

Article

Oral Health Status Among Iraqi Children with Downs Syndrome

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Abstract: Introduction: Downs syndrome is a genetic disorder caused by the presence of all or part of a third copy of chromosome 21. It is usually associated with physical growth delays, mild to moderate intellectual disability, and characteristic facial features. The average IQ of a young adult with Down syndrome is 50, equivalent to the mental ability of an eight- or nine-year-old child, but this can vary widely. The syndrome can obscure dental treatment for the affected patients; furthermore, children commonly have destructive oral habits. Aim: The aims of this study were to evaluate the Modified Gingival Index (MGI), Plaque Index (PI), salivary pH and buffering capacity of the saliva among children with Down syndrome compared to normal children in AlKut City, Wassit (Iraq) to provide baseline data to enable comparison and future planning of dental services for children with Downs syndrome. Materials and Methods: A total of 50 children diagnosed with Downs syndrome (mean age 9.5 years) were selected from Downs syndrome center AlKut City, Wassit (Iraq). The control group consisted of 50 normal children (mean age 9.7 years), gender matched, selected from Outpatient Dental Clinic, AlKut University College. MGI, PI, salivary pH and salivary buffer capacity test were done for all participants. The buffering capacity of the stimulated saliva was grouped under 'very low', 'low' and 'normal'. Pearson's Chi square and one-way ANOVA were used to find statistical significance if any among the Downs and the normal control group. Results: The results of the study showed that the mean $\pm$ standard deviation of MGI, PI and pH of unstimulated resting saliva for Downs group were 1.82 ± 0.65 , 1.92 ± 0.35 and 6.8 ± 0.5 respectively. Normal control group had values 1.35 ± 0.85 , 1.44 ± 0.43 and 7 ± 0.4 respectively. A statistically significant difference between both groups for all parameters was found. Salivary buffering capacity was found to be normal for the majority among both groups. However, 60% of children among the Downs group presented with normal buffering capacity of the stimulated saliva as compared to 70% among the normal control group. However, this difference was not statistically significant ($p = 0.544$). Conclusion: Children with Downs syndrome appear to have higher gingival inflammation, poor oral hygiene and a slightly lower salivary pH as compared to healthy control groups. Special oral health programs regarding treatment and maintenance of good oral health should be taken in consideration for Downs children.

Keywords: Down syndrome; Oral health; Gingival index; Plaque index; Salivary pH.

Introduction

Down syndrome, also called trisomy 21, or (formerly) mongolism, is a congenital disorder caused by the presence in the human genome of extra genetic material from chromosome 21. The affected individual may inherit an extra part of chromosome 21 or an entire extra copy of chromosome 21, a condition known as trisomy 21 (1). British physician John Langdon Down first described the physical features of Down syndrome in 1866, and thus the disorder was later named for him (2).

The physical and cognitive impacts of Down syndrome range from mild to severe (3). Some common physical signs of the disorder include a small head, flattened face, short neck, up-slanted eyes, low-set ears, enlarged tongue and lips, and sloping under chin (4). Other characteristics of the disorder may include poor muscle tone, heart or kidney malformations (or both), and abnormal dermal ridge patterns on the palms of the hands and soles of the feet (5). Intellectual disability occurs in all people with Down syndrome and usually ranges from mild to moderate. Congenital heart disease is found in about 40 to 60 percent of people with Down syndrome (6).

Although, it has been observed that people with Downs are more likely to be caries-free than their unaffected counterparts; yet more patients with Downs are uncooperative and require general anesthesia for dental treatment (7). Moreover, children with Downs also commonly have destructive and detrimental oral habits such as bruxism, tongue thrusting, picking at the gingiva and lip biting (8). It has also been proposed that children with Downs syndrome have preference for sweet food which makes them more vulnerable to dental caries (9). There are few studies describing gingival health and salivary parameters of children with Downs. Some of them reported statistically significant differences in the prevalence of caries, gingivitis and degree of oral hygiene in comparison with normal individuals. While as, other studies reported no significant differences in Downs patients (10). Downs syndrome group like other special needs groups presents a high unmet dental need (11). Nevertheless, the dental professional should be flexible to modify the treatment approach according to the individual patient needs (12).

Therefore, the aim of the present study was to evaluate gingival health by means of gingival index and plaque index among children with Downs and normal children. The present study also looked at salivary parameters like pH of unstimulated saliva as well as the buffering capacity of the stimulated saliva among the groups. These parameters can be of prime importance in making an individual susceptible or resistant to dental diseases like caries.

Materials and Methods

Study Design and Study Population: This study was a case control study. Out of 100 participants enrolled at Downs syndrome center AlKut City, Wassit (Iraq). 90 names were tabulated from the registration numbers of the center register after the application of the inclusion and exclusion criteria. Eventually a total of 50 patients with Downs (mean age 9.5 years) were selected by random sampling using random number tables. The control group consisted of 50 normal (mean age 9.7 years), gender matched controls, selected from the Outpatient Dental Clinic, AlKut University. The following parameters were evaluated for every patient:

- a. Modified Gingival Index described by Lobene et al., 1986 (13)
- b. Plaque Index described by Silness and L  e 1964 (14)
- c. Salivary pH of the resting saliva using pH-Fix test strips [Macherey-Nagel CE 3.1-8.3]
- d. Buffering capacity of the stimulated saliva using GC's Saliva- Check Buffer kits

The study was conducted between August 2025 and December 2025. There are specialized centers for Downs people in main cities of Iraqi. The study describes one specific type of special center for Downs children and adolescents, Downs syndrome center AlKut City, Wassit (Iraq). The participants in the case group were 4 to 15 years old. The subjects were diagnosed mostly as Downs with or without learning disability. Potentially uncooperative patients were excluded from the study and eventually a

total of 50 subjects were enrolled in this study. The inclusion criterion for the case group was a diagnosis of Downs. The exclusion criteria set was dental prophylaxis in the last 6 months, patients with systemic disorders that affect periodontal disease and diabetes. Controls were equally matched in terms of age and gender. All controls included in the study were medically not compromised and were not undergoing antibiotic or anti-inflammatory therapy or had undergone dental prophylaxis in the past 6 months.

Ethical Approval: The proposal of the project was presented to the Chair of the Research Ethics Committee, at AlKut University. The parents of the participants were given participant information letters in the local language (Arabic), distributed from the center. After fulfilling all these requirements and in accordance with International Guidelines a formal ethical approval was granted vide KUC-NFR 5775/2021. An official permission was also obtained from the principal of the Downs syndrome center.

Training and Calibration: Before the commencement of the study, the examiners were standardized and calculated in the Department of Periodontic Dentistry, AlKut University to ensure uniformity in the collection of data. Two examiners underwent training for clinical examination using the equipment and underwent training exercise to record data for one week. Overall reliability of the examiners was assessed after two weeks. Furthermore, calibration was done in the third week to seek the intra-examiner and inter-examiner variability. Overall, Kappa score of 0.96 was achieved for intra-examiner variability and 0.90 for inter-examiner variability.

Methodology: All subjects were examined by two examiners using dental mirror, explorer and Marques periodontal probe. Each examiner was assisted by a person who recorded the scores on Ramfjord teeth. Each child was accompanied by his/her parents. MGI as described by Lobene et al., (13) does not require dental equipment for recording. The scores can be recorded visually. The codes range between 0-4. Each tooth was scored based on inflammation present or absent in the accompanying gingiva. The overall score was divided by the total number of teeth examined. The overall mean of the group was eventually calculated. Plaque Index (PI) scores range between 0-3 from absence to abundance of plaque. Marques periodontal probe was used to assess the plaque index of the groups. The score for the four areas of the tooth was summed up and divided by four to yield a total tooth score (vestibular, medial, oral, and distal) (14). By adding the tooth scores together and dividing by the number of teeth examined, the patient's PI was obtained. Similar to the MGI, the overall mean of PI for both groups was calculated. The pH of resting saliva was calculated using suction apparatus. The pH-fix strips 3.1-8.3 were used for estimation of pH of resting saliva for both groups. GC's salivary buffer strips were used to estimate the buffering capacity of the saliva. Stimulated saliva was collected from the subjects by asking them to chew a paraffin wax tablet prior to the collection. The salivary buffering capacity was categorized into 'very low', 'low' and 'normal' according to the color change from red, yellow and green respectively on the strip.

Data Recording: Each examiner was accompanied by a person who recorded data for each subject and recorded the color change in the pH-fix strips as well as GCs salivary buffering strips. All universal and standard precautions of infection control were considered and observed strictly for all subjects.

Statistical Analysis

The recorded data were compiled and entered in a computer using Statistical Package for Social Sciences (SPSS) version 20.0 software (Chicago, IL, USA). One-way ANOVA and Chi-square tests were used for comparisons. A p-value of less than 0.05 was considered as statistically significant. The data was analyzed comparing both groups. The descriptive statistics included the mean, range and standard deviation for both groups.

Result

The study evaluated the MGI, PI, pH of the resting saliva and salivary buffering capacity of the stimulated saliva among 50 Downs and 50 normal children. The age range in both groups was between 4-15 years. The average age among the Downs group was 9.5 years while as 9.7 years among the normal children group. Only 17 among the Downs group were girls. Same number of genders was selected from the normal control group. Since there was uneven distribution of gender, data was not analyzed according to the gender. [Table/Fig-1] describes the minimum, maximum and mean scores along with the standard deviation for MGI, PI and pH for resting saliva. The mean of the MGI score in the Downs

group (1.82) was higher than that of the normal children group (1.35). The mean MGI score of 1.82 in the Downs group was even higher than the mean (1.59) of the overall combined groups. However, the maximum MGI in Downs group (3.75) was slightly less than the maximum MGI score in the normal children group (3.87). Similarly, the PI mean score of the Downs group (1.92) was higher than that of the normal children group, 1.44, as well as the mean PI score of the overall children group (1.68). The salivary pH of the resting saliva in the Downs group was in the range of 5.4 – 7.8 with a mean pH of 6.8. The mean pH of the resting saliva in the normal children group was 7 with a range of 5.9- 7.9. [Table/Fig-2] shows one-way ANOVA of mean MGI, mean PI and the pH of the resting or unstimulated saliva in the Downs and the normal children group. In all the variables there was a statistically significant difference, $p < 0.05$, between the Downs and the normal children group. However, the mean pH of the Downs group 6.8 was only slightly less than the overall pH of 6.9 and pH of 7 in the normal children group. [Table/Fig-3] compares graphically the mean MGI, mean PI and pH of the resting saliva among the Downs and the normal children groups.

[Table/Fig-4] describes the salivary buffering capacity among the Downs and the normal children groups. The buffering capacity of the saliva was categorized as 'very low', 'low' and 'normal'. There was no statistically significant difference of the salivary buffering capacity among the two groups (sig 0.54), $p < 0.05$.

Table 1. Shows the average (mean) scores of Modified Gingival Index (MGI), Plaque Index (PI) and the salivary pH (resting saliva).

Test and Control Groups		Modified Gingival Index (MGI)	Plaque Index(PI)	Salivary pH
Downs	N	50	50	50
	Minimum	0.87	1.25	5.4
	Maximum	3.75	2.74	7.8
	Mean	1.8254	1.9250	6.854
	Std. Deviation	0.65343	0.35782	0.5545
Normal	N	50	50	50
	Minimum	0.22	0.69	5.9
	Maximum	3.87	2.73	7.9
	Mean	1.3582	1.4426	7.088
	Std. Deviation	0.85763	0.43056	0.4364
Total	N	100	100	100
	Minimum	0.22	0.69	5.4
	Maximum	3.87	2.74	7.9
	Mean	1.5918	1.6838	6.971
	Std. Deviation	0.79404	0.46249	0.5102

Table 2. Shows one-way ANOVA of MGI, PI and resting salivary pH with respect to the Downs and normal groups.

		One Way ANOVA				
		Sum of Squares	df	Mean Square	F	Sig.
Modified Gingival Index	Between Groups	5.457	1	5.457	9.388	0.003*
	Within Groups	56.963	98	0.581		
	Total	62.419	99			
	Between Groups	5.818	1	5.818	37.124	0.000

One Way ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Plaque Index						*
	Within Groups	15.358	98	0.157		
	Total	21.175	99			
Salivary pH	Between Groups	1.369	1	1.369	5.499	0.021*
	Within Groups	24.397	98	0.249		
	Total	25.766	99			

* Significant at $p < 0.05$

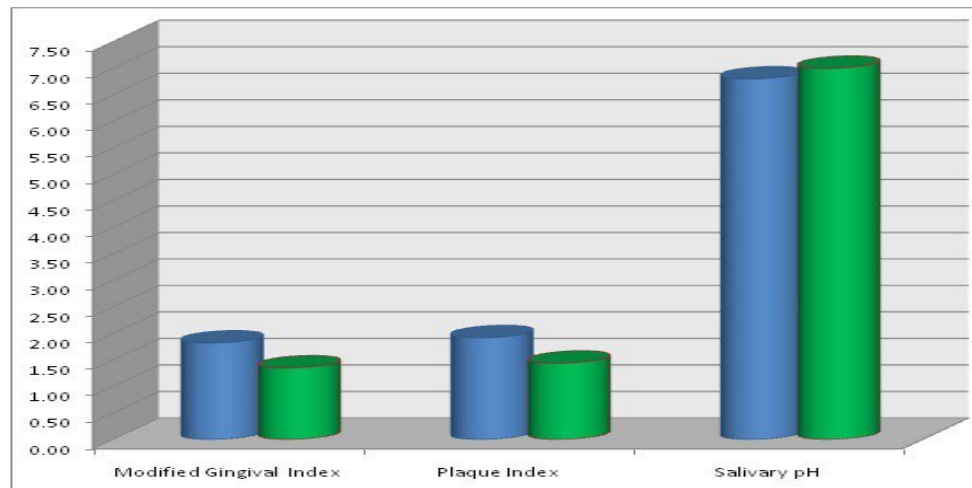


Figure 1. Shows graphical comparison of mean MGI, mean PI and mean salivary pH in Downs and normal children groups. Blue represent Downs and green represent normal participant.

Table 3. Shows the salivary buffering capacity of the stimulated saliva among the Downs and the normal children groups.

Test and Control Groups		Salivary Buffer Capacity			Total	Sig.
		Very Low	Low	Normal		
Downs	Count	5	15	30	50	
	% within the group	10.0%	30.0%	60.0%	100.0%	0.544 \$
Normal	Count	3	12	35	50	
	% within group	6.0%	24.0%	70.0%	100.0%	
Total	Count	8	27	65	100	
	% within Testand Control groups	8.0%	27.0%	65.0%	100.0%	Pearson's Chi Square

\$ Not significant $p > 0.05$

Discussion

Behavior of children with Downs syndrome makes examination of oral hygiene and dental treatment a problem (15). It has been shown that children with Downs experience more difficulties as compared to other normally developing children, they experience significant barriers to care in both the home and dental office (16). The studied group showed more males than females, almost a ratio of 2:1, which might reflect the higher prevalence of Downs in males as it was reported in other studies (17,18,19). In the present study, children with Downs exhibited higher gingival and plaque indices and similar salivary buffer capacity compared to healthy control group. Similar results were found by Desai SS 1997 (20). While as Reuland-Bosma 1986 (21) found out that oral hygiene was poor in children with Downs whereas the Salivary total antioxidant capacity was significantly reduced in Downs children. Higher scores of MGI particularly in the Downs group may be related to poor oral hygiene. It has been shown that Downs children have significantly poor oral hygiene and higher incidence of malocclusion and dental caries when compared to other oral conditions (22,23). These differences may be attributed to irregular use of brushing habits, owing to the behavioral problems associated with Downs, which result in inadequate tooth brushing. It has been reported that people with Downs may reflect poor dental awareness, a lack of dental education and deficiency in receiving oral hygiene instructions from dental staff (24). It has been suggested that the dental team should be better educated and prepared for the needs of patients with special needs like the Downs group (25). Siqueira et al 2002 proposed improvement in oral hygiene through visual pedagogy as a useful tool for people with Downs syndrome (26). Another possible explanation could be the side effects of medications used to control the manifestations of Downs. A novel method known as Sensory Adapted Dental Environment (SADE) to reduce distress, sensory discomfort, and perception of pain during dental procedures has been proposed for children with Downs syndrome (27).

Higher PI in the present study for the Downs group may indicate a higher risk of oral disease particularly dental caries. The oral condition of children with Downs might increase the risk of developing dental diseases (28). In one study, Downs group showed improvement in oral hygiene with a plaque control programme; yet that improvement was significantly higher among co-operative patients. Their behavior and life factors may complicate provision of services and limit access to dental care (29). In a study, it was found that Down children exhibited a higher caries prevalence, poor oral hygiene and wide-ranging unmet dental health needs than normal healthy control group (30). In another study child with Downs were found to have lower DMFT scores and be more likely caries-free. However, it was found that they have higher unmet periodontal treatment needs than the normal control children (31). In another study, similar dental caries status was observed in children with Downs and their healthy normal siblings (32). Gabre P in 2000 also found that there was a higher complexity for periodontal treatment need for Down's syndrome and behavioral disorders (33). Apart from this, one study in USA about Down children also proposed high prevalence of oral soft tissue lesions, caries, and gingivitis among the Down group (34). In this study, the mean Gingival Index (GI) and mean PI scores were slightly less than the scores in the present study. It is noteworthy that in the present study, MGI was used instead of GI. The MGI has scores between 0-4 as compared to 0-3 for GI. Regarding the PI, it may be assumed to be either a variation in diet or plaque control measures such as tooth brushing.

Some studies have compared salivary parameters among Downs and normal children. Saliva is an important component in determining progression or inhibition of dental diseases (35). In the present study, the pH of saliva of Downs group was slightly less than the other control group. This contrasts with findings of Boulet et al 2008. However, this slight variation may be attributed to the small size of the sample as well as the dietary habits of the population. Salivary pH is very important particularly for dental caries as low pH can result in rapid demineralization of the enamel and thus aid in progression of dental caries (28). In the present study there was no significant difference of buffering capacity of the stimulated saliva of the both groups. The buffering capacity of the saliva is a protective factor for the teeth with respect to the attack from the acidic environment in the mouth created by diet as well as the cariogenic bacteria.

Limitation

The limitations are a limited sample size and a single center study; it can be said that the oral cavity is a dynamic environment with many factors both present inside the saliva or from outside like the diet that can contribute to progression or regression of oral disease. To be able to recommend a certain oral health regime other factors associated with the oral health environment need to be examined. However, such studies may enable comparison and future planning of dental services to the Downs children and young adults.

Conclusion

Children with Downs syndrome appear to have higher gingival inflammation, poor oral hygiene and slightly lesser salivary pH when compared to healthy control group. Children with Downs thus may be at higher risk of developing dental diseases. As such, special oral health programs regarding treatment and maintenance of good oral health should be taken into consideration for Downs patients.

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