

Article

Association Between Tongue-Coating Index (TCI) and Severity of Halitosis in Adolescent Male Students in the City of Karbala, Iraq

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Citation: Madhloom, B. N. Association Between Tongue-Coating Index (TCI) and Severity of Halitosis in Adolescent Male Students in the City of Karbala, Iraq. American Journal Of Biodiversity 2026, 3(9), 29-35

Received: 13th Jun 2026

Revised: 28th Jul 2026

Accepted: 15th Aug 2026

Published: 29th Sep 2026



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Abstract: Background: The tongue coating (TC) is the formation of a white-greyish layer in the mouth which is mainly responsible for intraoral halitosis (IOH) and is usually unwanted. One of the leading contributors to IOH is volatile sulfur compounds (VSC), with TC and periodontal disease recognized as the primary sources of VSC. The dorsum of the tongue has a papilla-covered surface that contains a relatively high amount of desquamated cells, leukocytes, and microbes that produce the odorous substances responsible for bad breath. This study aimed to analyze the relationship between tongue coating and halitosis. Materials and methods: The population consists of 400 males students from 44 secondary institutions located in Karbala city, Iraq. The Halimeter was used to measure the extent of bad breath among the test subjects. The levels of tongue coating were assessed by the use of the tongue coating index (TCI) method. Results: There was a relationship revealed regarding halitosis and tongue score (P value 0.000). It was also found that tongue coating scores had a significant relationship with values of VSC. Conclusion: Halitosis can lead to psychological issues for individuals, representing a significant health concern. The findings indicate a positive impact of increased awareness regarding oral hygiene and the practice of tongue brushing, which contribute to enhanced oral odor and overall oral health.

Keywords: Halitosis; oral hygiene; volatile sulfur compounds; tongue coating; halimeter; adolescent students

Introduction

The significance of halitosis extends beyond the understanding of its origins, diagnosis, and treatment; it intersects with several sociological factors including as culture, religion, race, and gender. The awareness of this grievance dates back to antiquity. Oral halitosis is a prevalent issue among dental patients; moreover, an important percentage of adult's experience socially unacceptable breath upon awakening in the morning [1], [2]. Halitosis is classified into several main types, namely genuine bad breath resulting from causes either inside or outside the mouth, transitory halitosis, delusional halitosis, and halitophobia [3]. No oral halitosis originates from outside the oral cavity, while oral halitosis arises from within the cavity of the oral. In the case of pseudo-halitosis odor a condition in which no unpleasant is detected, yet the person in question firmly believes they have halitosis.

Generally, TC is significantly more associated with other conditions than concurrent lingual disorders-such as the tongue fissured, which can be linked with decrease in saliva, thrush, diabetes, and deficiency of B vitamins, lichenoid conditions, and the disease of Sjögren's, and smooth tongue, meaning lack of vitamins, dryness of the mouth, local injury, or thrush [4]. The lingual tissues reflects the state of the body, as it frequently offers insights into systemic variations for diagnostic evaluation [5], [6]. Accumulation of food debris and bacteria in the filiform lingual papillae may result in development in dense coating [7]. Furthermore, The tongue consists of both keratinized and non-keratinized epithelial cells, so the balance between keeping and getting rid of the two types of epithelial cells can control TC formation [5].

A TC is typically found in healthy individuals [7]. The typical tongue biofilm is thin and mildly damp, pale-white layer that adheres to the dorsal aspect of the tongue. The typical tissue property may differ in wetness, thickness, distribution or color, contingent upon the overall health status. The thickness and coloration characteristics of the tongue coating are influenced by nutritional circumstances. The consistency of the TC varies from a clear, aqueous solution to a thick, colored, mucilaginous paste, based on the type of foods consumed. Furthermore, fatty foods that are high in grease lead to the development of total cholesterol (TC) [8]. [9].

The removal of TC resulted in a comprehensive reduction of VSCs, which can infiltrate oral tissues and enhance the permeability of the oral mucosa. [12] and influence collagen production and breakdown [13]. Moreover, VSCs induce the release of IL-1 cytokines, which elicits a response that facilitates bone resorption associated by prostaglandin E2. Composition, increased mucosal permeability mediated with VSCs may contribute significantly to the progression of gingivitis into periodontitis, although this is presently indistinct [14].

Halitosis induces psychosocial issues for the patient, representing a significant health concern. Healthcare personnel must get comprehensive understanding of the various facets of halitosis to adequately diagnose and treat patients. Furthermore, understanding the TC is essential for differentiating IOH from other types of halitosis. The clinical assessment significance of the tongue may be considerable in relation to illnesses [15].

Materials and Methods

This study was an observational cross-sectional research conducted from December 2023 to February 2024 to assess the influence of tongue coating on halitosis in 15 years old youths.

Ethical approval

Approval from the reviewing authority was acquired, and all study participants provided informed consent.

Sample and sampling

Multistage Random Sampling comprised male secondary school students aged 15 years. The age was determined based on the criteria established by the World Health Organization (1997) and calculated from the individual's most recent birthday. The overall number of schools was 44, and the total number of pupils was 5,477 at the schools located in the center of Karbala city.

Sample size

The sample size was detected by using G- power program The sample consists of 400 kids randomly picked from schools in the center of Karbala city.

Excluded criteria

1. Students with systemic disorders.
2. A medical history of infectious diseases, tonsillitis, sinusitis, respiratory infections, and nasal polyps. All pupils ought to refrain from smoking.
3. Malocclusion and draining fistulas linked to persistent alveolar abscesses.
4. Use of any chemical plaque-disclosing agent form control or administration of drugs within one month prior to the commencement of the examination.
5. The existence of dental crowding or overlapping, leading to significant gingival inflammation, particularly in students undergoing orthodontic treatment.

Tools and instruments

The volatile sulfides were measured using a sulfide monitor (Fitscan, Tanita Corp., Arlington, USA) (15).

Methods of data collection

Students participating in this study should refrain from all oral functions such as food intake, drinking, and oral hygiene routines, for at least one hour prior to halitosis measurement using a halimeter (16). In cases of forgetfulness, the mouth should be thoroughly cleaned, and a minimum of 10 minutes must pass before use the halimeter. Following the placement of the student in an isolated room, he should be instructed to maintain closed lips for approximately 3 minutes and to breathe nasally, following which halitosis will be evaluated. Seventeen.

Measurements conducted in accordance with the manufacturer's specifications:

1. Initially, the lid was elevated to activate the sensor. The countdown display shows the digits 5 to 1, while the device is gently agitated 4 - 5 times to remove any odor or.
2. Upon activating the device, the student must exhale into the sensor until a beep is emitted, which typically requires approximately 4 seconds, ensuring that neither the sensor nor the back ventilation is obstructed by hand. The aperture must be positioned roughly 1cm from the mouth; therefore, the student should place the thumb on the chin to ensure the sensor is directly aligned with the mouth, as illustrated in Figure (2-2) (B). If the student ceases to breathe prior to the beep or fails to breathe within six seconds, the camera will immediately deactivate.

Instruments score

The displayed term level flashes on the screen blinks for several seconds prior to gadget powers down. The sensor closes with the tip at completion of the procedure, and the score is recorded on the student case sheet.

Table 1. Breath odor levels

Score	Criteria
S0	No odor
S1	Slight odor
S2	Moderate odor
S3	Heavy odor
S4	Strong odor
S5	Intense odor
E	Error "please try again".

Tongue scores were evaluated through direct visual assessment utilizing the tongue coating index (TCI) [18]. The Shimizu approach was extensively utilized in clinical practice and research [7], [19], [20], [21], [22]. The tongues of each student were assessed covering the area between the tongue tip and vallate papillae, segmenting the tongue surface into 9 areas, a central region accompanied by two lateral regions for the posterior, middle and anterior thirds portions of tongue. Each of the nine sections will be evaluated based on the criteria established by Shimizu (2007) [18]. A thin layer was assigned score when the underlying pink hue remained visible beneath the coating. A thick coating was assigned a score if no underlying pink coloration could be observed.

To achieve a score over 0, each segment of the tongue must be coated for over one-third. The scores for tongue-coating condition degree were documented in the corresponding part of the Tongue Coating Record (TCR). The aggregate scores of the nine categories scores were normalized by eighteen and multiplied by one hundred to derive the percentage of tongue coating.

Table 2. Criteria for the tongue coating index (TCI) as per Shimizu (2007).

Score	Criteria
0	No detectable TC
1	Thin TC with clearly discernible lingual papillae
2	Dense coating obscuring the underlying lingual papillae

Results

Figure (1) depicts the distribution of tongue coating index (TCI) scores among students. A thin tongue coating with a pinkish hue beneath the papilla (score 1) was observed as the predominant score among 168 students (42%), whereas a thick tongue coating devoid of a pinkish tint on the papilla (score 2) was noted as the highest score among 232 students (58%).

Table (1) depicts the distribution of students and the mean value of tongue coating in relation to halimeter scores. The value of the tongue coating index escalated with increasing halimeter scores, with a greater mean observed for score 5 compared to other scores. The differences was statistically significant (was observed) at $P=0.000$.

Table (2) presents several comparisons of the tongue coating index relative to halimeter scores utilizing the Games-Howell test. Most results were statistically significant among halimeter scores, with the exception of the comparison between score 3 and the final two scores, as well as between the last two scores themselves, which were not significant.

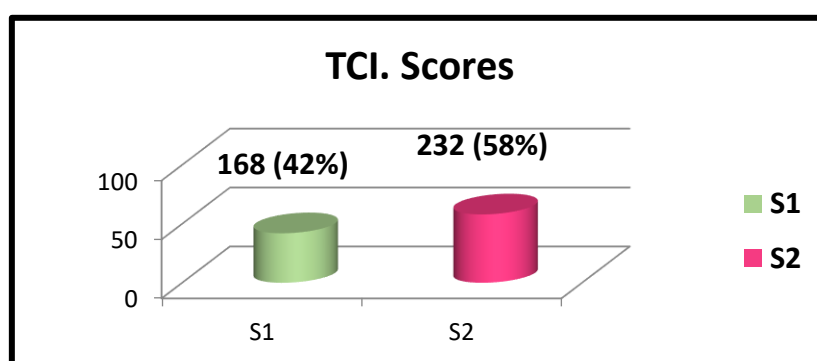


Figure 1. Cluster chart shows the tongue coating index (TCI) scores

Table 1. Descriptive and statistical test of tongue coating index according to halimeter scores

HS	TCI					P-value
	No.	Percent%	Mean	SE	F	
0	59	14.75%	25.518	1.033	144.764	0.000
1	79	19.75%	45.007	1.009		
2	99	24.75%	56.173	1.018		
3	74	18.50%	65.541	1.438		
4	65	16.25%	71.026	1.703		
5	24	6.00%	75.000	3.769		

HS=halimeter scores *=significant TCI= Tongue coating index NO.= number

Table 2.: Multiple Comparisons of Tongue coating index between Halimeter scores using Games-Howell

(I) HS	(J) HS	Mean Difference (I-J)	P value
0	1	-19.489*	0.000*
	2	-30.655*	0.000*
	3	-40.023*	0.000*
	4	-45.508*	0.000*
	5	-49.482*	0.000*
1	2	-11.166*	0.000*
	3	-20.534*	0.000*
	4	-26.019*	0.000*
	5	-29.993*	0.000*
2	3	-9.368*	0.000*
	4	-14.853*	0.000*
	5	-18.827*	0.001*
3	4	-5.485	0.144**
	5	-9.459	0.208**
4	5	-3.974	0.927**

**NS= non-significant *S= significant HS=halimeter score

Discussion

The primary contributors to halitosis include the teeth, gums, and tongue [23]. A growing body of evidence suggests that the tongue coating is the primary factor contributing to halitosis [24]. Although participants in the study might not be representative of the whole adolescent population, the data they have provided contribute to our understanding of the relationship between tongue coatings and halitosis. So, tongue coating scores were found to correlate with both the VSC values and self-reported questionnaire scores, and this finding has been reported also in previous epidemiological studies [20], [25], [26], [27], [28].

Posterior portion of the tongue is always coated by a layer of mush which consists of cells such as bacteria and dead epithelial cells along with substances like proteins found in saliva. The presence of this layer on the tongue increases the abundance of volatile sulphur compounds in the oral cavity.

A significant increase in the severity of halitosis associated with the occurrence of tongue coating was revealed [30]. These results are consistent with the findings of [25], [26], identifying tongue coating as the primary variable associated with volatile sulfur compound (VSC) levels.

Conclusion

Halitosis can lead to psychological issues for the individual, indicating a significant health concern. Healthcare practitioners should possess sufficient understanding of the various aspects of halitosis to effectively diagnose and treat patients. Furthermore, understanding the TC is crucial for differentiating IOH from other forms of halitosis. Furthermore, the clinical relevance (significance) of the tongue may hold considerable relevance.

Suggestions

1. Enhancing students' comprehension of the causes of bad breath and steps to prevent it.
2. Encouraging proper tongue care to minimize plaque formation and unpleasant mouth odor.
3. Training health professionals and oral care practitioners on the early detection and effective evaluation of bad breath.

4. Carrying out constant examinations on students to spot bad breath and other dental problems early.
5. Tutoring students on the reasons behind bad breath like inadequate oral hygiene, particular eating habits, and smoking.
6. Conducting studies on diverse age groups including females, and in different areas to broaden the applicability of the studies.
7. Carrying out large-scale studies to examine the connection between plaque formations, bad breath and other dental and medical conditions.

Considerations

The authors claim that there are no conflicts of interest to declare. The study was funded independently.

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