



Original Article

Tongue Strength and Dental Caries in Individuals with Down Syndrome

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ABSTRACT

Background: The tongue controls the bolus during mastication, keeps the bolus in the oral cavity and generates pressure to direct the bolus through the hypopharynx. A decrease in tongue movement and strength can increase the oral and pharyngeal food residues. Food residues have the potential to increase the risk of dental caries. The aim of this study was to investigate the correlation between tongue strength and the prevalence of dental caries in individuals with Down syndrome.

Methods: Sixteen children with Down syndrome participated in this cross sectional study; none of them had dysphagia and they had normal diet. The tongue strength was measured using the Iowa Oral Performance Instrument (IOPI) and dental caries were assessed by Decayed – Missing –Filled Teeth Index (DMFT). A speech therapist measured and investigated tongue strength and a dentist did the dental examination and filled out the DMFT form.

Results: The mean age of participants was 11.06 (SD=2.83). Most of the participants were female (n=14, 87.50%). All of the subjects had mixed dentition. The mean of tongue strength was 10.23KPa (SD=7.08). There was no correlation between tongue strength and the total number of DMF plus dmf, according to Pearson correlation (P=0.96; r=-0.01).

Conclusion: Tongue strength was very low in these children compared with reports in the literature. There was no correlation between the tongue strength and number of DMF and dmf; the main reason is that the development of dental problems such as caries are multi factorial. In other word there are additional factors apart from poor tongue strength that can cause caries.

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Introduction

Down syndrome (DS), the most common chromosomal abnormality affecting live births [1], is responsible for several physical debilities especially in the head and neck region [2], which interfere with normal daily

function and necessitate extra care and supervision. Abnormalities such as protruded mandibles, open mouth, disordered teeth, impaired tongue activity and chewing indicators, and also muscular hypotonia [3-7] may lead to various problems in individuals with Down syndrome, such as; feeding and swallowing difficulties [8, 9], gastrointestinal disorders like constipation and chronic malnutrition [6, 10], and increased risk of dental caries [11, 12]. Furthermore, the different components of the oral phase of swallowing, that is lip closure, tongue

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movements and mastication are compromised in DS patients [13].

The important role of the tongue in the sequence of mastication and transportation of the bolus to the mesopharynx has been studied in detail [14], revealing that the force generated by the compression of the tongue against the hard palate is a major propulsive force to transport a food bolus toward the pharynx. Tongue force abnormalities in DS patients encompass a lower magnitude and a shorter duration of pressure [7]. Hence, it is obvious that the decreased tongue strength leads to ineffective transportation of food particles, increased residues and ultimately a greater chance of tooth decay [15].

On the other hand, although many studies have shown lower rates of dental caries in DS patients compared to groups not affected by DS or groups with other disabilities [16-25], some have reported contrary findings resulting in financial burdens [10, 11, 26-30]. Regardless of the dental health state, DS children require particular attention to maintain oral hygiene [27].

Therefore, the goal of the present study was to evaluate the correlation between the tongue strength and the prevalence of Decayed, Missing and Filled Teeth (DMFT) in DS patients.

Methods

Patients and Settings

This cross-sectional study was conducted in an education center for students with special needs in Shiraz, Iran. All DS students were invited to participate in this study (n=20). Sixteen DS students were included in the study. The inclusion criteria were; 1- ability to follow the examiners' instructions during the process and 2- having a normal diet. The exclusion criteria consisted of: 1- having any comorbid problem which can affect the swallowing ability of the participants or ability to follow instructions such as autism, cerebral palsy or hearing loss, 2- having dysphagia which was acknowledged by parents and/or caregivers, 3- refusing to participate in the study.

An informed written consent was obtained from parents or the lawful guardian of the participants. The study protocol was designed in accordance to the Helsinki Declaration and approved by the institutional review board of Shiraz University of Medical Sciences, Shiraz, Iran. Confidentiality of the patients' data was ensured.

Data Gathering

A researcher made interview checklist was prepared to gather demographic characteristics of the participants. The items such as sex, age, having any dysphagia problem which was confirmed by the physician, tongue movement (up, down, right, left, in and out of the mouth) and the need for tooth brushing assistance were included in the checklist.

Tongue strength was measured with the Iowa oral performance instrument (IOPI) model 2.3 (Figure 1). The IOPI is a device and a tongue bulb is attached to

it. Its aim is to measure oral motor structures such as tongue and lip strength and endurance. For measuring the strength, the participant should press the bulb with their tongue against the palate or by the lips. The peak pressure is a measure of strength and is expressed in kilopascal (kPa). The endurance is used to assess tongue fatigability. Low endurance is an indicator of high fatigability. It is measured by quantifying the length of time that a participant can maintain 50% of their peak pressure. The IOPI was originally developed to examine the relationships between tongue strength or endurance and speech motor control; its role has subsequently been extended to examine relationships with swallowing [31]. Currently it is one of the most commonly used measurement techniques available to objectively measure tongue strength and endurance [32]. Three days before the study, all the participants were taught to press the bulb with their tongue as tight as possible to their palate and not bite the bulb. Training and investigation of the tongue strength was performed by a speech therapist who worked with DS children.

A dentist with 5 years of experience with DS patients assessed the dental health state and completed the DMFT form. DMFT index was applied to evaluate the dental health state. The DMFT index has been in use for about 65 years, and is well established as the leading measure of caries experience in dental epidemiology [33]. The number of decayed, missing or filled teeth was recorded for both deciduous and permanent teeth.

After investigating the tongue strength and dental health status, students were provided with a biscuit and were requested to eat all of it and inform the speech therapist when there was no biscuit left in their mouth. After the subjects confirmed there was nothing left in their mouths, the speech therapist did the physical examination to investigate the residues in the mouth.

Statistical Analysis

Variables are represented as frequency, mean and standard deviations as applicable. Pearson coefficient was used to demonstrate the correlation between tongue strength and the DMFT indices. A P value less than 0.05 is considered statistically significant.

Results

Sixteen DS students with a mean age (an ordinal variable) of 11.06 ± 2.83 years participated in this study. Most of the participants were female (a nominal variable) (n=14, 87.50%). All of them had mixed dentition. Mean tongue strength (an ordinal variable) was 10.22 ± 7.08 kilopascals. Mean DMFT score for deciduous and permanent teeth (an ordinal variable) were 3.56 ± 3.26 and 2.18 ± 2.71 , respectively. The overall mean score was 5.75 ± 3.54 . Six students brushed their teeth with the help of their parents (a nominal variable) (Table 1). All of the participants had oral residues (a nominal variable). No significant correlations were found between tongue strength and deciduous ($r=-0.38$, $P=0.13$), permanent



Figure 1: Iowa Oral Performance Instrument model 2.3.
 Note: Obtained from Northwest IO. Iowa oral performance instrument: user's manual. Carnation, WA: IOPI Northwest. 2005.

($r=0.44$, $P=0.81$) and the overall DMFT scores ($r=0.014$, $P=0.95$).

Discussion

This is the first study that has examined the correlation of tongue strength and dental caries in individuals with DS. It has been assumed that the dental biofilm of children with DS may have a higher cariogenic potential than that of children without this condition; oral hygiene in children with DS is worse than in children with no DS, and self-cleaning in children with hypotonia may be reduced resulting in more food remaining on the teeth after eating [34, 35].

The tongue strength scores in DS children in our study were very low (10.22 ± 7.08 kilopascal) in comparison to the mean value results in the literature (43 to 78

kilopascal) [31]. According to the research of Potter et al., the tongue strength values in participants who were in the age range of 3-17 years was much higher (48.08 ± 18.85 for males and 38.16 ± 8.14 for females) [36] than the results of this study. This could be due to hypotonia of tongue muscle [34, 35].

The present study showed that only about one third of the participants (six students) were helped by their parents when brushing their teeth, while all of them had residues in their mouth which is an indication of poor tongue strength [32]. On the other hand, residues have the potential to increase the risk of tooth decay, [15] therefore we suggest that all children with DS should brush their teeth under parents / caregivers' supervision until the time their tongue strength and sense of residues in the mouth improve.

There was a poor relationship between oral residue and DMFT score in this study. One of the reasons for finding this result was the limitation in sample size. Therefore, we suggest doing such a study with a greater sample size so that the results can be more powerful and reliable. However, we did not find any relationship between tongue strength and DMFT score of the children with DS in our study.

Data from normal children showed that there is a direct correlation between DMFT score and tongue strength. The authors of these articles suggested that poor dental status and conditions such as dental caries may affect the tongue strength development in normal children. [37-39] On the other hand, other data showed that the oral residues remaining in the mouth have the potential to increase the risk of dental caries in the participants [40, 41]. Therefore, it would be wise for speech therapists or other health professionals who are experts in swallowing therapy to consider these issues and refer children to dentists for further investigation so that they can find and prevent the potential dental decay and reduce the burden of dental diseases in individuals with Down syndrome, their families and society [40, 41].

The treatment of hypotonia by speech therapists or other health professionals who are experts in swallowing therapy is most significant since it targets strengthening

Table 1: Dependence on tooth brushing, age and sex of participants in detail

Participants	Dependency to others for tooth brushing	Age	Sex
1	No	13.00	Female
2	Yes	9.00	Female
3	Yes	6.00	Female
4	No	9.00	Female
5	No	12.00	Female
6	No	12.00	Female
7	Yes	8.00	Male
8	No	9.00	Male
9	No	10.00	Female
10	Yes	14.00	Female
11	Yes	13.00	Female
12	No	16.00	Female
13	No	9.00	Female
14	No	10.00	Female
15	Yes	16.00	Female
16	No	11.00	Female

the mouth muscles which improves basic oral functions such as chewing and swallowing and has the potential to decrease the risk of dental caries [11, 12, 42]. In general, health care of those with Down syndrome should be based on a team approach to provide each patient with their own special need care. Additionally, parental education and involvement is also necessary for the child's management [43]. Hence, we emphasize on a team approach and parental education in treating and managing DS individuals. This team work would best address health problems that DS children face such as swallowing as well as dental caries.

Conclusion

According to the results of the present study, all participants had food debris in their mouth which could be a risk factor for dental caries.

However, further studies are required to understand tongue function in limiting tooth caries and how it may be different in individuals with DS and other populations.

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Conflict of Interest: None declared.

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