0.49	0.0	0.69	4.3626	0.00001*
healthy		0.98	1.0	0.70	The above values refer to healthy children	

<sup>a</sup> – OHI-S Index – Oral Hygiene Index, Simplified

<sup>b</sup> – Median

<sup>c</sup> – Standard deviation

<sup>d</sup> – MannWhitney U test

<sup>e</sup> – Significance level

The condition of the marginal periodontium was assessed with the use of the Plaque Index (Pl.I), whose mean value in children with ALL was  $0.59 \pm 0.74$  in examination 1. Pl.I index value in the examination 2 was higher at  $0.61 \pm 0.64$ . In examination 3, the lowest index value Pl.I at  $0.49 \pm 0.67$  was reported. In the group of healthy children, the mean value of the Pl.I. was  $0.96 \pm 0.69$ . Differences in values of Pl.I between children with ALL and children in the control

**Table 2.** Incidence of dental plaque (Pl.I) in children suffering from acute lymphoblastic leukaemia, and in children in good general health

Studied group of children	Index	Mean value	Me	SD	Z	p
with ALL examination 1	Pl. I. <sup>a</sup>	0.59	0.32	0.74	3.4945	0.0005*
with ALL examination 2		0.61	0.5	0.64	3.1125	0.0018*
with ALL examination 3		0.49	0.0	0.67	4.3336	0.00001*
healthy		0.96	1.0	0.69	The above values refer to healthy children	

<sup>a</sup> – dental Plaque Index

group were statistically significant (Tab. 2). In the group of rural children, dental plaque was less severe than in children from towns. Pl.I index in children from the rural environment in examinations 1, 2 and 3, respectively, was:  $0.57 \pm 0.72$ ,  $0.59 \pm 0.69$ ,  $0.53 \pm 0.72$ . Whereas, in the group of children from the town, Pl.I index was  $0.61 \pm 0.82$  in examination 1,  $0.66 \pm 0.50$  in examination 2 and  $0.38 \pm 0.50$  in examination 3.

The analysis values of OHI-S and Pl.I demonstrated significant correlation between the condition of oral hygiene and dental plaque occurrence in children with ALL. In the study group children with ALL, an increase was observed in the mean values of OHI-S and Pl.I in examination 2, compared to examination 1, indicating a deterioration of health during this period. The average value of OHI-S and Pl.I indices in examination 3 was the lowest in relation to examinations 1 and 2, suggesting that with the improvement of general health and hygienic regimen, there was improved oral hygiene in children with ALL (Tab. 3).

**Table 3.** Oral hygiene (OHI-S and Pl.I indices) in children suffering from acute lymphoblastic leukemia in 3 consecutive examinations

OHI & Pl.I	N	R <sup>a</sup>	t (N-2) <sup>b</sup>	p <sup>c</sup>
Examination 1	62	0.9866	46.832	<0.00001*
Examination 2	54	0.9224	17.2169	<0.00001*
Examination 3	63	0.9925	63.590	<0.00001*

a – Spearman R correlation coefficient significance test

b – Spearman R correlation coefficient significance test

c – Significance level

Gingival Index (GI) value, indicating a condition of the gums, in children with ALL was  $0.084 \pm 0.34$  in examination 1, whereas in healthy children GI index was  $0.003 \pm 0.03$ , and this difference was statistically significant. In examination 2, GI index was the lowest and amounted to  $0.007 \pm 0.04$ , and in examination 3 –  $0.017 \pm 0.13$  (Tab. 4). GI value in children with ALL in examination 1 from the rural region was  $0.08 \pm 0.34$ , in children from towns –  $0.09 \pm 0.35$ . GI value in children from the rural region was  $0.002 \pm 0.01$ , in children from the towns it was higher –  $0.02 \pm 0.07$  in examination 2. GI value in children from the rural region was  $0.02 \pm 0.15$ , in children from the town –  $0.0 \pm 0.0$  in examination 3.

**Table 4.** Gum condition (GI) in children suffering from acute lymphoblastic leukemia, and in children in good general health

Studied group of children	Index	Mean value	Me	SD	Z	Significance level P
with ALL examination 1		0.084	0.0	0.34	-2.5393	0.0111*
with ALL examination 2		0.007	0.0	0.04	-0.2360	0.8134
with ALL examination 3	GI <sup>a</sup>	0.017	0.0	0.13	-0.1928	0.8471
healthy		0.003	0.0	0.03	The above values refer to healthy children	

a – Gingival Index

## DISCUSSION

As a result of the studies performed, it was concluded that the oral hygiene status is notably better and the decrease of the incidence of dental plaque is statistically significant in children with acute lymphoblastic leukemia, compared to children from the control group. This tendency has already been observed in previous publications, which noted slightly better oral hygiene and less intense incidence of dental plaque in children with acute lymphoblastic leukemia [22]. As in this study, authors from the centre in Wrocław observed good oral hygiene in children with ALL and acute non-lymphoblastic leukemia (ANLL), which made gingivitis less advanced and more localized. The results of those authors' research showed that in 48.3% of patients dental plaque was present on less than 40% of tooth surfaces examined. Those authors observed definitely bad oral hygiene in only 25.8% of ill children, and generalized gingivitis in only 9.6% of ill children. They also noted that the oral hygiene index had a significant positive correlation with the Gingival Index [24]. Results close to those in the presented study were obtained by Dens et al., who observes a negative correlation between age and the Plaque Index ( $r = -0.37$ ;  $p < 0.01$ ) between children undergoing chemotherapy because of a cancer disease, of which almost 50% had acute lymphoblastic leukemia, and healthy children. In a group of children aged 14-17, the Plaque Index, on average, was  $1.1 \pm 0.1$ ; in a group aged 6-9 the Pl. I., on average, was  $1.6 \pm 1.3$  [25]. Fleming and Kinirons demonstrated that the incidence of dental plaque was the same in children with acute lymphoblastic leukemia and in children in good general health [26, 27]. High values of oral hygiene status and gum condition indices are presented by Sonis et al., although they noted statistically significant differences only in the group of children with ALL undergoing radiotherapy. The mean OHI-S in their studies of children with ALL who received only chemotherapy was  $4.9 \pm 3.3$ . They explained the high values of these indices by the greater number of teeth with abnormalities and irregular surface of the enamel in the patients [28]. In the examinations by Avsar et al. of children in the total remission, significantly higher indicators of the Plaque Index (Pl.I) and Gingival Index (GI) of gums were observed, compared to their healthy peers [29]. In Uderzo et al., examinations analysis of the state of the periodontium of children after transplants allo- or autogenic, the majority of whom were suffering from ALL, the presence of soft deposits was shown in 77.7%, gingivitis in 59.2%, and pathological changes in the periodontium in 3.7% of the examined children [30]. Brazilian authors, after having examined children with acute lymphoblastic leukemia for 7 months, demonstrated that the systematic use of 0.12 chlorhexidine indeed influences the decrease in inflammatory conditions and ulceration of gums. The authors suggest that such therapy may influence the decrease in oral cavity morbidity during chemotherapy, for example oral *mucositis* [31].

In a study of children with haematological diseases, Mielnik-Błaszczak noted that oral hygiene in ill children was better than in healthy children. The mean value of the OHI in her study was 1.04, and a value of this index higher than 0 was noted in 39% of ill children [32]. In the studies of adult patients by Laskus-Perendyk et al., the highest value of the Plaque Index was observed in 85% of patients, and gingivitis was present in 73% of studied patients [33]. In the study of adult patients in the period of 3, 6, and 12 months

after allogenic bone marrow transplant, Sobczyńska et al. observed a notably higher amount of plaque, but they did not demonstrate notable differences in bleeding from the gum during gentle touch with an explorer both in patients with symptoms of Graft-Versus-Host Disease (GVHD) and in patients with no symptoms of GVHD. In the period before the transplant, these authors did not observe oral *mucositis*, and after 6 and 12 months, they observed inflammation in 25% of patients without GVHD and in 100% of patients with symptoms of GVHD [34].

An appropriate treatment of dental care is a very important problem for patients with a cancer disease, who are to undergo chemotherapy and/or radiotherapy, and including prophylaxis such as instruction about hygiene and rigorous implementation of hygienic and care procedures that eliminate dental plaque. The patients who undergo chemotherapy and radiotherapy will often be advised to change from wrong hygienic habits and maintain a good state of oral hygiene in order to more effectively eliminate the etiological factors connected with the development of diseases of the periodontium. Frequent and astute observation of all pathological indications within the oral cavity is equally important in order to undertake early medical intervention [35, 36, 37, 38, 39].

## CONCLUSIONS

In the course of analysing the results of the presented study, the following conclusions were made:

Children with ALL from the rural environment have a worse state of oral hygiene than children from towns, but a significantly better oral hygiene was observed in children with acute lymphoblastic leukemia, compared with children in the control group.

The better condition of oral hygiene in children with acute lymphoblastic leukemia than children in the control group was the result of the oral hygiene regime that the children were following during cancer treatment protocols.

Significantly higher Gingival Index in children suffering from acute lymphoblastic leukaemia, compared to children from the control group was observed, despite the better oral hygiene, which may become a greater risk for *mucositis*.

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