ORAL HEALTH STATUS OF CHILDREN WITH KIDNEY DISEASE: A CROSS-SECTIONAL STUDY

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ABSTRACT
This cross-sectional study aimed to compare the oral health status of children with kidney disease and healthy children. A total of 158 children aged 4-15 years were included, comprising 79 children with kidney disease and 79 healthy controls. Oral examinations were conducted to assess dental caries using the dmft/DMFT index, oral hygiene status using the Simplified Oral Hygiene Index (OHI-S), and developmental defects of enamel (DDE). Information on oral hygiene behaviors, access to dental services, and socioeconomic characteristics was collected using structured questionnaires. The results showed no statistically significant differences between children with kidney disease and healthy controls in terms of dental caries prevalence, dmft/DMFT scores, or overall oral hygiene status ($p > 0.05$). Children with kidney disease demonstrated slightly higher debris index and OHI-S scores, although these differences were not statistically significant. DDE was observed exclusively in children with kidney disease.
Keywords: Kidney Disease, Oral Health, Children

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INTRODUCTION

The kidneys are vital organs in maintaining homeostasis within the human body by regulating water balance, solute levels, and electrolyte concentrations in the blood. Kidney disease occurs when the kidneys are damaged or unable to function properly and may progress to renal failure or ESRD (Levey et al., 2013). KDIGO defines CKD as abnormalities in kidney structure or function lasting longer than three months (Stevens et al., 2024). Several kidney disorders in children, including nephrotic syndrome, chronic renal failure, chronic pyelonephritis, and chronic glomerulonephritis, can lead to a decline in renal function and, if left inadequately treated, can progress to ESRD requiring dialysis or kidney transplantation (Svsg, 2018). When chronic kidney disease occurs during childhood, it can lead to progressive renal failure and long-term health consequences. As children are still undergoing physical growth and developmental maturation, pediatric CKD represents an important global public health concern (Becherucci et al., 2016; Gupta et al., 2015; Vaidya & Aeddula, 2024). In the pediatric population, renal impairment typically stems from congenital anomalies, hereditary conditions, or secondary systemic complications like lupus and severe infections (Harambat et al., 2012).
Children with kidney disease frequently present with a variety of oral manifestations related to uremic, metabolic, and immunological disturbances associated with impaired renal function, as well as the effects of long-term medical treatment. These manifestations may involve both the soft and hard tissues of the oral cavity and often vary with disease severity and duration. Common soft tissue findings include oral mucosal pallor related to anemia, xerostomia, uremic stomatitis, halitosis, gingival inflammation, and drug-induced gingival enlargement, particularly in patients receiving immunosuppressive or antihypertensive medications (Kamel et al., 2024; Skorecki et al., 2005). Hard tissue involvement is frequently observed as DDE, which is attributed to disturbances in calcium-phosphate metabolism and vitamin D regulation during critical periods of tooth development. Any disruption in ameloblast activity during enamel formation can result in DDE, making children with early-onset CKD particularly vulnerable. Evidence from systematic reviews has indicated that CKD increases the risk of DDE by approximately 4.9 times (Amrollahi et al., 2024; Sezer et al., 2023).
The prevalence of dental caries in children with kidney disease has been reported inconsistently in the literature. Several studies have demonstrated a relatively low prevalence of dental caries in this population, which has been attributed to elevated salivary urea levels that increase salivary pH and buffering capacity, thereby reducing enamel demineralization (Andrade et al., 2014). However, children with renal disease may still be predisposed to dental caries due to multiple contributing factors, including poor oral hygiene, medication-induced xerostomia, disease-related debilitation, hypoplastic enamel, and diets high in carbohydrates (Gupta et al., 2015). In Thailand, limited studies have examined the oral health status of children with renal disease. A previous study has investigated the oral health status of children with renal disease, and most have not included comparisons with healthy control groups. (Weraarchakul, 2015). Therefore, this study aimed to compare the oral health status of children with kidney disease and healthy children at Bhumibol Adulyadej Hospital, Bangkok, Thailand.

RESEARCH METHODOLOGY

The study was conducted in the pediatric examination room on the second floor of the Khumklao Building at Bhumibol Adulyadej Hospital, and it received ethical review and approval from the Human Research Ethics Committee of the Faculty of Dentistry at Chulalongkorn University and from Bhumibol Adulyadej Hospital.
Children aged 4-15 years were included. The study group comprised children diagnosed with kidney disease and treated at Bhumibol Adulyadej Hospital, while the control group included healthy children who attended the pediatric outpatient clinic at the same hospital for routine medical check-ups and had no history of kidney disease. Children who required protective

stabilization during examination or had other systemic conditions that could affect oral health were excluded.

Oral Examination Procedure

Before the interview, the researcher explained the study procedures to the parents or guardians and obtained written informed consent. The questionnaire was administered through face-to-face interviews conducted by the researcher. Each participant had an oral exam with adequate illumination. All teeth were examined with a mouth mirror and explorer. Initially, the assessment of dental caries was performed using the dmft/DMFT index. Subsequently, the participants' oral hygiene status was evaluated using OHI-S. DI-S and CI-S scores were recorded separately for representative teeth, including teeth 11, 16, 26, 31, 36, and 46 in the permanent dentition and teeth 55, 61, 65, 75, 81, and 85 in the primary dentition. Each tooth was scored on a scale from 0 to 3. The final step of the examination involved the assessment of DDE. Before the DDE evaluation, all teeth were thoroughly cleaned with gauze to remove plaque and debris, allowing clear enamel surfaces.

RESEARCH RESULTS

A total of 158 children were included in the study, comprising 79 children with kidney disease and 79 healthy controls. Overall, 91 participants (57.6%) were male and 67 (42.4%) were female. The age of the participants ranged from 4 to 15 years. No significant differences were observed between groups regarding history of preterm birth, maternal complications, primary caregiver category, caregivers' caries experience, or family income ($p > 0.05$) (Table 1).

Table 1 Demographic characteristics of the study participants

Characteristics	**Kidney disease Group n (%)**	**Control group n (%)**	**p-value**
Age (years)	9.76±3.13*	8.51±3.07*	0.102
4-5	8(10.1)	12(15.2)	
6-11	42(53.2)	52(65.8)	
12-15	29(36.7)	15(19.0)	
Gender			0.421
Male	43(54.4)	48(60.8)	
Female	36 (45.6)	31(39.2)	
Preterm birth			0.339
Yes	8(10.1)	12(15.2)	
No	71(89.9)	67(84.8)	
Maternal complications			0.617
Yes	8(10.1)	10(12.7)	
No	71(89.9)	69(87.3)	
Primary caregiver			0.172
Mother	48(60.8)	56(70.9)	
Father	15(19.0)	7(8.9)	
Others	16(20.3)	16(20.2)	
Caregivers' dental caries status			0.424
Yes	33(41.8)	38(48.1)	
No	46(58.2)	41(51.9)	
Family income (baht/month)			0.740
<20 000	14(17.7)	18(22.8)	
20 000-39 999	27(34.2)	26(32.9)	
40 000-59 999	23(29.1)	18(22.8)	
≥60 000	15(19.0)	17(21.5)	

*Mean±SD

There were no statistically significant differences in oral hygiene behaviors between children with kidney disease and healthy controls. Most participants in both groups reported brushing their teeth twice daily, accounting for 75.9% of children in the kidney disease group and 75.9% in the control group. Most of the children in both groups reported using fluoride toothpaste, with 93.7% in the kidney disease group and 96.2% in the control group, and no significant difference was observed between groups. Regarding dental service utilization, the timing of the last dental visit did not differ significantly between the two groups. Approximately one-third of children in both groups had visited a dentist within the previous six months (Table 2).

Table 2 Oral hygiene habits of the study participants

Characteristics	**Kidney disease Group n (%)**	**Control group n (%)**	**p-value**
Toothbrushing			0.377
once a day	15 (19.0)	11 (13.9)	
twice a day	60 (75.9)	60 (75.9)	
more than twice a day	4 (5.1)	8 (10.1)	
Fluoride toothpaste			0.468
Yes	74 (93.7)	76 (96.2)	
No	5 (6.3)	3 (3.8)	
Last dental visit			0.346
Within 6 months	29 (36.7)	28 (35.4)	
6-12 months	10 (12.7)	4 (5.1)	
>12 months	23 (29.1)	29 (36.7)	
Never	17 (21.5)	18 (22.8)	

Assessment of dental caries status showed that, in both healthy children and children with kidney disease, caries experience was more frequently observed in the primary dentition than in the permanent dentition. Comparison of oral health status between the two groups revealed no statistically significant differences in dental caries prevalence, dmft scores, DMFT scores, or overall oral health status. Evaluation of oral hygiene indices showed that, among healthy children, mean debris index and OHI-S generally increased with age, while calculus index scores remained low across all age groups. A similar trend was observed in children with kidney disease, who had slightly higher mean debris index and OHI-S scores than healthy children in most age groups; however, calculus index scores remained low, and no statistically significant differences were found between the two groups. DDE was observed only in children with kidney disease, affecting 6 participants (7.6%), whereas no cases were observed in the control group. The difference in DDE prevalence between the two groups was statistically significant (Table 3).

Table 3 Clinical examination among the studied groups.

Oral health parameter	Kidney disease group*	Control group*	Overall*	p-value
DI-S	1.11±0.66	0.97±0.52	1.04±0.59	0.135
CI-S	0.11±0.22	0.08±0.16	0.09±0.19	0.658
OHI-S	1.21±0.77	1.05±0.60	1.14±0.69	0.136
dt	1.14±2.26	2.06±3.81	1.60±3.16	0.552
mt	0.11±0.53	0.18±0.55	0.15±0.54	0.266
ft	0.15±0.53	0.14±0.62	0.15±0.57	0.568
dmft	1.41±2.61	2.38±4.12	1.89±3.47	0.316
DT	0.58±1.28	0.52±1.11	0.55±1.19	0.855
MT	0.04±0.25	0.04±0.25	0.04±0.25	1.000
FT	0.04±0.25	0.09±0.51	0.06±0.40	0.642
DMFT	0.66±1.33	0.65±1.26	0.65±1.29	0.923
DDE, n (%)	6 (7.6)	0	6 (3.8)	0.028

*Mean±SD

DMFT/dmft: decayed, missing, and filled teeth; DI-S: Debris Index-Simplified; CI-S: Calculus Index-Simplified; OHI-S: Simplified Oral Hygiene Index; DDE: developmental defects of enamel.

DISCUSSION & CONCLUSION

This study compared the oral health status of children with kidney disease and healthy children. In both groups, dental caries was more frequently observed in the primary dentition than in the permanent dentition. The higher prevalence of dental caries in the primary dentition can be attributed to the anatomical and structural characteristics of primary teeth, which include thinner enamel and dentin layers, lower mineral content, and larger pulp chambers compared with permanent teeth. Supporting this finding, it reported that among children aged 6-12 years, the incidence of enamel caries on the distal surface of the second primary molar was approximately two to three times higher than that observed on the mesial surface of the first permanent molar (Mejàre & Stenlund, 2000).

Interestingly, several studies have reported a relatively low prevalence of dental caries in children with kidney disease. This paradox has been attributed to alterations in salivary composition associated with impaired renal function. In individuals with kidney disease, increased salivary urea concentration leads to elevated salivary pH and enhanced buffering capacity (Martins et al., 2008), which may neutralize organic acids produced by cariogenic bacteria following sugar intake and reduce enamel demineralization. However, children with kidney disease may still be susceptible to dental caries due to a combination of behavioral, systemic, and dietary factors.

In the present study, the absence of a statistically significant difference in dental caries prevalence between children with kidney disease and healthy controls (Table 3) differs from a systematic review and meta-analysis, which reported lower caries experience among children and adolescents with CKD (Limeira et al., 2019). Differences in study design, age distribution, disease severity, oral hygiene behaviors, dietary habits, and access to dental care among study populations may explain this discrepancy.

Overall, the participating subjects had low levels of dental plaque and calculus, which may be attributed to generally good oral hygiene habits, as most participants reported brushing their teeth twice daily and having prior experience with dental services. The mean OHI-S scores of the kidney patients were slightly higher than those of the healthy children, although the difference was not statistically significant (Table 3). This finding may be related to alterations in salivary composition commonly reported in children with chronic kidney disease, which may contribute to increased plaque accumulation (Serni et al., 2023).

DDE was observed exclusively in children with kidney disease, while no cases were identified in the healthy control group. (Table 3) Enamel defects affecting the deciduous dentition are indicative of disturbances occurring during the prenatal or early postnatal periods, which interfere with ameloblast function and enamel maturation. In children with chronic renal failure, phosphate excretion is impaired, leading to phosphate retention and elevated serum phosphate levels. At the same time, the diseased kidneys lose their ability to convert 25-hydroxyvitamin D into its active form, 1,25-dihydroxyvitamin D. Reduced calcitriol levels impair intestinal calcium absorption, further exacerbating hypocalcemia. This disruption in calcium-phosphate homeostasis directly affects mineral availability during amelogenesis. Ameloblasts are highly sensitive to systemic metabolic changes during the secretory and maturation phases of enamel formation. Adequate calcium and phosphate concentrations are essential for proper hydroxyapatite crystal deposition and enamel matrix mineralization. When mineral balance is disrupted, ameloblast function may be compromised, resulting in incomplete mineralization or defective enamel matrix formation. Clinically, this manifests as qualitative defects, such as demarcated or diffuse opacities, or quantitative defects, such as enamel hypoplasia. In addition, a low-protein diet combined with proteinuria may contribute to defective enamel matrix formation, resulting in enamel hypoplasia (Costacurta et al., 2025; Sheetal et al., 2013). In this study, none of the children were born preterm or had low birth weight; therefore, these factors are unlikely to account for the observed enamel hypoplasia, further supporting a systemic renal-related etiology. Importantly, DDE may serve as an early clinical indicator of systemic metabolic disturbances occurring during tooth development in children with kidney disease.

Clinically, the presence of DDE has important implications for oral health. Teeth affected by enamel defects often exhibit irregular surface and reduced mineralization, which may increase plaque retention and susceptibility to dental caries and tooth wear (Costa et al., 2017). Although the present study did not demonstrate a significantly higher caries prevalence in children with kidney disease, the presence of DDE may represent a potential risk factor for future oral complications if preventive measures are not implemented.

To our knowledge, this is one of the few studies in Thailand to directly compare the oral health status of children with kidney disease and healthy controls. Nevertheless, several limitations should be considered when interpreting the findings. In addition, the stage and severity of kidney disease were not analyzed separately, which may influence oral health outcomes. Future studies with larger, multi-center samples and stratified analyses according to disease severity are recommended to provide more comprehensive evidence.

In conclusion, this study found that the oral health status of children with kidney disease was comparable to that of healthy children, with no significant differences in dental caries prevalence or oral hygiene indices. However, DDE was identified exclusively in children with kidney disease, underscoring the impact of systemic metabolic disturbances on tooth development. These findings highlight the importance of early and regular oral health check-ups, including dental visits every six months, fluoride application, reinforcement of proper toothbrushing practices, and dietary guidance. Integrating these preventive measures into routine care through collaboration among pediatric nephrologists, dentists, and caregivers may help reduce long-term oral complications and support better overall health outcomes in children with kidney disease.

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