ORIGINAL ARTICLE

Oral health status and its determinants in children with leukaemia at the Radiation and Isotope Center Khartoum, Khartoum State, Sudan

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ABSTRACT

The burden of oral health diseases in children with leukaemia and the impact of cancer treatment on their oral health have not been studied in Sudan. The present study assesses the oral health status of leukemic children through measuring caries experience, gingival status, oral hygiene status and mucositis. It also explores the association between the oral health status of children with leukaemia and their parental education, oral hygiene habits, treatment stage and type of leukaemia. A cross sectional hospital-based study was conducted at the Radiation and Isotope Center Khartoum, Khartoum State. A total of 87 children were included in this study. Data were collected by interviewer questionnaire and clinical examination. The oral health status revealed high prevalence of untreated dental caries (37.9%) and the majority (67.9%) of children had poor oral hygiene. Nearly, all children with leukaemia (93.1%) had never visited a dental health facility in their lives. Regarding the treatment stages of leukaemia, the severity of dental caries was found to be more significant in the maintenance phase, while oral mucositis was more significant in the induction phase.

KEYWORDS

Oral health status; Leukaemia; Treatment; Children; Khartoum; Sudan.

INTRODUCTION

Leukaemia is a hematopoietic malignancy in which there is production of abnormal leukocytes in the bone marrow and dissemination of these cells into the peripheral blood [1].The abnormal leukocytes (blast cells) substitute normal cells in bone marrow and accumulate in other tissues and organs of the body [1]. It is classified clinically on the basis of the period and character of the disease (acute or chronic), the type of cell involved (myeloid, lymphoid or monocytes) and increase or non-increase in the number of abnormal cells

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in the blood [2]. Acute lymphoblastic leukaemia (ALL) represents the most common type of leukaemia, and occurs mostly in children [3].

In the first report on cancer incidence in Sudan (2009–2010), by the National Cancer Registry, leukaemia was described as the most common cancer among children in Khartoum state with an incidence rate of 10 per 100,000 [4]. Similarly, in northern Africa, it is the most common malignancy in children [5]. Sixty five percent of patients with leukaemia, when revised in the course of their disease, demonstrated oral signs or symptoms [6]. Erythematous or cyanotic gingival hyperplasia, with or without necrosis, is reported to be the most regular symptom leading to a diagnosis of acute leukaemia that directs the patient to look for early dental consultation. Other oral findings include petechiae, ecchymosis, mucosal ulcers, haemorrhage, herpetic infections and candidiasis [7,8]. The treatment modalities widely known for leukaemia are chemotherapy and a combination of chemotherapy with radiation [9].

Oral and systemic problems of leukemic treatment may include pain, mucositis, oral ulcerations, bleeding, taste dysfunction, secondary infections (e.g., candidiasis, herpes simplex virus), dental caries, salivary gland dysfunction (e.g., xerostomia), neurotoxicity, mucosal fibrosis, post-radiation osteonecrosis, soft tissue necrosis, temporomandibular dysfunction (e.g., trismus) and craniofacial dental developmental anomalies [10].

The burden of oral health diseases and the impact of treatment of leukaemia on oral health are not known in this population. This study aimed at assessing the oral health status of children with leukaemia receiving treatment at the Radiation and Isotope Center Khartoum (RICK), Khartoum State and its risk factors.

MATERIALS AND METHODS

This was a cross-sectional study design conducted at RICK, Khartoum State. The target population was children with leukaemia less than 15 years of age. All patients found at RICK during the data collection period (from January to May 2016) and met the inclusion criteria were invited to participate in the study. The sample size was not calculated a priori due to the absence of prevalence data (prevalence of leukaemia in children and size of target population) and the low flow of patients at the centre. Therefore, post-hoc (retrospective) power analysis conducted after the study was completed to determine the power of the study and interpret negative [11]. With a sample size of 87, type one error alpha of 0.05, true proportion of 0.37 and null hypothesis proportion of 0, the study power was found to be 0.64. Principal Investigator (MHMA) was calibrated to satisfaction (Kappa 0.87) on the following indices: DMFT: Decayed, Missing, Filling, Teeth (for dental caries measuring); MGI: Modified Gingival Index (for gingival inflammatory measurement); PI: Plaque index (for oral hygiene measurement) and mucosal lesion diagnosis. Test–retest reproducibility (Kappa 0.94) was assessed through the principal investigator's examination and re-examination of 15 cases with a 2-week interval and the result was 0.94 [12].

Data were collected using an interviewer administered questionnaire followed by the clinical examination which was conducted inside the consultation room at RICK, under direct examination light. The sterilized examination set included a mouth mirror and CPI metallic probe. The patient was seated in upright position during the examination. A note taker recorded the information in the assessment tool as reported by the dentist during examination. Oral health status was measured using the following indices: caries experience using decayed missing and filling tooth DMF-T or dmf-t, gingival status using MGI, oral hygiene status using PI and mucositis using WHO mucositis grading scale.

Patients were categorized into three groups based on the status of their treatment:

1. Group I: Patients who were newly diagnosed to have leukaemia.
2. Group II: Patients who were under chemotherapy/ radiotherapy/combination.
3. Group III: Patients who were under maintenance phase.

Data were managed and analysed using Statistical Package for the Social Sciences version 18.

Descriptive statistics, such as frequencies and proportions, and analytical statistics, such as bivariate and multivariate tests, were used. Statistical significance was interpreted through confidence intervals.

Approval from Research Committee, Faculty of Dentistry, University of Khartoum was obtained prior to the conduction of the study. Ethics approval was also obtained from RICK. Written, informed consent was obtained from the child's caregiver.

RESULTS

A total of 87 children were included in this study (Table 1). The majority of participants (60.9%) were males and the most common age group (40.2%) ranged between 0 and 6 years. In terms of parents' level of education, most of the fathers had studied up to primary school level (40%), while the mothers tended to be illiterate (42%). ALL was by far the most common type of leukaemia among patients in this study (92%), with more

Table 1. *Demography of study population.*

		Frequency	Percent
Gender	Male	53	60.9
	Female	34	39.1
Age	0–6 years	35	40.2
	7–10 years	29	33.3
	11–14 years	23	26.4
School level	Preschool	36	41.4
	Primary	51	58.6
Father's education	Illiterate	29	33.3
	Khalwa (traditional Islamic School)	13	14.9
	School level	40	46
	University level	5	5.7
Mother's education	Illiterate	42	48.3
	Khalwa (traditional Islamic School)	12	13.8
	School level	24	27.6
	University level	9	10.3
Dental visits	Every 6 months	1	1.1
	More than 1 year	5	5.7
	Never	81	93.1
Brushing frequency	Once a day	68	78.2
	Twice a day	17	19.5
	More than 2 times a day	2	2.3
Mouthwash	Yes	29	33.3
	No	58	66.7
Brushing tool	Brush and toothpaste	80	92
	Miswak* (traditional method for brushing)	6	6.9
	Others	1	1.1

* A teeth cleaning twig made from the Salvadora persica tree.

than half the participants in the induction phase of treatment (56.3%).

Oral health status

The mean values of DMFT/dmft/PI/MGI and mucositis were measured (Table 2). No significant association was found between DFMT and the parents' level of education, oral hygiene practice and the type of leukaemia (Table 3). On the other hand, DFMT was found to be significantly associated with the level of treatment (p =0.027).

Regarding oral hygiene, there was no significant association between the plaque index and the parents' level of education, oral hygiene practice, type of leukaemia and level of treatment. As for gingival status, there was also no significant association between the MGI and the parents' level of education, oral hygiene practice, type of leukaemia and level of treatment.

The mucositis scale was found to be significantly associated with the level of treatment (first and second stage, p value =0.027). However, there was no significant association between the parent's' level of education, oral hygiene practice and type of leukaemia (Table 4).

Table 2. The mean value of DMFT (Decayed, Missing, Filling, Teeth (permanent), dmft (decayed, missing, filling, teeth (primary), PI (Plaque Index), MGI (Modified Gingival Index) and mucositis.

	Mean	SD
dmft	1.6	2.7
DMFT	0.3	0.8
Plaque Score	2.2	0.7
MGI	2.3	0.9
Mucositis	0.9	1

dmft (decayed, missing, filling, teeth [primary]); DMFT, (Decayed, Missing, Filling, Teeth [permanent]); MGI (Modified Gingival Index); PI (Plaque Index); SD, standard deviation.

DISCUSSION

In this study, the majority of patients with leukaemia had poor oral hygiene. This could

Table 3. *Factors associated with DMFT.*

		DMFT = 0	DMFT ≥ 1	*p*-value
Father's education	Not educated	26 (61.9%)	16 (38.1%)	0.862
	Educated	26 (57.8%)	19 (42.2%)	
Mother's education	Not educated	35 (64.8%)	19 (35.2%)	0.316
	Educated	17 (51.5%)	16 (48.5%)	
Brushing frequency	Once per day	42 (61.8%)	26 (38.2%)	0.65
	Twice and more	10 (52.6%)	9 (47.4%)	
Mouthwash use	Mouth wash	19 (65.5%)	10 (34.5%)	0.588
	No mouth wash	33 (56.9%)	25 (43.1%)	
Brushing Tool	Miswak @and others	4 (57.1%)	3(42.9%)	1
	Brush and toothpaste	48 (60%)	32 (40%)	
Leukaemia type	ALL	48 (60%)	32 (40%)	1
	AML	4 (57.1%)	3 (42.9%)	
Treatment level	Before/during chemo	40 (67.8%)	19 (32.2%)	0.027**
	After chemo	12 (42.9%)	16 (57.1%)	

ALL, acute lymphoblastic leukaemia; AML, acute myeloid leukaemia; DMFT, (Decayed, Missing, Filling, Teeth).
@A teeth cleaning twig made from the Salvadora persica tree.
Chi square test performed **p value is significant.

Table 4. *Factors associated with mucositis.*

		Mucositis = 0	Mucositis ≥ 1	*p*-value
Father's education	Not educated	14 (33.3%)	28 (66.7%)	0.096
	Educated	24 (53.3%)	21 (46.7%)	
Mother's education	Not educated	20 (37%)	34 (63%)	0.196
	Educated	18 (54.5%)	15 (45.5%)	
Brushing frequency	Once per day	27(39.7%)	41 (60.3%)	0.249
	Twice and more	11 (57.9%)	8 (42.1%)	
Mouthwash use	Mouth wash	13 (44.8%)	16 (55.2%)	1.0
	No mouth wash	25 (43.1%)	33 (56.9%)	
Brushing tool	Miswak@ and others	4 (57.1%)	3 (42.9%)	0.694
	Brush and toothpaste	34 (42.5%)	46 (57.5%)	
Leukaemia type	ALL	36 (45%)	44 (55%)	0.461
	AML	2 (28.6%)	5 (71.4%)	
Treatment level	Before/during chemotherapy	21 (35.6%)	38 (64.4%)	0.027**
	After chemotherapy	17 (60.7%)	11 (39.3%)	

A teeth cleaning twig made from the Salvadora persica tree.@
Chi square test performed ***p* value is sig\nificant.

be related to irregular brushing habits because of the difficulties the caregivers and the parents encountered when they brushed the children's teeth. It could also be due to lack of the essential manual dexterity of children with leukaemia, resulting in insufficient tooth brushing technique. Furthermore, the findings of this study reflected poor dental awareness, absence of dental education and deficiency in receiving oral hygiene instructions from dental staff [13–16].

Nearly, all children with leukaemia (93.1%) had never visited a dental health service in their life. This may be due to lack of awareness among their parents particularly since most of the mothers were illiterate. In accordance with this result, Gupta et al. [17] revealed that the majority of the Indian parents in their study (87%) had not taken their child to a dentist before [17].

In this population, the proportion of children with caries was found to be higher than that described previously among non-disabled 12-year-old Sudanese schoolchildren (24%) [18]. On the other hand, Awooda et al. [19] found a higher prevalence of dental caries in Sudanese preschool children (64.6%) compared to the current study (37.9%) [19].

The high prevalence of untreated dental caries in the current study (37.9%) highlights the need for dental involvement in the pre-treatment assessment of paediatric oncology patients. Because dental caries could lead to the spread of infection locally as well as systemically and could also lead to a compromise in the quality of the overall treatment of the systemic disease [20].

On dental examination, it was observed that there was a significant correlation between the dental caries index of the children and maintenance phases of treatment ($p < 0.05$). This may be due to poor oral hygiene and lack of dental services for children with leukaemia, which is consistent with findings reported by Sepet et al. [21] who assessed the presence of caries among children in the maintenance phase of chemotherapy related with healthy children, observing no correlation between the presence of caries and the use of chemotherapeutic drugs.

Oral mucositis is an often tender inflammation of the mucosa which occurs within 5 to 7 days after anticancer therapy depending on the grade

of tissue loss and aggression of pathogens. This change in the mucosa can progress to cell desquamation resulting in symptomatic ulceration, hindering speech power and alimentation [22].

In this study, a significant increase in oral mucositis cases was found to occur between the first and second phases of treatment as a side effect of chemotherapy; a finding similar to that described in other studies [13,15,16,23]. On the other hand, a study conducted in São Luis, Brazil reported findings different than those of this study, as few cases of mucositis occurred during anticancer treatment for leukaemia. This is likely due to the small sample size which included only 12 individuals [24].

In the present study, mild-to-moderate gingival inflammation was observed, while severe gingivitis and gingival enlargement were seen less frequently; a finding in contrast with the results obtained by Nasim et al. [25] where a significant deterioration of the gingiva was detected in patients undergoing chemo-radiation therapy. On gingival examination, it was observed that there was no significant difference between the gingival indices of children in different phases of treatment. In contrast, a study conducted by Al-Mashhadane [26] to evaluate the oral health status among children receiving chemotherapy showed that chemotherapeutic agents affected the patients' oral health and there was a significant increase in plaque and gingival indices.

We observed no significant difference in oral hygiene among the phases of treatment. This could be associated to the oral hygiene practice other than the effect of the chemotherapy treatment .In accordance to that. Pels and Mielnik-Błaszcza [27] reported that oral hygiene status was particularly better in children with ALL compared to children from the control group. In contrast, Dontasky et al. [28] found that the oral health status of hospitalized children diagnosed with leukaemia or other cancers is generally poor. In the present study, the majority of patients (40.2%) were aged between 2 and 6 years, similar to findings reported by other studies [15,23,29]. The studied group showed more males than females, with a ratio of 3:2. This might reflect the higher prevalence of leukaemia in males as reported in other studies [16,23].

Finally, power is directly related to effect size, sample size and significance level. An decrease in the power (less than 80%) due to low sample size (low flow in the centre) could reduce the numbers of significant results [30].

CONCCLUSIONS AND RECOMMENDATIONS

The oral health status of this study showed high prevalence of untreated dental caries (37.9%) and the majority (67.9%) of children had poor oral hygiene. Regarding the treatment levels of leukaemia, the severity of dental caries (DMFT) was found to be more significant in the maintenance phase, while oral mucositis was more significant in the induction phase.

Patients, parents and all health care workers involved in the treatment of leukaemia should be instructed about the oral problems and their prevention and management protocols. Health authorities also should provide adequate facilities for child dental care, including materials, instruments and specialised clinics. Finally, further study population of Sudanese children with leukaemia and controls should be planned to have insight into the dental problems of childhood leukaemia in Sudan.

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CONFLICTS OF INTEREST

None.

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None.

ETHICAL APPROVAL

Approval from Research Committee, Faculty of Dentistry, University of Khartoum was obtained prior to the conduction of the study. Ethics approval was also obtained from RICK. Written, informed consent was obtained from the child's caregiver.

REFERENCES

1. Dean JA, Avery DR, McDonald RE. Dentistry for the child and adolescent. Boston, MA: Mosby; 2011, pp 11–12.
2. Xavier AM, Hegde AM. Preventive protocols and oral management in childhood leukemia—the pediatric specialist's role. Asian Pac J Cancer Prev. 2010;11(1):39–43.
3. de Morais EF, da Silva Lira JA, de Paiva Macedo RA, Santos KSd, Elias CTV, de Arruda Morais MdLS. Oral manifestations resulting from chemotherapy in children with acute lymphoblastic leukemia. Braz J Otorhinolaryngol. 2014;80(1):78–85.
4. Saeed IE, Weng HY, Mohamed KH, Mohammed SI. Cancer incidence in Khartoum, Sudan: first results from the Cancer Registry, 2009–2010. Cancer Med. 2014;3(4):1075–84.
5. Hadley LG, Rouma BS, Saad-Eldin Y. Challenge of pediatric oncology in Africa. Semin Pediatr Surg. 2012;21(2):136–41.
6. Deliverska EG, Krasteva A. Oral signs of leukemia and dental management–literature data and case report. J IMAB Annual Proc Sci Papers 2013;19(4):388–91.
7. Menezes L, Rao JR. Acute myelomonocytic leukemia presenting with gingival enlargement as the only clinical manifestation. J Indian Soc Periodontol. 2012;16(4):597.
8. Chavan M, Subramaniam A, Jhaveri H, Khedkar S, Durkar S, Agrwal A. Acute myeloid leukemia: a case report with palatal and lingual gingival alterations. 2010;9(1):67–9.
9. Azher U, Shiggaon N. Oral health status of children with acute lymphoblastic leukemia undergoing chemotherapy. Indian J Dental Res. 2013;24(4):523.
10. Dentistry AAoP. Guideline on dental management of pediatric patients receiving chemotherapy, hematopoietic cell transplantation, and/or radiation. Pediatr Dent. 2013;35(5):E185.
11. Lovell DP, Omori T. Statistical issues in the use of the comet assay. Mutagenesis. 2008;23(3):171–82.
12. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics. 1977;33(1):159–74.
13. Azher U, Shiggaon N. Oral health status of children with acute lymphoblastic leukemia undergoing chemotherapy. Indian J Dent Res. 2013;24(4):523.
14. Pels E, Mielnik-Blaszczak M. Oral hygiene in children suffering from acute lymphoblastic leukemia living in rural and urban regions. Ann Agric Environ Med. 2012;19(3).
15. Atoof WM, Sabea DW, Hameed SM. Oral manifestation of leukemic children under chemotherapy. Kufa J Nurs Sci. 2015;4(2).
16. Mathur VP, Dhillon JK, Kalra G. Oral health in children with leukemia. Indian J Palliat Care. 2012;18(1):12–8.
17. Gupta A, Marwaha M, Bansal K, Sachdeva A, Gupta A. Dental awareness among parents and oral health of paediatric cancer patients receiving chemotherapy. 2016;10(5):92.
18. Nurelhuda NM. Aspects of dental caries in Sudanese Schoolchildren (Doctoral dissertation, University of Bergen Bergen, Norway 2011).
19. Awooda E, Saeed S, Elbasir E. Caries prevalence among 3-5 years old children in khartoum State-Sudan. Innov J Medical Health Sci. 2013;3(2).
20. Venkataraghavan K, Majithia U, Choudhary P, Trivedi K, Shah S. Relationship between oral health status and hematological values in pediatric leukemic patients: an evaluative survey. J Contemp Dent Pract. 2014;15(5):614.
21. Sepet E, Aytepe Z, Ozerkan AG, Yalman N, Guven Y, Anak S, et al. Acute lymphoblastic leukemia: dental health of children in maintenance therapy. J Clin Pediatr Dent. 1997;22(3):257–60.
22. Babu KLG, Mathew J, Doddamani GM, Narasimhaiah JK, Naik LRK. Oral health of children with acute lymphoblastic leukemia: a review. J Orofacial Sci. 2016;8(1):3.
23. Javed F, Utreja A, Bello Correa FO, Al-Askar M, Hudieb M, Qayyum F, et al. Oral health status in children with acute lymphoblastic leukemia. Crit Rev Oncol Hematol. 2012;83(3):303–9.
24. Ye Y, Carlsson G, Agholme MB, Karlsson-Sjöberg J, Yucel-Lindberg T, Pütsep K, et al. Pretherapeutic plasma pro-and anti-inflammatory mediators are related to high risk of oral mucositis in pediatric patients with acute leukemia: a prospective cohort study. PLoS One. 2013;8(5):e64918.
25. Nasim V, Shetty YR, Hegde A. Dental health status in children with acute lymphoblastic leukemia. J Clin Pediatr Dent. 2007;31(3):210–3.

26. Al-Mashhadane F. Oral health status among children receiving chemotherapy. Al-Rafidain Dent J. 2007;7:96–100.
27. Pels E, Mielnik-Błaszczak M. State of oral hygiene and levels of selected salivary parameters in children with acute lymphoblastic Leukemia. Pol J Environ Stud. 2007;16(2C):114–7.
28. Donatsky O, Ahlgren P, From Hansen P. Oral health status and treatment needs in long-term medicine patients in a Copenhagen hospital department. Commun Dent Oral Epidemiol. 1980;8(2):103–9.
29. Velten DB, Zandonade E, de Barros Miotto MHM. Prevalence of oral manifestations in children and adolescents with cancer submitted to chemotherapy. BMC Oral Health. 2016;16(1):107.
30. Lachin JM. Introduction to sample size determination and power analysis for clinical trials. Control Clin Trials. 1981;2(2):93–113.