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ORIGINAL ARTICLE

Oral health status among medically compromised children within Riyadh, Saudi Arabia: a case-control study

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ABSTRACT

Background: The perceived need for dental care for children with special healthcare needs (SHCN) exceeds the need for either preventive or specialty medical care. The current study aimed to assess the oral health status among hospitalized and non-hospitalized children with SHCN in Riyadh, Kingdom of Saudi Arabia.

Methodology: This case-control study assessed the oral health status in SHCN children by measuring the prevalence of sum of the number of decayed, missing, and filled permanent teeth, def, gingival index, plaque index, and oral lesions, and related it to hospitalization. The sample size was 300 participants, aged 2-18 years old, who were divided into 150 hospitalized children and 150 non-hospitalized children from several governmental and private hospitals in Riyadh. Oral examination was conducted after receiving consent from the legal guardians who were interviewed using the self-administered 28-item questionnaire assessing demographics, hospitalization characteristics, oral hygiene practices, dental visits, dietary behaviors, medical conditions, medication use, and self-reported recurrent aphthous stomatitis. Chi-squared test was used to compare the incidence of dental diseases, periodontal diseases, and oral lesions to hospitalization.

Results: Caries was more prevalent in the controls (non-hospitalized) than in hospitalized cases (uncontrolled). Moderate gingivitis was more prevalent in hospitalized cases; however, mild gingivitis was more prevalent in controls. Plaque scores were found to be better in hospitalized cases than controls.

Conclusion: The prevalence of dental caries and plaque accumulation was significantly poorer in non-hospitalized children when compared to hospitalized patients, and gingival health was more deteriorated in hospitalized children in Riyadh city.

Keywords: Oral health, children, hospitalized, caries prevalence, gingival index, plaque index.

Introduction

Oral health is considered to be an essential part of overall health [1]. The World Dental Federation defines oral health as multifaceted. It includes the ability to speak, smile, smell, taste, touch, chew, swallow, and convey a range of emotions through facial expressions with confidence and without pain, discomfort, and disease of the craniofacial complex [2]. Oral diseases such as dental caries, periodontal diseases, and plaque accumulation are major factors that disturb the comfort and function of an individual, leading to poor oral health. As a result, the subject may experience pain, inability to eat or speak, the spread of infection, low self-esteem, and inability to sleep or concentrate [3].

Dental caries among children is a public health problem due to its high prevalence. According to the Global Oral Health Data Bank, the prevalence varies from 49% to 83% across different countries [4]. A cross-sectional study that was conducted in Riyadh, Saudi Arabia, among primary school children found the prevalence of dental caries among children to be 83% [confidence interval (CI) = 79.7%-86.0%] [5]. Another study in Jeddah, Saudi Arabia found the caries prevalence in permanent dentition to be

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71.3% and that in the deciduous teeth to be 85.5% [6]. Similarly, high caries prevalence was found in different regions in Saudi Arabia [7,8].

Mild and moderate gingival inflammation forms are almost a universal oral finding in young people [9]. A study conducted in Riyadh, Saudi Arabia, assessing the periodontal condition among 6, 9, and 12-year-old children, recorded 40% gingival bleeding among 6–year-old children, 48.7% bleeding and 7.8% calculus among 9-year-old children, and 52% of 12-year-old children reported gingival bleeding and 16% reported the presence of calculus [10]. Another study on a sample of 11-82-year-olds, conducted in Abha, Saudi Arabia, showed the incidence of different types of periodontal diseases [11]. For instance, gingivitis cases were 63.2% of the sample in which mild cases were 49.8% and moderate cases were 45.8%, while 36.8% of the cases had periodontitis [11].

Oral health status variance is caused by a broad range of determinants, such as biological determinant factors (including gender) [12], socio-behavioral factors (including age, parents' level of education, and socioeconomic class) [13,14], behavioral factors (including oral health behaviors and snacking habits) [13], and psychosocial factors that can be caused by prolonged hospitalization [15].

The relationship between medical conditions and oral health has been investigated. Two studies have suggested that cerebral palsy might be associated with increased dental caries and malocclusion [16,17]. Diabetes mellitus was reported to be a risk factor for gingival bleeding and possible periodontal complications [18]. Patients with leukemia, asthma, and those who underwent chemotherapy were found to have more decayed, missing, and filled teeth than normal children [19,20]. Moreover, patients with multiple systemic disorders might have a higher risk of poor oral health status [21].

During hospitalization, children are exposed to different environmental factors that can jeopardize their oral health. Moreover, children are more vulnerable to different kinds of pathogenesis that might increase the prevalence of dental caries and periodontal disease due to neglecting their oral hygiene during hospitalization. Also, children might be introduced to cariogenic medications daily during hospitalization [22]. The quality of life of medically compromised children is usually affected by poor oral hygiene, and accumulation of dental plaque was also a common oral finding among hospitalized patients [18,24]. Furthermore, hospitalized children with chronic obstructive pulmonary disease reported significantly lower brushing frequency, poor periodontal health (oral hygiene index and PI), greater gingival inflammation, and deeper pockets/clinical attachment level than non-hospitalized children [25].

The relationship between hospitalization and oral health status among Saudi children has not been assessed to the best of our knowledge. Therefore, the present study was designed to explore the oral health status of hospitalized children and assess the relationship between hospitalization and bad oral health status.

Subjects and Methods

This is a cross-sectional analytical study that aimed to assess the oral health status among hospitalized and non-hospitalized children in Riyadh province, Kingdom of Saudi Arabia. The minimum valid sample of 249 participants was calculated using the Calculator website [26] based on a 95% confidence level, a 5% significance interval, and an estimated population response of 50%. In this study, 300 participants were divided into 150 hospitalized children and 150 non-hospitalized children. The data collection, using interviews and clinical dental examinations from consenting participants, started from 1st March until 10th October 2019. Approval was obtained from an authorized person of each hospital prior to collecting the data. A convenient sampling technique was used to draw a sample of 150 admitted children from different governmental and private hospitals in north and east Riyadh city and 150 non-hospitalized children who were waiting for their appointment at the outpatient clinics of the same hospitals. Children aged 2 to 18 years old were eligible to participate in the study. The exclusion criteria of the selected sample were adults older than 18 years, children younger than 2 years, absence of guardian at the time of the examination, and severely compromised patients, such as patients in the intensive care unit, high dependency unit, and extremely immunodeficient patients.

Interviews were conducted at the Pediatric centers of private and governmental pediatric hospitals across Riyadh, Saudi Arabia, with the presence of the patients' legal guardians in addition to the authorized personnel of the departments. Those participants who fulfilled the inclusion criteria were invited to participate in the study after explaining the objective and the methods to be adopted. The legal guardian of the eligible patient freely signed the informed consent form before answering the questionnaire and undergoing the clinical examination, according to the International Guidelines for Research with Human Beings.

Each participant was interviewed once. An interview was conducted not only to obtain the subject's general and oral health-related information, but also to build a rapport with the patient in order to obtain cooperation during the oral health assessment. A face-to-face interview with a maximum duration of 5-10 minutes was conducted with each participant. Two teams of calibrated observers conducted the interviews and examinations, and each team consisted of two examiners and one interviewer who were trained on the assessment criteria. Patients' legal guardians were interviewed using the questionnaire (face-to-face method) before the oral examination. All participants answered the survey that comprised several questions (open-ended and closed-ended) assessing demographics, socioeconomics, length and reason of current hospitalization and its psychological effect on the child, previous hospitalizations history, oral hygiene practices, dental visits, dietary behaviors, systemic

conditions, medications, self-reported recurrent aphthous stomatitis, and its locations.

For the examination, mouth mirrors, periodontal probe, and cotton rolls were used to examine the soft and hard tissues. Patients were lying in their beds, and a flashlight was used for better visualization. One student carried out the examination, and a helper was holding the flashlight and recorded the findings at the same time. A systematical examination was carried out starting from the upper right side moving to the anterior teeth, followed by the upper left side, ending with the right lower side. The clinical assessments were conducted and measured the sum of the number of decayed, missing, and filled permanent teeth (DMFT), def, gingival index (GI), and plaque index (PI).

DMFT was recorded in which dental caries, missing teeth, and filling of permanent dentition were examined. Equivalently, def was used in which the 'e' indicated extractions. Accordingly, dental caries was defined as an enamel and dentine lesion caused by the loss of tooth structure with an easily identified cavity using a mouth mirror and dental probe. The tooth extracted due to caries was considered as missing. A tooth that had a permanent restoration without recurrent caries was defined as filled teeth, and fissure sealants were excluded.

GI was conducted according the method described in Loe and Silness [27] to assess the gingival health scores by gentle probing and visual inspection. The gingival health status was scored from 0 to 3. Zero was for normal gingival tissue with no inflammation or bleeding; a score of 1 was given for mild inflammation and a slight change in the color with no bleeding; 2 for moderate inflammation with erythema and bleeding; and 3 for severe inflammation, severe erythema, bleeding, and some ulcerations. The mesiofacial, facial, distofacial, and lingual surfaces of all selected teeth (two posterior teeth and one anterior tooth for each arch) were examined. The GI score for each tooth was obtained and then divided by 4 (the number of surfaces examined). Moreover, the patient's GI was calculated by adding the sum of the six teeth and dividing it by 24 (the total number of surfaces). Patients who scored 0.1-1.0 were diagnosed with mild gingivitis, with scores of 1.1-2.0 had moderate gingivitis, and 2.1-3.0 was scored as severe gingivitis.

Plaque index (PI) [27] was conducted to measure the plaque accumulation by inspection and gentle probing. The PI was scored from 0 to 3. Zero for no debris or stains; 1 for debris on the cervical third of the tooth, or the presence of stains regardless of the debris presence; 2 for debris extending above the cervical third but not more than the mid-third; and 3 for debris covering more than two-thirds of the tooth. The same steps that were used for GI were applied for obtaining the PI. Patients who scored 0 had excellent oral hygiene; 0.1-0.9 good oral hygiene; 1.0-1.9 fair oral hygiene; and 2.0-3.0 scored as poor oral hygiene.

Data were analyzed using Statistical Package for the Social Sciences (SPSS) software version 22 (SPSS, Inc, Chicago, IL), version 10 for Windows. The quantitative variables were evaluated for normality using the Kolmogorov-Smirnov test. For initial analysis of the data, descriptive statistics including frequency distribution, means, and standard deviations were employed in a *t*-test of the variables including DMFT, def, GI, and periodontal index among hospitalized vs. non-hospitalized cases. A 95% confidence interval was employed ($p < 0.05$). Chi-squared tests were used to categorize hospitalized and non-hospitalized children based on demographic data and medical health conditions and to assess the association between the duration of hospitalization and variables, including demographics, medical, and oral health conditions.

Results

Of the total number of participants, 150 children were hospitalized and 150 were outpatient children. The mean age of the participants was 7.43 years (SD = 3.55). Among the total participants, 54% were male and the rest were female; 47.1% of the hospitalized and 52.9% of the outpatient participants were female and the remaining were male, as shown in Table 1. Although all the participants belonged to special healthcare needs, only 23.7% ($n = 71$) were previously hospitalized for chronic illness and 28.7% ($n = 85$) for acute illness (Table 1). Almost 98% of the controls were never previously hospitalized. Infections, followed by blood disorders, allergy, and immune disorders, were the most common causes of hospitalization among the cases, as shown in Table 2.

Table 3 presents the mean DMFT, def, GI, and PI among both groups of children. The mean DMFT for permanent

Table 1. *Number of female and male participants.*

Variables	Category	Case		Controls		Total
		n	%	*n*	%	
Gender	Male	85	52.5	77	47.5	162(54%)
	Female	65	47.1	73	52.9	138 (46%)

Table 2. *Causes of hospitalization in relation to diseases.*

Causes of hospitalization in relation to diseases	Patient category	
	Controlcount	Case count
Diabetes	2	5
Asthma	23	21
Infection	9	31
Cancers	3	15
Leukemia	1	6
Blood disorders	10	29
Cardiac diseases	8	5
Allergy	22	25
Renal disease	8	11
Immune disorder	5	24

Table 3. *Correlation between hospitalization duration and DMFT, def, PI, and GI.*

			DMFT	def	GI	PI
Spearman's rho	Days of hospitalization	Correlation coefficient	−0.052	−0.163**	0.042	−0.223**
		p-value	0.365	0.005	0.471	0.000
		N	300	300	300	300

Table 4. *Relationship between hospitalization and oral health status.*

		Patient category		Total	Pearson's chi-square	*p*-value
		Control	Case			
Permanent teeth (DMFT)	Caries present	68	56	124	1.979	0.159
	Caries free	82	94	176		
Deciduous teeth (def)	Caries present	108	89	197	5.337	0.020*
	Caries free	42	61	103		
Gingival status	Normal	11	26	37	15.319	0.002**
	Mild gingivitis	82	53	135		
	Moderate gingivitis	36	52	88		
	Severe gingivitis	21	19	40		
Plaque	Good	40	55	95	8.376	0.015#
	Fair	61	67	128		
	Poor	49	28	77		

Table 5. *Prevalence of recurrent aphthous stomatitis (RAS) in hospitalized and non-hospitalized children.*

Patient category		Frequency	Percent
Control	Yes	11	7.3
	No	139	92.7
	Total	150	100.0
Case	Yes	40	26.7
	No	110	73.3
	Total	150	100.0

teeth among children was 1.7 teeth, while the mean def for deciduous teeth was 3.39 teeth. The def, GI, and PI scores were found to be higher and statistically significant in non-hospitalized children than in hospitalized children, as shown in Table 3.

Caries in permanent teeth was more prevalent in the controls (45.3%) than hospitalized cases (62.7%); however, the difference was statistically insignificant. Caries prevalence in deciduous teeth was more prevalent in cases (40.7%) than controls (28%) and was statistically significant (p = 0.02), as shown in Table 3. Moderate gingivitis was more prevalent in hospitalized children, while mild gingivitis prevalence was higher in controls (p = 0.002). Statistically significant and better plaque scores were found in cases than controls who demonstrated poor plaque index scores (p = 0.015), as shown in Table 3.

On examining the correlation between duration of hospitalization and oral health status, a strong correlation was found between duration of hospitalization and caries in deciduous dentition, as well as PI values, as shown in Table 4. Recurrent aphthous ulcers (RAU) were more prevalent in cases than controls, as shown in Table 5.

The majority of the participants had poor oral hygiene practices. Only 19% of the participants brushed twice a day, and almost 20% never brushed their teeth, as shown in Figure 1. More than half of the sample never visited a dentist or used mouth rinses. The most reported reason for visiting a dentist was pain. Among the participants, only five children visited the dentist periodically. Less than half received parental guidance while brushing their teeth. Almost 80% of the participants consumed moderate to high amounts of carbohydrates in their diet. The carbohydrate intake level was more in non-hospitalized children than hospitalized children; however, it was statistically insignificant. The consumption of fast food among the cases was lesser than the controls and it was found to be statistically significant (p = 0.024). The majority of the participants consumed soda/juices at least once a day.

Discussion

Son et al. [28] reported that hospitalized children had a high caries experience. The level of caries in primary teeth in the current study was significantly higher in hospitalized children than in non-hospitalized children. Similar results were found in a study conducted by Martins et al. [16], where the mean def score was significantly higher than other studies. However, a study conducted by Franklin et al. [19] on intensive care unit children showed no significant differences between the mean scores of the two samples. For permanent teeth, the

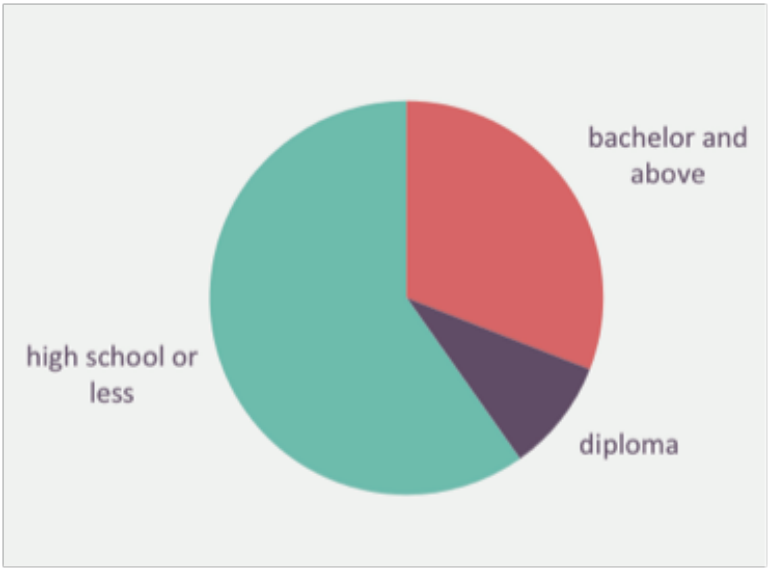

Figure 1. *Family educational level.*

difference in DMFT index between hospitalized and non-hospitalized children was statistically insignificant in the current study. The possible reason for the insignificant difference of DMFT despite poor oral hygiene practice is that almost 80% of the participants consumed a moderate to high amount of carbohydrates in their diet, as shown in Figure. According to the literature, a higher index of caries in the deciduous dentition is usually due to negligence in oral hygiene practices in younger children. Additionally, for some parents, the deciduous dentition is not considered as important as the permanent teeth [16,29].

It was noted that there was a positive correlation between def scores and plaque scores with the duration of hospitalization. Some studies have reported increased plaque scores during the hospitalization period [19,30]. Moderate gingivitis was more prevalent among hospitalized children (37%), while mild gingivitis prevalence was higher in non-hospitalized children (55%). This finding was found to be statistically significant (p = 0.002). It could be associated with higher plaque scores among the cases. It has been suggested that the potential for infection is higher in critically ill patients, as micro-organisms that colonize their oral cavity are more virulent than those found in healthy individuals. Similar results were found by Carrilho Neto et al. [18], wherein gingival inflammation was found in 98.1% of the participants, out of which the majority of the hospitalized patients had moderate gingival inflammation.

The most frequent causes of hospital admission among the participants were infections, followed by blood disorders, allergy, and immune disorders. In this study, RAUs were more prevalent among the cases (26%) than in controls (7.3%). This might be attributed to the different factors, such as the medical condition of the patient, medication intake, or others. In a study conducted by Martins et al. [16] on hospitalized children over 7 months, the prevalence of ulceration was calculated to be 12% in hospitalized children with chronic and acute conditions, while the prevalence of RAS was calculated to be 26%. These results were mostly reported in children receiving chemotherapy or radiation therapy to the head and neck region, since damage to the oral mucosa by cancer therapy could lead to various problems, including mucositis, bacteremia, infection, pain, and xerostomia. Another possible cause might be immunosuppressive conditions (e.g., HIV or sickle cell disease). Maintaining oral hygiene and having vigilant recall exams with adjunctive fluoride therapy during cancer treatment can decrease the risk and sequelae of oral mucositis [17].

Oral hygiene practices play an important role in the prevention of oral diseases. The oral hygiene of children, who are hospitalized, often becomes secondary to their medical problems or the need for rest, leading to neglect of oral hygiene practices. Unless a child has an obvious high risk for oral health problems, such as oral mucositis associated with cancer treatments, oral care often loses priority. The majority of our study participants reported poor oral hygiene practices. The majority of them rarely or never brushed their teeth. Similar results were found in other studies conducted on hospitalized children, wherein hospitalization was associated with a significant reduction in the frequency of daily brushing [18,24].

Some limitations of this study included underestimating caries due to usage of DMFT, def, and the lack of radiographic records. Another limitation was obtaining the medical history and the medications usage from their guardians rather than the medical records, which might affect the accuracy of obtaining a proper medical history. Also, the duration of hospitalization was not long enough to establish a strong relationship between hospitalization and oral health status. However, this study

assessed DMFT, def, GI, and PI in hospitalized and non-hospitalized children, and then correlated the relationship between hospitalization and oral health status, which was a strong point for this study.

Conclusion

Hospitalized children are more likely to have caries on their primary dentitions compared to non-hospitalized children; however, there was no statistically significant difference in the permanent dentition. Moreover, the periodontal condition of hospitalized children has deteriorated in terms of plaque accumulation and severity of gingival inflammation. Oral hygiene awareness should be raised among caregivers and nurses to reduce oral diseases and complications in hospitalized children. Collaboration between nursing and dentistry and the emphasis of the dental home concept to parents/caregivers is necessary to promote better oral health care provision among children with special needs. The pediatric nurses can encourage all children's caregivers, especially those at high risk, to visit community dental centers or regular dental visits to promote oral health.

List of Abbreviations

CAL	Clinical attachment level
CI	Confidence interval
COPD	Chronic obstructive pulmonary disease
def	The sum of the number of decayed, extracted , and filled primary teeth
DMFT	The sum of the number of decayed, missing, and filled permanent teeth
FDI	World dental federation
GI	Gingival index
OHI	Oral hygiene instruction
PI	Plaque index
RAU	Recurrent aphthous ulcers
SHCN	Children with special healthcare needs
SPSS	Statistical Package for the Social Sciences

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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Consent to participate

Not applicable.

Ethical approval

Ethical approval was granted by the Institutional Review Board of King Abdullah International Medical Research Center via reference/letter number RYD-19-419812-188949 dated: 19/12/2019.

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