Determinants of Gingivitis in Children Aged 6–12 Years with Thalassemia: A Mixed-Method Cross-Sectional Study

Tran Thi My Hanh[1], Ha Ngoc Chieu[1]*, Vu Duc Binh[2], Le Thi Thuy Linh[1], Tran Nhat Yen[3], Nguyen Manh Cuong[4], Truong Manh Nguyen[1], Dao Thi Hang Nga[1], Luu Van Tuong[5], Nguyen Dinh Phuc[6], Pham Thi Hanh Quyen[1], Nguyen Hoang Thanh[7]

1. School of Dentistry, Hanoi Medical University, Hanoi, Vietnam.
2. National Institute of Hematology and Blood Transfusion (NIHBT), Hanoi, Vietnam.
3. Thanh Hoa Pediatric Hospital. Thanh Hoa, Vietnam.
4. Da Nang University of Medical Technology and Pharmacy.
5. VNU University of Medicine and Pharmacy, Vietnam National University, Hanoi, Vietnam.
6. DongDa General Hospital, Hanoi, Vietnam.
7. School of Preventive Medicine and Public Health, Hanoi Medical University, Hanoi, Vietnam.

Abstract

Gingivitis is a prevalent oral condition among children with thalassemia, influenced by both systemic complications and behavioral factors. Despite its clinical relevance, gingivitis remains underexplored in pediatric thalassemia care in Vietnam. To assess the prevalence of gingivitis and identify associated clinical, behavioral, and socioeconomic factors among children with thalassemia aged 6–12 years in Hanoi, Vietnam.

This mixed-method cross-sectional study was conducted between September 2022 and May 2023 at the National Institute of Hematology and Blood Transfusion. A total of 260 children (130 with thalassemia and 130 healthy controls) were enrolled. Data collection included structured questionnaires, clinical oral examinations using the Gingival Index, and in-depth interviews with five parents of children with thalassemia. Quantitative data were analyzed using logistic regression, and qualitative data were analyzed thematically.

The prevalence of gingivitis was significantly higher in the thalassemia group (91.5%) than in controls (77.7%) (OR = 3.11; 95% CI: 1.48–6.53). Older age (9–12 years) was significantly associated with increased risk (OR = 6.43; 95% CI: 1.33–31.05). No significant associations were found for gender, knowledge, attitude, or oral care behavior. Qualitative findings revealed barriers such as oral discomfort, parental time constraints, lack of dental education, and limited access to appropriate oral health services.

Gingivitis is highly prevalent among Vietnamese children with thalassemia and is driven by both biological and systemic care challenges. Integrating oral health into routine thalassemia management is essential to improve outcomes in this population.

Clinical article (J Int Dent Med Res 2025; 18(2): 676-684)

Keywords: Gingivitis; children, Thalassemia.

Received date: 22 April 2025 **Accept date:** 12 May 2025

Introduction

Gingivitis is a common and reversible inflammatory condition of the gingival tissues, characterized by redness, swelling, and bleeding during brushing or probing. Among school-aged children worldwide, the prevalence of gingivitis varies widely depending on geographic, socioeconomic, and health-related factors [1-3]. Studies have reported particularly high prevalence rates among medically vulnerable populations, such as children with thalassemia. For example, a study in Baghdad, Iraq, found that 86% of children with β-thalassemia major exhibited gingivitis, with poor oral hygiene and dental plaque being the most significant contributors [4]. Multiple factors contribute to the development of gingivitis in children with thalassemia. Poor oral hygiene remains one of the most significant contributors, as inadequate toothbrushing and infrequent dental visits lead to

Corresponding author:
Ha Ngoc Chieu, M.D., Ph.D.
School of Dentistry, Hanoi Medical University, Hanoi, Vietnam
E-mail: hangocchieu@outlook.com; hangocchieu@gmail.com

plaque accumulation and gingival inflammation [4,5]. Moreover, iron overload resulting from frequent blood transfusions can alter salivary composition and encourage the growth of pathogenic oral bacteria, further increasing gingival vulnerability [6]. Dental plaque and calculus act as local irritants that exacerbate inflammatory responses in the gingiva, and thalassemia patients often exhibit higher indices of both compared to their healthy peers [7].

Beyond its high prevalence, gingivitis in children with thalassemia is influenced by a complex interplay of systemic and local factors. Poor oral hygiene is the most consistent and well-documented risk factor, often exacerbated by inadequate toothbrushing habits and infrequent dental visits [4,5]. Repeated blood transfusions—a mainstay in the management of thalassemia—lead to iron overload, which can accumulate in the salivary glands and promote bacterial colonization and gingival inflammation [6]. Additionally, dental plaque and calculus act as local irritants, contributing to the progression of gingival disease, particularly in individuals with compromised oral hygiene.

Systemic immune dysfunction further complicates oral health in children with thalassemia. Studies have shown that thalassemia is associated with neutrophil dysfunction, impairing the body's ability to mount an effective immune response to oral pathogens [8]. This makes children with thalassemia more susceptible to bacterial infections in the gingiva, increasing the likelihood of inflammation and tissue damage. Other contributing factors include socioeconomic status, parental education, and access to dental care—all of which influence oral health behaviors and outcomes[9].

In addition, mouth breathing and malocclusion, which are more common in thalassemia patients due to craniofacial abnormalities, can further promote plaque retention and increase the risk of gingivitis[10].

In Vietnam, thalassemia represents a growing public health burden, affecting a significant proportion of the population. According to recent estimates, approximately 13.8% of the Vietnamese population are carriers of thalassemia or other hemoglobinopathies [11,12]. These genetic disorders are distributed across all 54 ethnic groups in the country, with particularly high carrier rates observed in the Northern Highland and Southern Middle regions. The frequency of α0- and β0-thalassemia is notably elevated among ethnic minorities in the north, while α+-thalassemia and Hb E mutations are more prevalent in the central and southern regions. Carrier prevalence ranges dramatically—from 0.23% in the La Hu ethnic group to 88.6% in the Raglai population—highlighting the uneven geographic and ethnic distribution of disease risk [11]. Despite national efforts to reduce the birth of affected children through prenatal and neonatal screening programs, most diagnosed patients continue to rely on lifelong supportive therapies such as regular blood transfusions and iron chelation. Curative options like hematopoietic stem cell transplantation are available but remain inaccessible to the majority [13,14]. However, while hematologic aspects of thalassemia have received national attention, oral health—particularly conditions like gingivitis—has not been adequately integrated into existing care models. Given the systemic implications of both the disease and its treatment, addressing oral health needs in this population is essential to improving their overall quality of life and clinical outcomes [15,16].

This study aims to investigate the factors associated with gingivitis in children aged 6–12 years diagnosed with thalassemia at the National Institute of Hematology and Blood Transfusion in Hanoi, Vietnam. By comparing this group to healthy children of the same age range, the study seeks to identify significant behavioral, clinical, and demographic determinants of gingivitis. The findings are expected to contribute to the development of comprehensive care models that include oral health as a critical component of chronic disease management in children with thalassemia.

Materials and methods

Study Design and Participants

This study employed a mixed-method cross-sectional design, conducted from September 2022 to May 2023, to investigate the factors associated with gingivitis in children aged 6 to 12 years diagnosed with Thalassemia. The study was carried out at the National Institute of Hematology and Blood Transfusion (NIHBT) in Hanoi, Vietnam. A comparison group of healthy children was concurrently recruited from Ly Thai To Primary School, also located in Hanoi.

The quantitative component included children clinically diagnosed with Thalassemia at NIHBT, who met the inclusion criteria: aged between 6 and 12 years, with informed consent provided by parents or guardians. Children with coexisting systemic diseases were excluded. The comparison group included healthy children of the same age range, with no history of systemic illness, who voluntarily participated with parental consent.

Sample size was calculated using the formula for comparing two proportions, assuming a 43% prevalence of gingivitis among Thalassemia patients (Hattab, 2012), and a margin of error (ε) of 0.2. The calculated minimum sample size was 128 per group, and 130 children were ultimately recruited in each group. Data were collected through structured interviews and clinical oral examinations. Four calibrated dental specialists conducted standardized assessments of gingival and plaque status. Interviewers were trained prior to data collection to ensure consistency in questionnaire administration.

To complement the quantitative data, a qualitative component was included through in-depth semi-structured interviews with five parents of children in the Thalassemia group. These interviews aimed to explore factors associated with oral care practice of children and parents, and the need for oral care service. Participants were selected using purposive sampling to represent diverse socioeconomic backgrounds. Interviews were audio-recorded with consent, transcribed verbatim, and analyzed thematically to identify common patterns and insights that could not be captured through quantitative methods alone.

Variables and Measurement

A structured set of variables was used to investigate potential determinants of gingivitis in children with and without Thalassemia. Demographic variables included age (grouped as 6–8 years and 9–12 years) and gender. The primary outcome was gingivitis status, classified dichotomously (present/absent), and assessed using the Gingival Index (GI). Based on GI criteria, severity was further categorized into very good, good, average, and poor.

All Thalassemia cases were confirmed through hemoglobin electrophoresis. Although disease subtypes such as α-Thalassemia and HbE-β-Thalassemia were recorded, all included participants were ultimately classified with β-Thalassemia major; hence, no subtype comparison was conducted.

Behavioral and cognitive factors were assessed using a structured questionnaire, covering oral health knowledge, attitudes, and hygiene practices. These were categorized as “good” or “not good” based on predefined scoring criteria. Questions addressed awareness of brushing techniques, frequency, use of dental services, and understanding of fluoride use. These variables were designed to explore the influence of psychosocial and behavioral dimensions on gingival health.

Statistical Analysis

Quantitative data were analyzed using SPSS version 22.0. Descriptive statistics summarized demographic and clinical characteristics, with means and standard deviations for continuous variables, and frequencies and percentages for categorical variables. Associations between categorical variables were assessed using Chi-square or Fisher exact tests when expected cell values were below five. Multivariate logistic regression was performed to identify independent factors associated with gingivitis, with odds ratios (ORs) and 95% confidence intervals (CIs) reported. A p-value of <0.05 was considered statistically significant.

For the qualitative data, thematic analysis was conducted following Braun and Clarke’s six-step framework. Transcripts were coded and reviewed to identify emerging themes related to parental perspectives on oral health behaviors, challenges in maintaining hygiene, and access to care. These qualitative findings were used to complement and contextualize the quantitative results.

Ethical Approval

The study was approved by the Ethics Review Boards of Hanoi Medical University and the National Institute of Hematology and Blood Transfusion. Written approval was also obtained from the Board of Directors of Ly Thai To Primary School. Informed consent was obtained from all parents or legal guardians prior to participation. All data were anonymized and stored securely, and participants were informed of their right to withdraw from the study at any time without any consequence.

Results

Table 1 presents the distribution of gingivitis in children aged 6–12 years, comparing those with Thalassemia and a healthy control group, according to age group and gender. Among children with Thalassemia, the prevalence of gingivitis was significantly higher in the older age group (97.2% in 9–12 years) compared to the younger group (84.5% in 6–8 years), with a p-value of 0.01. In contrast, the comparison group did not show a statistically significant age-related difference. Regarding gender, both female and male children in the Thalassemia group had high rates of gingivitis (93.5% and 90.5%, respectively), which were significantly higher than in the comparison group (77.0% and 78.3%). The overall incidence of gingivitis was markedly greater in the Thalassemia group (91.5%) compared to the control group (77.7%), emphasizing a potential association between Thalassemia and poor periodontal health.

Table 2 summarizes the distribution of gingival health status, as assessed by the Gingival Index (GI), across age and gender groups in both Thalassemia and comparison cohorts. In both groups, children aged 9–12 years exhibited a higher proportion of average or poor GI scores compared to those aged 6–8 years. The difference in GI distribution by age was statistically significant in both the Thalassemia ($p = 0.01$) and comparison groups ($p = 0.05$). Gender-wise, although female participants in the Thalassemia group showed a slightly higher proportion of average/poor scores compared to males, the differences were not statistically significant ($p > 0.05$). Notably, the Thalassemia group showed a lower frequency of “very good” gingival health and a higher percentage of average or poor scores overall compared to the comparison group, reflecting poorer periodontal health status among children with Thalassemia.

Table 3 presents the association between age, gender, and the occurrence of gingivitis in the Thalassemia and comparison groups. Among children with Thalassemia, those aged 9–12 years had a significantly higher risk of gingivitis compared to the 6–8 years group, with an odds ratio (OR) of 6.43 (95% CI: 1.33–31.05), indicating a strong age-related effect. In contrast, the control group showed no significant difference in gingivitis risk between age groups (OR = 0.76; 95% CI: 0.33–1.77). Regarding gender, no statistically significant association with gingivitis was observed in either group. In the Thalassemia group, males had a slightly lower odds of gingivitis than females (OR = 0.66; 95% CI: 0.17–2.63), while in the comparison group, the OR for males was 1.07 (95% CI: 0.47–2.45). Overall, these findings suggest that older age is a significant risk factor for gingivitis in children with Thalassemia, while gender does not appear to play a substantial role in either group.

Table 4 illustrates the association between Thalassemia status and the prevalence of gingivitis in the study population. Children with Thalassemia exhibited a significantly higher rate of gingivitis (91.5%) compared to the comparison group of healthy children (77.7%). The odds of developing gingivitis were over three times higher in the Thalassemia group (OR = 3.11; 95% CI: 1.48–6.53), and this association was statistically significant. These findings suggest a strong relationship between having Thalassemia and increased risk of gingival inflammation, emphasizing the need for targeted oral health interventions in this vulnerable population.

Table 5 explores the relationship between knowledge, attitude, and oral care practices with the occurrence of gingivitis in both Thalassemia and comparison groups. In both groups, there was no statistically significant association between knowledge levels and gingivitis, as reflected by the wide confidence intervals crossing unity. Similarly, while children with poor attitudes toward oral hygiene showed slightly higher rates of gingivitis in the comparison group, the odds ratio (0.61; 95% CI: 0.13–2.90) did not suggest a significant association. Regarding oral care behavior, although children with poorer practices in the Thalassemia group had a slightly higher likelihood of gingivitis (OR = 1.78), this finding was not statistically significant. Overall, the results indicate that knowledge, attitude, and behavior toward oral care were not significantly associated with gingivitis in either group, suggesting that clinical and systemic factors may play a more prominent role in gingivitis among children with Thalassemia.

To enrich the quantitative results, in-depth interviews were conducted with five parents of children diagnosed with Thalassemia. Thematic analysis revealed insights into three key areas: (1) factors influencing oral care practices of

children, (2) factors influencing parental involvement in oral hygiene, and (3) perceived needs for oral health services. These themes help contextualize the behavioral patterns and care gaps that may underlie gingivitis in this vulnerable group.

Factors influencing oral care practices of children

Parents reported various child-related factors that influenced daily oral hygiene routines. The child's age, awareness, motivation, and discomfort from oral conditions were among the most prominent influences.

"My son is still small, only 6 years old, so I have to remind him every time to brush his teeth. Sometimes he does it, sometimes he doesn't." (P1)

"She doesn't like brushing because she said her gums hurt when she uses the toothbrush." (P2)

"He just brushes quickly and says he's done. I don't think he really knows how to brush properly." (P3)

"When he's tired from the hospital or after transfusions, he skips brushing. I don't want to force him." (P4)

"I think my daughter only brushes when I'm there to watch her. If I don't check, she forgets." (P5)

Many children with Thalassemia experience fatigue and oral discomfort, which further discourages consistent brushing. Some parents attributed poor oral care to limited understanding among children about the importance of oral hygiene. Lack of manual dexterity in younger children also contributed to ineffective brushing routines.

Factors influencing parental involvement in oral hygiene

Parental knowledge, time constraints, and prioritization of general health over oral health emerged as central factors shaping their engagement in their child's oral care.

"To be honest, I focus more on his blood transfusions and nutrition. Teeth are not something I worry much about." (P1)

"I work from morning to evening, so I'm not always there to remind her to brush." (P3) "Sometimes I forget too. Life is busy, and we have too many hospital appointments already." (P5)

"I only take him to the dentist if there is a problem, like pain or swelling." (P2)

"I don't know much about oral hygiene. I just tell him to brush but not really how or why." (P4)

"We never received instructions about dental care from the hospital, only about blood and medicine." (P2)

While some parents expressed guilt or frustration about not being able to monitor their child's hygiene more closely, others mentioned that oral care is not emphasized during clinical visits. Parental knowledge gaps and low perceived urgency surrounding dental issues appear to contribute to inconsistent oral care support at home.

Perceived need for oral health services

All participants acknowledged that access to pediatric oral health services for children with Thalassemia was lacking or insufficient. They expressed interest in integrated, affordable, and specialized dental care tailored to their child's medical condition.

"The hospital only talks about blood and iron. I wish they had a dentist there to check my child's mouth too." (P1)

"I don't even know where to take her for dental check-ups that are safe for her condition." (P2)

"If the school had free dental check-ups, I would let him go. But we can't afford private clinics." (P4)

"I think Thalassemia kids need more help with their teeth, especially when they get dark or hurt." (P3)

"No one ever told me that Thalassemia affects the teeth. If I knew earlier, I would have paid more attention." (P5)

"I would feel more confident if the doctor could explain the risks of dental issues and what to do." (P2)

"We need a place where both the blood disease and teeth can be checked in one visit." (P4)

These responses reflect a strong perceived need for accessible and holistic oral health services. Parents also indicated a lack of communication between hematology and dental care providers, contributing to confusion and neglect regarding oral health.

Discussion

This study investigated the factors associated with gingivitis in children aged 6–12

years with thalassemia, using a mixed-method cross-sectional design. The combination of quantitative analysis and qualitative interviews with parents provided a comprehensive understanding of both clinical and contextual determinants of oral health in this population. The findings revealed a markedly higher burden of gingivitis in thalassemia patients compared to healthy peers, with older children in the thalassemia group particularly affected. Importantly, the study also identified systemic, behavioral, and socioeconomic challenges that contribute to inadequate oral hygiene and poor gingival outcomes in these children.

The high prevalence of gingivitis among children with thalassemia observed in this study aligns with findings from Iraq [4] and Iran [5], confirming a consistent pattern of heightened periodontal vulnerability in this population. While plaque accumulation and inadequate hygiene remain primary contributors, the pathophysiology of thalassemia further exacerbates the condition. Frequent blood transfusions, a core component of thalassemia management, often lead to iron overload. This iron can accumulate in the salivary glands, creating a favorable environment for bacterial growth and inflammation [6]. The presence of iron deposits may also stain teeth and reduce children's motivation to maintain oral hygiene, as highlighted in our qualitative interviews.

Beyond iron-related complications, immune dysfunction—specifically neutrophil impairment—plays a significant role in the pathogenesis of gingivitis in children with thalassemia. Neutrophils are critical for the clearance of microbial biofilms, and their dysfunction increases susceptibility to persistent bacterial colonization and chronic gingival inflammation [8]. This immune compromise makes standard oral hygiene measures less effective, further emphasizing the need for early, aggressive preventive strategies. Additionally, our findings support prior reports that thalassemia patients exhibit significantly higher plaque and calculus indices, which are directly linked to gingivitis severity [4,5].

Socioeconomic and demographic factors also emerged as critical influences. Lower parental education, limited access to dental services, and the burden of managing a chronic illness reduce the prioritization of oral care in families of children with thalassemia [5,9]. These findings were echoed in our qualitative interviews, where parents expressed feeling overwhelmed by the medical demands of thalassemia and often neglected oral health unless acute symptoms arose. Malocclusion and mouth breathing—common craniofacial complications in thalassemia—were also mentioned as contributing to plaque retention and oral discomfort, which may further deter children from engaging in routine brushing [10].

The implications of untreated gingivitis in this population extend beyond localized oral discomfort. Chronic gingival inflammation can lead to periodontitis and systemic inflammatory responses, potentially worsening the overall health status of thalassemia patients. Gingival bleeding and pain can interfere with eating and nutrition, which are already critical concerns in children with chronic anemia [8]. The multidisciplinary management of thalassemia must therefore include oral health as an integral component of comprehensive care. Regular dental check-ups, professional prophylaxis, and family-centered education should be incorporated into hematology follow-up visits. Preventive strategies should focus on non-surgical periodontal therapy, including routine scaling, polishing, and the use of antimicrobial mouth rinses, which have shown efficacy in reducing plaque and gingival inflammation [8]. Educational interventions targeting both children and caregivers are vital, particularly those that address brushing techniques, flossing, and the importance of dental follow-up. Additionally, addressing systemic contributors such as iron overload and neutrophil dysfunction requires close collaboration between dental and hematology teams to ensure medical and oral health plans are aligned[6].

This study has several limitations. As a cross-sectional design, it cannot establish causality between the identified factors and gingivitis outcomes. The relatively small sample size, particularly in the qualitative component, limits the generalizability of the findings. Additionally, all participants were recruited from urban Hanoi, where access to care may differ from more remote or underserved regions of Vietnam, which are known to have higher thalassemia carrier rates (Bach et al., 2022). Future studies should explore longitudinal trends and include broader geographic representation to capture the full spectrum of oral health disparities

in this population.

Conclusions

In conclusion, this study reinforces the significant association between thalassemia and gingivitis in children, driven by a combination of biological, behavioral, and systemic factors. Poor oral hygiene, iron overload, immune dysfunction, and socioeconomic constraints collectively contribute to poor gingival outcomes. Integrating oral health care into thalassemia management protocols is essential to improve quality of life and prevent long-term complications. A collaborative, interdisciplinary approach is urgently needed to meet the oral health needs of children living with thalassemia.

Declaration of Interest

The authors report no conflict of interest.

Variables	Thalassemia Group (n = 130)		Comparison Group (n = 130)		p-value
	No Gingivitis	Gingivitis	No Gingivitis	Gingivitis	
	N(%)	N(%)	N(%)	N(%)	
Age group					
6–8 years	9 (15.5)	49 (84.5)	11 (19.6)	45 (80.4)	0.56*
9–12 years	2 (2.8)	70 (97.2)	18 (24.3)	56 (75.7)	<0.01**
p-value	0.01**		0.53*		
Gender					
Female	3 (6.5)	43 (93.5)	14 (23.0)	47 (77.0)	0.02**
Male	8 (9.5)	76 (90.5)	15 (21.7)	54 (78.3)	0.04
p-value	0.75**		0.87*		
Total	11 (8.5)	119 (91.5)	29 (22.3)	101 (77.7)	

Table 1. Distribution of Gingivitis by Age and Gender in the Thalassemia and Comparison Groups (n = 260).

*Chi-square test; **Fisher-exact test

Variables	Thalassemia Group (n = 130)				Comparison Group (n = 130)				p-value
	Very Good	Good	Average	Poor	Very Good	Good	Average	Poor	
	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	
Age group									
6–8 years	9 (15.5)	33 (56.9)	15 (25.9)	1 (1.7)	11 (19.6)	35 (62.5)	10 (17.9)	0 (0)	0.54*
9–12 years	2 (2.8)	37 (51.4)	33 (45.8)	0 (0)	18 (24.3)	31 (41.9)	25 (33.8)	0 (0)	0.01*
p-value	0.01**				0.05*				
Gender									
Female	8 (9.8)	46 (54.8)	29 (34.5)	1 (1.2)	15 (21.7)	34 (49.3)	20 (29.0)	0 (0)	0.13*
Male	3 (6.5)	24 (52.2)	19 (41.3)	0 (0)	14 (23.0)	32 (53.5)	15 (24.6)	0 (0)	0.03*
p-value	0.81**				0.85*				
Total	12 (9.2)	70 (53.9)	48 (36.9)	1 (0.8)	29 (22.3)	66 (50.8)	35 (26.9)	0 (0)	

Table 2. Distribution of Gingival Index Scores by Age and Gender in the Thalassemia and Comparison Groups (n = 260).

*Chi-square test; **Fisher-exact test

Variables	Thalassemia Group (n = 130)			Comparison Group (n = 130)		
	Gingivitis N(%)	No Gingivitis N(%)	OR (95% CI)	Gingivitis N(%)	No Gingivitis N(%)	OR (95% CI)
Age group						
6–8 years	49 (84.5)	9 (15.5)	1.00	45 (80.4)	11 (19.6)	1.00
9–12 years	70 (97.2)	2 (2.8)	6.43 (1.33 – 31.05)	56 (75.7)	18 (24.3)	0.76 (0.33 – 1.77)
Gender						
Female	43 (93.5)	3 (6.5)	1.00	47 (77.1)	14 (22.9)	1.00
Male	76 (90.5)	8 (9.5)	0.66 (0.17 – 2.63)	54 (78.3)	15 (21.7)	1.07 (0.47 – 2.45)
Total	119 (91.5)	11 (8.5)		101 (77.7)	29 (22.3)	

Table 3. Association Between Age, Gender, and Gingivitis in the Thalassemia and Comparison Groups (n = 260).

Group	No Gingivitis	Gingivitis	OR (95% CI)
Comparison group	29 (22.3%)	101 (77.7%)	1.00 (reference)
Thalassemia group	11 (8.5%)	119 (91.5%)	3.11 (1.48 – 6.53)
Total	40 (15.4%)	220 (84.6%)	

Table 4. Association Between Thalassemia Status and Gingivitis in Children (n = 260).

Factors	Thalassemia Group (n = 130)			Comparison Group (n = 130)		
	Gingivitis N(%)	No Gingivitis N(%)	OR (95% CI)	Gingivitis N(%)	No Gingivitis N(%)	OR (95% CI)
Knowledge						
Good	49 (90.7%)	5 (9.3%)	1.00	34 (73.9%)	12 (26.1%)	1.00
Not good	70 (92.1%)	6 (7.9%)	1.19 (0.34 – 4.12)	67 (79.8%)	17 (20.2%)	1.39 (0.60 – 3.24)
Attitude						
Good	116 (91.3%)	11 (8.7%)	–	90 (76.9%)	27 (23.1%)	1.00
Not good	3 (100%)	0 (0%)	–	11 (84.6%)	2 (15.4%)	0.61 (0.13 – 2.90)
Oral care practice						
Good	10 (9.0%)	101 (91.0%)	1.00	29 (23.4%)	95 (76.6%)	1.00
Not good	1 (5.3%)	18 (94.7%)	1.78 (0.21 – 14.78)	0 (0%)	6 (100%)	–

Table 5. Association Between Knowledge, Attitude, Oral Care Practices, and Gingivitis in Thalassemia and Comparison Groups (n = 260).

References

1. Gümüş P, Kahraman-Çeneli S, Akcali A, Sorsa T, Tervahartiala T, Buduneli N, Özçaka Ö. Association of thalassemia major and gingival inflammation: A pilot study. *Arch Oral Biol*. Apr 2016;64:80-4. doi:10.1016/j.archoralbio.2015.12.008
2. Mulimani P, Abas AB, Karanth L, Colombatti R, Kulkarni P. Treatment of dental and orthodontic complications in thalassaemia. *Cochrane Database Syst Rev*. Feb 2 2023;2(2):Cd012969. doi:10.1002/14651858.CD012969.pub3
3. Gunay A, Dogru AG, Isik B, Soker M, Gunay A. Investigation of periodontal parameters, total antioxidant status and ferritin levels in patients with thalassemia major. *Journal of International Dental and Medical Research*. 2015;8(1):15-20.
4. Haraa Khairi A-H. Periodontal Health Status among 6-12 years patients with Beta- thalassemia Major Syndrome in Baghdad – Iraq. *Mustansiria Dental Journal*. 2010;7(1):57-62.

5. Mohammad K, Tazhibi M, Mohebrasool S. Original Article The Prevalance and Risk Factors of Gingivitis Among the Children Referred to Isfahan Islamic Azad University (Khorasgan Branch) Dental School, In Iran. *Dental Research Journal* 2006;3(1):1-4.
6. Nuraini P, Wahluyo S, Pradopo, et al. Effects of Iron Accumulation on Dental Caries, Gingivitis, and Candida albicans Infection in Children with Beta Thalassemia Major: A Narrative Review. *Acta medica Philippina*. 2022;57(3):50-55. doi:10.47895/amp.vi0.3994
7. Fadel HT, Zolaly MA, Alharbi MO, Qarah LA, Alrehili MS, Alamri AD, Tarawah AM. Oral Health Profiles and Related Quality of Life in Thalassemia Children in Relation to Iron Overload: A Cross-Sectional Study. *Int J Environ Res Public Health*. Dec 16 2020;17(24):9444. doi:10.3390/ijerph17249444
8. Ayesha H, Saima Q, Asim Q, Moazzam Ali S, Soban QK, Komal K, Javairia W. Effect of Non-surgical Periodontal Therapy on the Clinical Periodontal Inflammatory Parameters in beta-Thalassemia Major Patients with Gingivitis. *Journal of pharmaceutical research international*. 2022;34(42A):19-27. doi:10.9734/jpri/2022/v34i42a36291
9. Raed Mohammed A, Ali A, Alemad Mustafa K, et al. Socio-Demographic Determinants as Predictors of Gingivitis in Children: A Systematic Review. *Journal of healthcare sciences*. 2024;04(09):357-370. doi:10.52533/johs.2024.40903
10. Fatemeh J, Hoda S. The prevalence and risk factors of gingivitis in a population of 6-year-old children in Iran. *Journal of Oral Health and Oral Epidemiology*. 2016;5(3):129-133.
11. Bach KQ, Nguyen HTT, Nguyen TH, Nguyen MB, Nguyen TA. Thalassemia in Viet Nam. *Hemoglobin*. Jan 2022;46(1):62-65. doi:10.1080/03630269.2022.2069032
12. Tran DC, Dang AL, Hoang TNL, et al. Prevalence of Thalassemia in the Vietnamese Population and Building a Clinical Decision Support System for Prenatal Screening for Thalassemia. *Mediterr J Hematol Infect Dis*. 2023;15(1):e2023026. doi:10.4084/mjhid.2023.026
13. Nabi AT, Muttu J, Chhaparwal A, Mukhopadhyay A, Pattnaik SJ, Choudhary P. Implications of β-thalassemia on oral health status in patients: A cross-sectional study. *J Family Med Prim Care*. Mar 2022;11(3):1174-1178. doi:10.4103/jfmpc.jfmpc_1215_21
14. Darkazali R, Hamadah O. Management of gingival hyperpigmentation induced by increased ferritin level in a HbS-β(+) thalassemia patient using diode laser. *Clin Case Rep*. Nov 2023;11(11):e8171. doi:10.1002/ccr3.8171
15. Fadel HT, Zolaly MA, Qarah LA, Alharbi MO, Alrehili MS, Tarawah AM. Oral health and caries risk profile assessment using the Cariogram in thalassemia patients with or without splenectomy: A cross-sectional study. *Dent Med Probl*. Jul-Sep 2023;60(3):453-458. doi:10.17219/dmp/147798
16. Olczak-Kowalczyk D, Turska-Szybka A, Studnicki M, Piekoszewska-Ziętek P. Gingivitis and Its Causes in Children Aged 3–7 Years. *Diagnostics*. 2024;14(23):2690.