

## Association between Sickle Cell Disease and Dental Caries among Sudanese Children

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### Abstract

**Background:** Sickle cell disease is an autosomal recessive hemoglobinopathy predominant among Afro-descendants, and has been categorized as a public health issue as it affects a significant percentage of the world's population. The aim of this study is to determine the association of dental caries among Sudanese sickle cell disease children in relation to healthy controls children.

**Methods:** dmft and DMFT were recorded for 212 sickle cell disease children aged 3-15 years old, matched with 212 control healthy children in Khartoum, Sudan. Statistical analysis was done using statistical software SPSS 17.5 version. Chi square test was used for the comparison of study and control groups, the level of significance was set at  $p < 0.05$ . The relative risk was estimated.

**Results:** dmft was significant among age group 4-6 and 7-11 years old while DMFT was only significant among group 12-14 years old sickle cell disease. There is highly significant association exists in dmft and DMF. Sickle cell disease group is 1.115 likely to have present component in dmft when compared to control group and 1.82 likely to have present component of DMFT when compared to control group.

**Conclusion:** Sudanese sickle cell disease children had high prevalence of dental caries than the healthy children. Establishment of frequent dental examination schedule for sickle cell disease children, including preventive dental care and promoting oral hygiene practices with toothbrushes, toothpaste, and mouthwash are recommended.

**Keywords:** Sickle cell disease; Dental caries; Control children; DMFT; dmft

### Introduction

Sickle Cell Disease is defined as hereditary autosomal recessive blood disorder characterized by hemoglobin gene mutation caused by amino acid substitution in the gene coding valine is encoded instead of glutamic acid, so that the amino acid results in the production of hemoglobin S rather than hemoglobin A [1,2].

Two types of sickle cell disease were recognized; homozygous and heterozygous. Homozygous have S-type haemoglobin (Hb-SS), and sickle-cell disease develops as a result. Heterozygous (Hb-SA) have a sickle cell trait with 40% of S-type haemoglobin (Hb-SS) and the remaining is normal (Hb-AA), which is a mild characteristics disease [1,3-6].

In Sudan, sickle cell disease is following natural extension of West African sub-Saharan belt. The majority of patients clustered in western Sudan (Kordofan and Darfur). The most prevalent variant among the African population is the HbSS variant, which happens to be the most prevalent form among the Sudanese population too [3-5].

Dental carries is a worldwide main issue and it considered a common disease affecting people [6]. Caulfield in 2005 defined the dental caries as an infectious and transmissible disease, caused by bacterial colonization of the tooth surfaces [7].

Dental caries is currently conceptualized as a multi-factorial disease involving the known biological factors and social modifying factors, although there is growing evidence that genetics contributes to caries [8,9].

### Research Hypothesis

Null hypothesis; there is no association between sickle cell disease

and dental caries among Sudanese children.

### Methodology

This is a retrospective cohort study, as sickle cell disease is genetic disease thus the exposure occurs at birth. A total of 212 children with confirmed diagnosis of sickle cell disease (HbSS genotype) 4-14 years old attended Jaafer Ibn Oaf hospital in Khartoum was selected through simple randomization, matched to randomly selected kindergarten and primary school children selected through multistage sampling, applied on the basis of birth date and gender.

Age stratification was done, according to the WHO [10] into three age groups; age group one, children 4-6 years old. Second age group, children 7-11 years old and third age group 12-14 years old children.

Approval from research Committee, University of Khartoum, Faculty of Dentistry was obtained prior to the conduction of the study. Clinical calibration of the investigator in the clinical examination was carried out in 20 cases. All Kappa values were considered acceptable according to the qualitative classification of kappa values as degree of agreement [11,12].

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All the clinical examination of the study group and control group were carried out in Jaafer Ibn Oaf hospital and schools respectively at the doctors or teachers offices under artificial light, while the child sitting in up-right position in front of the examiner, and the examination of dental caries was conducted using plane dental mirror and probe.

The dmft and DMFT scores for each child were the sum of the decayed, missed and filled teeth.

Teeth extracted for orthodontic reasons, congenitally absent, un-erupted or lost as result of trauma was not included according to the WHO guidelines for oral health survey [13]. The examination proceeded in orderly manner from one tooth to the adjacent tooth or tooth space, the caries was recorded as present when a lesion in a pit or fissure, or on a smooth tooth surface, has an unmistakable cavity, undermined enamel, or a detectably softened floor or wall. A tooth with a temporary filling, or one which is sealed but also decayed, should also be included in this category.

The CPI probe was used to confirm visual evidence of caries on the tooth surface. Where any doubt exists, caries should not be recorded as present.

### Statistical Analysis

Data was collected, summarized, coded and entered the Statistical Package for Social Science (SPSS) program (version 20), and the 95% confidence interval (CI) for malocclusion was estimated and compared using Chi-square test. A level of significance of 5% was adopted to reject the null hypothesis. The association between sickle cell disease and dental caries estimated by the adjusted relative risk (RR) and respective 95% CI were calculated.

### Results

The total number of children with confirmed diagnosis of sickle cell disease (HbSS genotype) and control group was 424 (212 each group) (Tables 1 and 2).

In Table 3 it obvious that the sickle cell disease group had higher mean dmft and DMFT than control group (2.3 vs. 0.7 for DMFT, 3.3 vs. 1.8 for dmft). The caries significant index was found to be 6.6 for DMFT and 4 for dmft among sickle cell disease children, whereas only 3.4 for DMFT and 1.6 for dmft among control group (Table 3).

The dmft was significant among age group 4-6 and 7-11 years-old while DMFT was only significant among group 12-14 years-old sickle cell disease. There is highly significant association exists in dmft and DMF. Sickle cell disease group is 1.115 likely to have present component in dmft when compared to control group and 1.82 likely to have present component of DMFT when compared to control group (Table 4).

	4-6 years	7-11 years	12-14 years	Total
<b>Boys</b>	88	76	62	226
	38.9%	33.6%	27.4%	100.0%
<b>Girls</b>	64	56	78	198
	32.3%	28.2%	39.4%	100.0%
<b>Total</b>	152	132	140	424
	35.8%	31.1%	33.0%	100.0%

Table 1: Distribution of the gender in the two study group according to age.

		4-6 years	7-11 years	12-14 years	Total
<b>SCD group</b>	<b>Boys</b>	44	38	31	113
		38.9%	33.6%	27.4%	100.0%
	<b>Girls</b>	32	28	39	99
		32.3%	28.3%	39.4%	100.0%
	<b>Total</b>	76	66	70	212
		35.8%	31.1%	33.0%	100.0%
<b>Control group</b>	<b>Boys</b>	44	38	31	113
		39.8%	32.7%	27.4%	100.0%
	<b>Girls</b>	32	28	39	99
		31.3%	29.3%	39.4%	100.0%
	<b>Total</b>	76	66	70	212
		35.8%	31.1%	33.0%	100.0%

Table 2: Distribution of the sickle cell and control groups according to gender.

Caries Index	Sickle cell Group		Control Group		P-Value	Relative risk
	Boys	Girls	Boys	Girls		
<b>dmft</b>	3.6 (±2.8)	2.90(±3.1)	1.9 (±1.9)	1.7 (±1.9)	0.001*	1.115
<b>Total</b>	3.3 (±2.97)		1.8 (±1.89)			
<b>DMFT</b>	2.6 (±2.4)	2.2(±2.1)	0.4 (±0.79)	1.4 (±1)	0.001*	1.82
<b>Total</b>	2.3 (±2.2)		0.7 (±0.9)			

\*P-Value was significant at ≥ 0.05

Table 3: The mean dmft and DMFT among sickle cell group and control group.

		Group	Mean	SD	P-Value
<b>4-6 years</b>	dmft	Sickle cell group	3.53	3.45	0.001**
		Control group	1.35	1.68	
<b>7-11 Years</b>	dmft	Sickle cell group	3.58	2.65	0.025**
		Control group	2.5	2.02	
	DMFT	Sickle cell group	1.72	1.78	0.772
		Control group	1.57	0.79	
<b>12-14 Years</b>	DMFT	Sickle cell group	2.87	2.32	0.001**
		Control group	0.45	0.87	

SD- standard deviation

\*\*P-Value was significant at ≥ 0

Table 4: dmft and DMFT according to the age group among sickle cell and control group.

### Discussion

The null hypothesis of this research was rejected, children with sickle cell disease showed remarkable findings in dental caries, in addition there was a higher risk of developing dental caries than individuals without the disease. Although the findings of the mixed dentition stage do not have precedents in the literature [14].

The present study was carried out at Jaafer Ibn Ouf Hospital; one of the third pediatric governmental hospital in Khartoum, Sudan. The hospital welcome all referred cases throughout the country from different ethnic background and socioeconomic status. To our knowledge, the current study was the first attempt in Sudan to investigate the prevalence of dental caries among sickle cell disease children. We emphasize that the sickle cell disease children belonged only to Jaafer Ibn Ouf Hospital, may not be representative of all sickle cell disease children in Sudan.

The results were interpreted with caution as a result of the difference in terms of the methodology used, the variety of existing indices, age group, and lack of consensus regarding the optimal measuring instrument and sample size.

World Health Organization declared dental caries indices for tooth (DMFT, dmft) and surface levels (DMFS, dmfs) for oral health survey, the dmft and DMFT were used for the participants in the current study [10].

In this study, age group 4-6 years and 7-11 years-old children with sickle cell disease reported high dmft than the control group, and the result was statistical significant. Similarly, high dmft (2.12) was reported among sickle cell disease [15-18] children in relation to socioeconomic factors in study conducted by Luna et al. in Brazil 2012 [15].

In contrast, De Matos [16] reported low dmft among sickle cell disease group than the control group (2.13), as well no significant difference was found. Low dmft (0.21) was reported by Fukuda [17] in USA among sickle cell disease population. This explained by the fact that, both studies conducted in sickle cell disease children under long-term penicillin prophylactic therapy.

DMFT of the age group 7-11 years old was 1.7 among the sickle cell disease group and the results was statistically insignificant. The results were in contrast to studies conducted by Luna and Singh [15,18] as they reported higher DMFT among sickle cell disease population. Moreover, De Matos et al. and Fukuda [16,17] reported low DMFT among sickle cell disease group under long term antibiotics than the control group and no significant difference was found.

In the current study, the DMFT of the age group 11-14 years-old was high among the sickle cell children 2.3 and the result was statistical significant. Which in lines with the studies conducted by Luna and Singh [15,18] among the sickle cell disease group, where high DMFT reported 6.59 and 1.50 respectively and the result was statistically significant.

A high level of dental caries among sickle cell disease population had been reported in previous studies [15,18]. This finding may be explained by prolonged use of sweetened drugs and consumption of carbohydrate rich foods, as well as the patients were more anxious with their main life threatening problem neglect basic preventive dental care [15,18].

In contrast, Laurence [19] in USA found no statistically significant difference in the prevalence of dental caries among sickle cell disease group determined by DMFS index. In addition, no statistical significant difference in the mean DMFT index between patients with sickle cell disease and control subjects had been reported by Passos et al. and Al-Alawi [20,21] among different population.

Difference in the results of caries index among sickle cell disease population may be attributed to the variation in terms of the methodology used and lack of agreement of caries indices used, Thus comparison may not be applicable with the studies all the time.

A decreased level of dental caries among sickle cell disease children was reported by Okafor [22] the results were explained by widespread avoidance of sweets by most Nigerian sickle cell disease patients. Also, Fukuda [17] reported a statistical significant reduction in the caries prevalence among sickle cell disease children under long term antibiotic prophylaxis in USA. The results were attributed to reduction in the *Streptococcus mutans* level associated with antibiotics, but this reduction had temporal effect during active drug use.

In the control group, the dmft of was 1.8, this was lower than that reported by De Matos [16] among control group, the mean dmft was 2.38. The mean DMFT of the control group was in the line with study conducted by Nurelhuda [23] among Sudanese 12 years old children, which was found to be 0.42. De Ma-tos [16] reported mean DMFT as 1.3 among the control group. A higher prevalence of DMFT in control group was reported by Singh et al. and Al-Alawi as 3.51 and 6.97 respectively [18,21].

The low caries index in the current study may be as a result of improved oral hygiene and dietary habits. Conversely, it may have been underestimated in the field due to the use of natural day-light for examining the DMFT index [10].

### Limitation of the Study

No previous research on oral manifestation of sickle cell disease has been done in Sudan. Studies with retrospective designs are limited in respect to the data that can be collected.

The number of children enrolled in the study was small and taken from only Jaa-fer Ibn Ouf Hospital in Khartoum.

Blood investigations should be done for the control group to ensure all of them are free of the disease and not relying on the family history alone.

### Conclusion

High prevalence of dental caries in children and adolescents with Sickle cell disease was noted in this study.

Sickle cell disease children are more susceptible to dental caries compared to normal population in Sudan, with higher prevalence in the permanent dentition.

### Competing Interest

The authors declare that they have no competing interests.

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