



ORIGINAL ARTICLE

The association between dental and periodontal diseases and sickle cell disease. A pilot case-control study



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KEYWORDS

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Abstract Objective: This is a pilot case-control study conducted to investigate the prevalence of dental caries and periodontal disease and examine the possible association between oral health deterioration and SCD severity in a sample of Saudi SCD patients residing in the city of Al-Qatif, Eastern Province, Saudi Arabia.

Materials and methods: Dental examination to determine the Decayed, Missing and Filled Teeth index (DMFT), Community Periodontal Index (CPI), and plaque index system were recorded for 33 SCD patients and 33 age and sex-matched controls in the Al-Qatif Central Hospital, Qatif, Saudi Arabia. Self-administered surveys used to assess socio-economic status; oral health behaviors for both SCD patients and controls were recorded. In addition, the disease severity index was established for all patients with SCD. SPSS data analysis software package version 18.0 was used for statistical analysis. Numerical variables were described as mean with a standard deviation.

Results: Decayed teeth were significantly more in individuals with ages ranging from 18 to 38 years with SCD compared to the control group ($p = 0.036$) due to oral hygiene negligence. The mean number of filled teeth was significantly lower in individuals with SCD when compared to the control group ($p = 0.015$) due to the lack of appropriate and timely treatment reflected in the survey responses of SCD patients as 15.2% only taking oral care during hospitalization. There were differences between the cases and controls in the known caries risk factors such as income level, flossing, and brushing habit. The DMFT, CPI, and plaque index systems did not differ significantly between the SCD patients and the control group.

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Conclusion: Data suggest that patients with SCD have increased susceptibility to dental caries, with a higher prevalence of tooth decay and lower prevalence of filled teeth. Known caries risk factors influenced oral health more markedly than did factors related to SCD.

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1. Introduction

Sickle cell disease (SCD) is a common inherited disease characterized by morphologic changes in erythrocytes, caused by abnormal hemoglobin polymerization. SCD has spread worldwide and has been described in the United States (Creary et al., 2007), Africa, and the Middle East (Makani et al., 2007). The Eastern Province of Saudi Arabia is known to have one of the highest prevalence rates of SCD worldwide (Alhamdan et al., 2007; Nasserullah et al., 2003). Signs and symptoms of systemic involvement and SCD severity differ among patients. A main feature of SCD is vaso-occlusive crisis of the microcirculation, which leads to limited blood supply to tissues and tissue necrosis (Steinberg, 1998). Patients with SCD usually report subjective pain in the form of acute pain crisis, which is considered to be one of the earliest clinical manifestations of this disease (Serjeant 1993). Bone marrow hyperplasia and osteomyelitis of the jaw are general manifestations of SCD (Javed et al., 2013). Numerous oral manifestations of SCD that affect the oral mucosa, gingival tissue, mandible, nerve supply, and tooth enamel and pulp have been reported (Andrews et al., 1983; Bishop et al., 1995; Borle et al., 2001; Demirbas Kaya et al., 2004; Kelleher et al., 1996; Okafor et al., 1986; Patton et al., 1990; Ramakrishna, 2007; Scipio et al., 2001; Singh et al., 2013; Taylor et al., 1995).

Few studies have examined the relationship between SCD and oral health, and results have been contradictory (Arowojolu, 1999; Arowojolu and Savage, 1997; Crawford, 1988; Fukuda et al., 2005; Laurence et al., 2002, 2006; Okafor et al., 1986; Sanger and Bystrom, 1977). Thus, this study was conducted to investigate the prevalence of dental caries and periodontal disease and examine the possible association between oral health deterioration and SCD severity in a sample of Saudi patients with SCD residing in the city of Al-Qatif, Eastern Province, Saudi Arabia.

2. Materials and methods

2.1. Study design and subjects

This prospective case-control study included 66 Saudi men (33 patients with SCD attending Al-Qatif Central Hospital and 33 apparently healthy male individuals selected from the general population). The two groups had similar socioeconomic backgrounds and were age matched. The Ethics Committee of the College of Dentistry, University of Dammam, approved the study and all subjects provided written informed consent.

2.2. Inclusion and exclusion criteria

Candidates were selected according to the following criteria: Saudi man aged ≥ 18 years, clinical diagnosis of SCD, and

(for the control group) a healthy individual attending a dental clinic for routine examination. Patients with any other systemic diseases, such as hypertension or epilepsy, were excluded from the study.

2.3. Dental examination

A single examiner performed oral examinations that included assessment of dental caries and periodontal status at patients' bedsides for the case group at the Center of Inherited Blood Diseases or the Internal Medicine Department of the Al-Qatif Central Hospital and examination of the control group in outpatient dental clinics in the hospital. All dental examinations were standardized according to the World Health Organization (WHO) standardized index and the decayed, missing, and filled teeth (DMFT) index (Klien and Knutson, 1938), including the use of mouth mirrors, explorers, periodontal probes, and a portable dental LED light.

Teeth that were missing for any reason other than dental caries, according to subjects' self-reports were excluded. Gingival bleeding, calculus, and periodontal pocket depth were measured with a Williams periodontal probe according to the community periodontal index (CPI) (WHO, 1982). Ten index teeth (#11, #16, #17, #26, #27, #31, #36, #37, #46, and #47) were probed at six sites (mesiobuccal, mid-buccal, distobuccal, and corresponding lingual sites) each, and the highest score was recorded for each sextant. Possible CPI scores were: 0 (healthy), 1 (bleeding after probing, observed directly or by mouth mirror), 2 (calculus detected during probing, but the entire black band of the probe remained visible), 3 (4–5-mm periodontal pocket depth), and 4 (≥ 6 -mm periodontal pocket depth).

The Silness–Løe plaque index (Silness and Loe, 1964) was also used to measure oral hygiene status. Dental plaque was recorded for all surfaces of teeth #12, #16, #24, #32, #36, and #44 using a scale ranging from 0 to 3: 0 = no plaque; 1 = film of plaque adhering to the free gingival margin and adjacent area of the tooth, observed in situ only after application of disclosing solution or by using a probe on the tooth surface; 2 = moderate accumulation of soft deposits within the gingival pocket or tooth and gingival margin, visible with the naked eye; and 3 = abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin. The plaque index was calculated by averaging scores from four surfaces of each tooth.

2.4. Self-administered survey

Patients in both groups were asked to complete a self-administered survey developed specifically for this study. The survey was pilot tested and consisted of 15 questions for cases and control individuals and 6 questions specific for SCD patients. The survey solicited demographic information, such as age, sex, education level, income, and marital status. It assessed

oral health behavior, including annual dental visits, tooth brushing frequency, dental floss use, and history of smoking. Respondents' level of awareness of dental hygiene was also assessed. Patients with SCD were also asked to provide information about disease severity based on the frequency of vaso-occlusive crisis, number of annual hospitalizations due to SCD, and average duration of hospitalization. These patients reported pain levels using the following scale: 0 (no pain), 1 (mild; sub-scaled as 1–3), 2 (moderate; sub-scaled as 4–6), and 3 (severe; sub-scaled as 7–10) (McCaffery, 1999).

2.5. Statistical analysis

IBM SPSS (Statistical Package for the Social Sciences) software SPSS Inc (version 18.00) was used for statistical analysis. Chi-square test was used and numerical variables were described as mean and standard deviations.

3. Results

The mean ages of patients with SCD and control subjects were 24.52 SD \pm 4.611 and 24.58 SD \pm 6.124 years (range 18–38), respectively. The level of education was high school or higher for 84.38% of the control group and 90.91% of the SCD cases. Patients with SCD were hospitalized a mean of 4.36 (range, 1–12) times per year. The mean duration of hospitalization was 5.91 (range, 1–14) days. The average pain level of patients with SCD was 7 (range, 5–10).

Table 1 shows mean DMFT, CPI, and plaque index values. The mean numbers of decayed and filled teeth differed significantly between groups ($p < 0.05$) due to the lack of appropriate and timely treatment reflected in the survey responses of SCD patients with 15.2% only of them taking oral care during hospitalization. No difference in the mean number of missing teeth, DMFT index, CPI, or plaque index was observed (Fig. 1).

There were differences between the cases and controls in the known caries risk factors such as income level, flossing, and brushing habit. Most patients with SCD were aware of the effects of the disease on their oral health (92%) and brushed their teeth in normal daily life (84.80%) compared to 90.91% of the control group. When hospitalized, however, most (84.80%) of these patients took no oral hygiene measure. The majority (87.88%) of patients with SCD visited the dentist only when they felt pain (Fig. 2).

4. Discussion

Patients with SCD are known to suffer more frequently from bone deformities in comparison with the general population (Sanger and Bystrom, 1977). However, studies of oral health deterioration in these patients have produced contradictory results (Okafor et al., 1986; Passos et al., 2012). For this

Table 1 DMFT, CPI, and plaque index mean values for SCD patients and controls.

Variable	Cases (SD)	Control (SD)	<i>p</i> -Value
Decayed teeth	5.30 (3.861)	3.33 (3.594)	0.036*
Missing teeth	0.85 (0.972)	0.67 (1.080)	0.475
Filled teeth	1.70 (1.403)	2.97 (2.568)	0.015*
Total DMFT	7.85 (4.071)	6.97 (3.729)	0.364
CPI	0.8461 (0.55656)	0.9394 (0.57333)	0.89
Plaque index	0.9103 (0.44085)	0.9755 (0.59946)	0.94

SD = standard deviation.

* *p*-Value < 0.05.

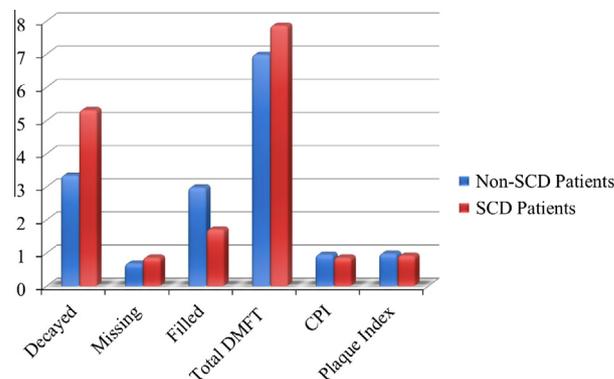


Figure 1 Bar chart showing the DMFT, CPI, and plaque index means values for cases and controls.

reason, we investigated the prevalence of oral health deterioration in subjects with SCD and control subjects in an area of high SCD prevalence (the Al-Qatif and Al-Ahssa oases, Eastern Province, Saudi Arabia). SCD has tremendous socio-economic impacts and depletes available health care resources in this region.

Although we found no significant difference in mean DMFT index between patients with SCD and control subjects, the prevalence of decayed and filled teeth differed significantly between groups. Tooth decay was more prevalent and the number of filled teeth was lower among patients with SCD than among healthy control subjects. These findings are in line with those of studies conducted in populations of low-income African Americans and Brazilians with SCD (Laurence et al., 2006; Passos et al., 2012). A study conducted in India found that oral health was not a primary concern of patients with SCD (Singh et al., 2013). Oral health problems in patients with SCD are rare and occur mainly as a result of poor oral hygiene maintenance (Javed et al., 2013). The small number of filled teeth in patients with SCD in this study is due to the lack of appropriate and timely treatment as the questionnaire revealed with 63.64% of SCD patients visiting the dentist when they have pain. This assumption was supported by survey responses revealing that 92% of patients with SCD were aware of the high risk of tooth decay, but did not take timely and appropriate action due to frequent hospitalization and vaso-occlusive crises, which deterred them from seeking regular dental consultations.

We would like to emphasize that some of the drawbacks encountered while conducting this study were due to the lack of research on the oral health of patients with SCD in this

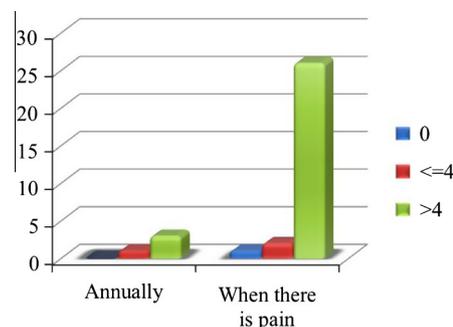


Figure 2 SCD patient's visits to the dentist in relation to the number of decayed teeth.

region. In addition, we believe that a study with a larger sample including sickle cell gene carriers should be conducted. Patients with severe SCD symptoms were reluctant to participate in the study. Finally, the small number of subjects limited the ability to perform stratified analysis. Future studies should seek to reproduce these findings using larger samples.

5. Conclusion

Our results suggest that patients with SCD are more susceptible to dental caries compared to general population in this community, with a higher prevalence of tooth decay and lower prevalence of filled teeth. Known caries risk factors influenced oral health more markedly than did factors related to SCD.

6. Recommendations

We recommend the establishment of a more frequent dental examination schedule for all individuals. Hospitals can promote oral hygiene practices by providing these hospitalized SCD patients with products such as appropriate toothbrushes, toothpaste, and mouthwash.

Conflict of interest

No conflict of interest.

References

- Alhamdan, N.A., Almazrou, Y.Y., Alswaidi, F.M., Choudhry, A.J., 2007. Premarital screening for thalassemia and sickle cell disease in Saudi Arabia. *Genet. Med.* 9, 372–377.
- Andrews, C.H., England, M.C., Kemp Jr., W.B., 1983. Sickle cell anemia: an etiological factor in pulpal necrosis. *J. Endod.* 9, 249–252.
- Arowojolu, M.O., 1999. Periodontal probing depths of adolescent sickle cell anaemic (SCA) Nigerians. *J. Periodontol.* 34, 62–64.
- Arowojolu, M.O., Savage, K.O., 1997. Alveolar bone patterns in sickle cell anemia and non-sickle cell anemia adolescent Nigerians: a comparative study. *J. Periodontol.* 68, 225–228.
- Bishop, K., Briggs, P., Kelleher, M., 1995. Sickle cell disease: a diagnostic dilemma. *Int. Endod. J.* 28, 297–302.
- Borle, R.M., Prasant, M.C., Badjate, S.J., Patel, I.A., 2001. Sickle cell osteomyelitis of the maxilla: a case report. *J. Oral Maxillofac. Surg.* 59, 1371–1373.
- Crawford, J.M., 1988. Periodontal disease in sickle cell disease subjects. *J. Periodontol.* 59, 164–169.
- Creary, M., Williamson, D., Kulkarni, R., 2007. Sickle cell disease: current activities, public health implications, and future directions. *J. Womens Health (Larchmt)* 16, 575–582.
- Demirbas Kaya, A., Aktener, B.O., Unsal, C., 2004. Pulpal necrosis with sickle cell anaemia. *Int. Endod. J.* 37, 602–606.
- Fukuda, J.T., Sonis, A.L., Platt, O.S., Kurth, S., 2005. Acquisition of mutans streptococci and caries prevalence in pediatric sickle cell anemia patients receiving long-term antibiotic therapy. *Pediatr. Dent.* 27, 186–190.
- Javed, F., Correa, F.O., Nooh, N., Almas, K., Romanos, G.E., Al-Hezaimi, K., 2013. Orofacial manifestations in patients with sickle cell disease. *Am. J. Med. Sci.* 345, 234–237.
- Kelleher, M., Bishop, K., Briggs, P., 1996. Oral complications associated with sickle cell anemia: a review and case report. *Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod.* 82, 225–228.
- Klien, H.P.C., Knutson, J.W., 1938. Studies on dental caries: I. Dental status and dental needs of elementary school children. *Public Health Rep.* 53, 65.
- Laurence, B., George, D., Woods, D., Shosanya, A., Katz, R.V., Lanzkron, S., Diener-West, M., Powe, N., 2006. The association between sickle cell disease and dental caries in African Americans. *Spec. Care Dentist.* 26, 95–100.
- Laurence, B., Reid, B.C., Katz, R.V., 2002. Sickle cell anemia and dental caries: a literature review and pilot study. *Spec. Care Dentist.* 22, 70–74.
- Makani, J., Williams, T.N., Marsh, K., 2007. Sickle cell disease in Africa: burden and research priorities. *Ann. Trop. Med. Parasitol.* 101, 3–14.
- Mccaffery, M.P.C., 1999. *Pain Clinical Manual*. 16.
- Nasserullah, Z., Alshammari, A., Abbas, M.A., Abu-Khamseen, Y., Qadri, M., Jafer, S.A., Wabel, M.A., 2003. Regional experience with newborn screening for sickle cell disease, other hemoglobinopathies and G6PD deficiency. *Ann. Saudi Med.* 23, 354–357.
- Okafor, L.A., Nonnoo, D.C., Ojehanon, P.I., Aikhionbare, O., 1986. Oral and dental complications of sickle cell disease in Nigerians. *Angiology* 37, 672–675.
- Passos, C.P., Santos, P.R., Aguiar, M.C., Cangussu, M.C., Toralles, M.B., da Silva, M.C., Nascimento, R.J., Campos, M.I., 2012. Sickle cell disease does not predispose to caries or periodontal disease. *Spec. Care Dentist.* 32, 55–60.
- Patton, L.L., Brahim, J.S., Travis, W.D., 1990. Mandibular osteomyelitis in a patient with sickle cell anemia: report of case. *J. Am. Dent. Assoc.* 121, 602–604.
- Ramakrishna, Y., 2007. Dental considerations in the management of children suffering from sickle cell disease: a case report. *J. Indian Soc. Pedod. Prev. Dent.* 25, 140–143.
- Sanger, R.G., Bystrom, E.B., 1977. Radiographic bone changes in sickle cell anemia. *J. Oral Med.* 32, 32–37.
- Scipio, J.E., Al-Bayaty, H.F., Murti, P.R., Matthews, R., 2001. Facial swelling and gingival enlargement in a patient with sickle cell disease. *Oral Dis.* 7, 306–309.
- Serjeant, G.R., 1993. The clinical features of sickle cell disease. *Baillieres Clin. Haematol.* 6, 93–115.
- Silness, J., Loe, H., 1964. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. *Acta Odontol. Scand.* 22, 121–135.
- Singh, J., Singh, N., Kumar, A., Kedia, N.B., Agarwal, A., 2013. Dental and periodontal health status of Beta thalassemia major and sickle cell anemic patients: a comparative study. *J. Int. Oral Health* 5, 53–58.
- Steinberg, M.H., 1998. Pathophysiology of sickle cell disease. *Baillieres Clin. Haematol.* 11, 163–184.
- Taylor, L.B., Nowak, A.J., Giller, R.H., Casamassimo, P.S., 1995. Sickle cell anemia: a review of the dental concerns and a retrospective study of dental and bony changes. *Spec. Care Dentist.* 15, 38–42.
- WHO, 1982. Community Periodontal Index (CPI) [Online]. WHO. Available: http://www.who.int/oral_health/databases/niigata/en/.