



## Translation, Transcultural Adaptation and Validation of the Halitosis Associated Life-Quality Test for Use in Brazilian Adolescents

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Academic Editors: Alessandro Leite Cavalcanti and Wilton Wilney Nascimento Padilha

Received: 29 July 2018 / Accepted: 28 December 2018 / Published: 09 January 2019

### Abstract

**Objective:** To perform the transcultural adaptation to Brazil and validation of the Halitosis Associated Life-quality Test (HALT) for use in adolescents. **Material and Methods:** Students aged 12 to 15 years, of both sexes, with healthy permanent dentition, attending public schools in Piracicaba, Brazil, were selected for this study. The HALT was translated, backtranslated, reviewed by an expert committee and submitted to a pre-test. In the first phase (n = 13), 15% of the sample did not understand items 2, 12 and 15; therefore, these items were reformulated and resubmitted to 13 adolescents. The version with a sociocultural adaptation was self-applied by 56 adolescents (64% females, 13.4 ± 1.0 years), of whom 25 participated in the test-retest. The presence of visible biofilm, gingival bleeding, calculus and tongue coating, was evaluated. Self-perception of halitosis after exhalation/breathing was assessed by a single question. **Results:** The HALT score ranged from 0 to 62 points (mean = 10.1 ± 13.4) and the floor effect was 5.4%. Internal consistency was excellent (Cronbach's alpha = 0.92) and reproducibility was moderate (Intraclass Correlation Coefficient = 0.59). Individuals with “excessive” tongue coating had a higher HALT score than those with mild and/or moderate coating (p < 0.001). Multiple linear regression analysis indicated that only the male sex was related to a higher HALT score (p < 0.05). **Conclusion:** The Brazilian Portuguese version of the HALT was easily understood by adolescents. Those with greater tongue coating accumulation reported more frequently the presence of halitosis, which was only associated to male sex.

**Keywords:** Validation Studies; Surveys and Questionnaires; Quality of Life.

## Introduction

Halitosis, also known as bad breath or malodor, is a term used to describe malodor present in the mouth, with an intraoral or extraoral origin [1-4]. This condition may be permanent or transitory depending on oral hygiene habits [5]. Currently, halitosis is a very prevalent complaint whose frequency is only behind that of dental caries and periodontal disease [6].

The report of bad breath occurs most commonly after waking up, a transient physiological condition resulting from the reduced salivary flow during sleep [7]. Persistent halitosis can be caused by intraoral factors, such as oral diseases (periodontal disease, gingivitis, caries, biofilm accumulation and tongue coating) [4,7] as well as extraoral factors, such as systemic diseases (upper and lower respiratory tract infection, gastrointestinal disorders, metabolic diseases affecting the kidneys and liver, and endocrine disorders such as diabetes mellitus) [1,4,7-9].

The malodor originates from volatile sulfur compounds (VSC), i.e., hydrogen sulfate ( $H_2S$ ), methyl mercaptan ( $CH_3SH$ ) and dimethyl sulfate [ $(CH_3)_2S$ ] [1,2,7,8,10], which are produced by gram-negative bacteria present in the oral cavity [7,8,10]. In addition, previous in vitro studies have shown that gram-positive bacteria such as *Peptostreptococcus* spp. are also able to produce VSC and therefore play an important role in halitosis [7,10].

Halitosis can be clinically detected by organoleptic evaluation of the air emanating from the mouth, by gas chromatography (Oral Chroma) [1,8] or through a sulfide monitor [11]. Other alternative methods include the BANA test (benzoyl-DL-arginine-naphthylamide enzyme), chemical sensors, salivary incubation test, B-galactosidase activity quantification, ammonia monitoring, ninhydrin method and polymerase chain reaction [2].

Epidemiological studies have reported a prevalence of 32% of self-perceived halitosis in the general population [12] and of 25% to 47% in dental patients [2,13]. Previous studies have suggested a relationship between age and halitosis, with more intense odor detected in older individuals; as well as an equal proportion between the sexes [13,14]. Although halitosis is a more frequent complaint in the adult population, children may likewise be affected by this condition [10].

Self-perceived oral health-related quality of life is a valid method to evaluate the impact of oral conditions in adults and children [15]. Halitosis has a negative effect on the individual's day-to-day life, affecting socialization and interpersonal relationships [5]. In adolescence, it is a relevant condition impairing social development [15]. Previous studies have found a significant association between malodor self-perception and the clinical diagnosis of halitosis in individuals who were not concerned with such a condition [14], as well as in patients seeking dental care [16]. These findings have provided evidence that the subjective method is a valid approach in the evaluation of halitosis. Currently, there is only one specific tool available to assess halitosis-related quality of life, which was developed in English and requires 5 minutes for its application [5]. The "Halitosis Associated Life-quality Test" (HALT) is valid and reliable for use in adults with halitosis detected by organoleptic testing [5]. Nevertheless, there is no proposal for the translation and validation of this questionnaire in Brazil, especially for use in young individuals with a subjective and clinical diagnosis of halitosis.

Thus, the aim of this study was to translate the HALT into Brazilian Portuguese, and perform its transcultural adaptation and validation for use in adolescents. The specific aims were to evaluate the differences and investigate an association of the HALT scores with the demographic, clinical and halitosis self-perception characteristics of the study population.

## Material and Methods

### Study Design and Ethical Issues

This was a quantitative and cross-sectional study carried to validate the HALT questionnaire. The study project was previously approved by the Research Ethics Committee at Piracicaba Dental School, University of Campinas (FOP/UNICAMP), under Protocol No. 1.918.555. Written authorization was obtained from the corresponding author of the original questionnaire for translation into Portuguese and transcultural adaptation to the context of the Brazilian culture. In addition, the directors of public schools in the city of Piracicaba, SP, Brazil, authorized the study execution, as well as did all legal guardians and participants by signing an informed consent form.

### Measurement Tools

The HALT was originally developed in English [5] to assess the impact of halitosis on quality of life. It is a specific and self-applied questionnaire composed of 20 items related to physical, emotional and functional limitations as well as to personal and social difficulties resulting from the presence of halitosis. The items are measured by a Likert scale of 5 points and indicate the intensity of the issue based on its frequency (score 0, no issue; 1, very minor issue; 2, minor or mild issue, 3, moderate issue, 4, severe issue; 5, worst possible issue). The scores can range from 0 to 100, and a higher the score indicates greater impact on quality of life.

The methodology proposed in specific literature in the light of internationally recommended guidelines was followed to translate the questionnaire into Brazilian Portuguese, as well as to adapt and validate it for the Brazilian culture [17]. The steps of this process are illustrated in the Figure 1.

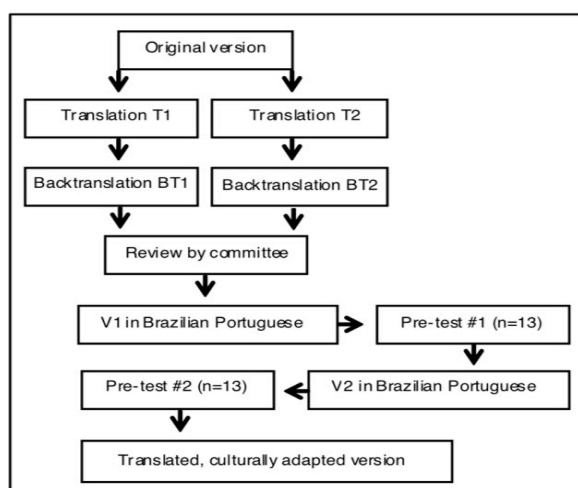


Figure 1. Flow diagram of the HALT translation and cultural adaptation process.

## Translation and Transcultural Adaptation

### Primary Translation

The questions from the English version of the HALT were translated into Portuguese by two independent English translators from Brazil, whom were unaware of the study purposes. The translators were instructed to carry out a conceptual, non-literal translation. A review committee evaluated the two translations (T1 and T2) and by consensus reduced the differences found between them. The best translation was chosen, and questions were modified by approximation of terms for better understanding by the Brazilian population. Thus, only one version translated into Portuguese was obtained.

### Backtranslation

The translated version in Portuguese was submitted to two bilingual translators with English as their first language, whom were unaware of the original text. The translators made a new version for the English language. They were not allowed to have contact with the original text written in English to avoid any influence during translation. The purpose of the backtranslation (BT1 and BT2) was to detect errors or deviations from the original questionnaire, as suggested by the backtranslation methodology [17]. Therefore, only one version backtranslated into English was obtained.

### Review by Expert Committee

A review committee composed of two specialists in Pediatric Dentistry, with expertise in the topics addressed in the questionnaire, fluent in English and Portuguese, compared the two translated versions of the HALT with the original English version. Adjustments were made accordingly to obtain a single accurate Portuguese version of the questionnaire, which corresponded to Portuguese version no. 1 (V1). During this procedure, semantic, idiomatic and experimental or cultural equivalences were observed [18].

### Cultural Adaptation (Pre-Test)

In a pre-test, V1 was self-applied in a group of 13 adolescents who did not participate in the final sample. The purpose of this step was to check for the clarity of the questions. An option was included in each question with the sentence "I did not understand". Cultural equivalence would be established when at least 85% of the adolescents did not demonstrate any difficulty in answering each question [17]. Questions that were not understood by more than 15% of participants were re-evaluated by the expert committee and replaced by others with the same concept, so that the structure and properties of their evaluation would not be significantly altered. After the modifications, the Portuguese version no. 2 was applied to another group of 13 students to test its cultural equivalence to guarantee that questions were understood by more than 15% of students. Then one socioculturally adapted version of the HALT for Brazilian Portuguese was obtained. At

this phase, the only exclusion criterion was the inability to understand and/or self-fill the questionnaire.

### Validation and Reproducibility

To validate the questionnaire, a sample of 56 adolescents of both sexes, aged between 12 and 15 years, with a permanent healthy dentition (except for third molars), was used. The sample calculation was based on the Pahm study [16], with Spearman's correlation coefficient of 0.50 for hydrogen sulfide (H<sub>2</sub>S) and 0.46 for methylmercaptan (CH<sub>3</sub>SH). Based on the lower correlation coefficient ( $r = 0.46$ ), a test power of 0.80, an alpha level of 0.05 and a correction factor of 1.2, the minimum recommended sample size was 36 volunteers.

The inclusion criteria consisted of the presence of all permanent teeth, except for third molars, and absence of dental caries. Subjects who reported upper respiratory tract infection, antibiotic use during the three weeks prior to examination, and inappropriate behavior and/or refusal to collaborate on dental procedures and data collection, were excluded from the study. The students in need of dental treatment were referred to the undergraduate dental clinics at FOP/UNICAMP. A total of 25 out of the 56 adolescents were randomly selected to redo the HALT after two weeks from the first application in order to determine the reproducibility of the questionnaire.

### Clinical Oral Examination

Oral hygiene was evaluated by a trained examiner (by the influx method) [19] considering the presence of dental biofilm, gingivitis and tongue coating. All evaluations took place before the school daily break, that is, before meals. The training consisted of visual observation of images (for 1 minute each) and the diagnosis (presence and absence) of the oral conditions, with different levels of severity; then the results were compared with the gold-standard records.

The presence of visible biofilm was evaluated in the vestibular surfaces of the upper incisors without the use of dye. The presence of biofilm in one incisor was classified with score 1, in two incisors with score 2, and so forth, until score 4 [20].

The periodontal condition of the adolescents was evaluated by the Community Periodontal Index (CPI) based on the World Health Organization criteria [21]. The index teeth (16, 11, 26, 36, 31, 46) representative of each buccal sextant were examined using the CPI probe. The probe was applied under pressure (20 grams: it is recommended as a practical test to place the tip of the probe on the thumbnail and press until a slight ischemia is seen) into the gingival sulcus of the index teeth to detect subgingival calculus and bleeding. The following codes were used: 0, healthy sextant; 1, sextant with bleeding; 2, presence of calculus; X, excluded sextant (less than 2 teeth); and 9, not registered. The CPI also considers the analysis of periodontal pockets (codes 3 and 4), but this is not applicable in children under 15 years of age.

Tongue coating was evaluated according to a previously described method [7]. Briefly, the tongue was divided into sextants: posterior portion (right, middle and left) and anterior portion (right, middle and left). Each sextant was given a score varying between 0 (no coating) and 2 (excessive coating); the sum of the sextants determined the final score. A higher score indicated a greater amount of tongue coating.

#### Self-Perceived Halitosis

To analyze the self-perception of halitosis, students were instructed to close their mouth for 3 minutes, place their hands over their mouth and nose, and then exhale the air from their mouth and breathe through their nose [1]. The students rated the intensity of the odor in a scale of 5 points, namely: 0, no smell; 1, questionable smell; 2, mild yet easily perceivable smell; 3, moderate smell; 4, strong smell; and 5, extremely bad smell [22].

The adolescents were instructed NOT to: (1) consume garlic, onion and/or food with strong seasoning 48 h before the examination; (2) drink alcohol, use mouthwash and smoke in the previous 12 h; (3) perform oral hygiene (brushing, flossing and tongue cleaning) 2 h prior to examination; (4) eat or drink in the previous 2 h; and (5) use perfume and aromatic cosmetics on the morning of the exam.

#### Psychometric Analysis

The data obtained were used to evaluate the psychometric properties of the questionnaire, which were: reliability (internal consistency and reproducibility) and validity (criterion, construct and predictive).

Internal consistency reflects the extent to which the items in a questionnaire measure the same phenomenon. This was evaluated by the standardized Cronbach's alpha coefficient, which evaluates whether the degree of total variance of the test results is associated to the sum of the variance from item to item; the result can range from -1 to +1, indicating, respectively, the maximum negative and positive correlations between the components of the measure. Values above 0.80 indicate good internal consistency; however, in questionnaires with a reduced number of items, such as in the present study, values starting at 0.60 are acceptable [23].

The temporal stability of a research instrument refers to the degree to which its repeated application to the same subject produces equal results, that is, it is related to the constancy of the results obtained. The Intraclass Correlation Coefficient (ICC) differentiates the variability attributed to the error of the differences between the data, in that values between 0.81 and 1.0 indicate nearly perfect test-retest reliability; 0.61 to 0.80, substantial; and 0.41 to 0.60, moderate reliability [24].

Criterion validity establishes the validity of a measuring instrument by comparing it with some external or standard criterion. In this study, the criterion validity was determined by comparing and correlating the HALT scores among the self-perceived halitosis responses obtained by a single question.



Construct validity refers to the degree to which an instrument is consistently related to other similar measures derived from the same theory and concepts. For the construct validity of the questionnaire, the hypothesis that demographic and clinical categories would have different mean HALT scores was established and tested by comparison tests.

### Statistical Analysis

The data were analyzed in the software Bioestat 5.0 (Instituto de Desenvolvimento Sustentável Mamirauá, Belém, PA, Brazil), with a significance level of  $\alpha = 0.05$ . The results were submitted to descriptive analysis (mean, standard deviation, percentage) and the Shapiro Wilk normality test, which detected a non-normal distribution, indicating therefore the need for non-parametric tests. The internal consistency and reproducibility of the questionnaire were determined by calculating the Cronbach's alpha coefficient and the ICC. The construct validity was checked by comparing the HALT scores between the categories of independent variables (sex, age, visible biofilm, CPI, tongue coating) by the Mann-Whitney or Kruskal-Wallis test, where appropriate. Criterion validity was assessed by comparing and correlating the categories of responses to the single question of self-perceived halitosis with the HALT scores. Multiple linear regression analysis was used to test the predictive validity, considering the HALT score as a dependent variable.

### Results

Table 1 summarizes the decision process regarding the specification of the Brazilian Portuguese versions for elaboration of the final questionnaire, which was submitted to a primary translation, backtranslation and review by an expert committee.

First, a primary conceptual translation was performed by two native Brazilian translators, whom were fluent in English. The comparison between the translated versions (T1 and T2) allowed for the selection of the best version and the modification by approximation of more appropriate terms, in order to facilitate the understanding by the Brazilian population of adolescents. Thereby, the first Brazilian Portuguese version (V1) of the questionnaire was obtained.

Second, V1 was backtranslated into English by two native English translators, whom were fluent in Brazilian Portuguese and did not know the original questionnaire. The two backtranslated versions (BT1 and BT2) were then compared by the expert review committee so that divergent sentences were rewritten to reach a consensus, resulting in the second Brazilian Portuguese version (V2). V2 showed similarity and prevalence in relation to V1 in items 1, 5, 10, 11, 12 and 20 and equality in items 14, 15, 16, 18 and 19.

Incomprehensible technical terms were replaced by others culturally accepted. The best expressions and words were used to adapt the text to the cultural background of the studied population. This part of the study considered the following: (1) semantic equivalence (grammar and vocabulary), where terms such as "change of taste", "problems speaking", "appearance affected", "spending time" and "mentioned" were replaced, respectively, by "altered taste", "avoid speaking",

“bad appearance”, “waste of time” and “speak up”; and (2) idiomatic translation (non-literal translation of expressions yet with equivalent meaning) and cultural translation (experiences lived within the cultural context of society), where terms like “limiting certain food” and “halitosis” were replaced, respectively, by “avoiding some food” and “bad breath”. Thereby, the third Brazilian Portuguese version (V3) of the questionnaire was obtained.

**Table 1. Summary of the decision process regarding the specification of the Brazilian Portuguese versions for elaboration of the final questionnaire.**

Terms	Version	Committee	Pre-test
1. Mouth breathing	V1≈V2	Breathing through the mouth	
2. Tonsillar infections	V1		Throat infections
3. Sinus infections	V1		
4. Worrying / self conscious / mouth breath	V3	Aware / Breathing through the mouth	
5. Miserable / tense / halitosis	V1≈V2	Bad breath	
6. Difficulty chewing / limiting certain food / halitosis	V3	Avoid some food / Bad breath	
7. Change of taste	V3	Altered taste	
8. Problems speaking / halitosis	V3	Avoid speaking / Bad breath	
9. Appearance affected / halitosis	V3	Bad appearance / Bad breath	
10. Depressed / mouth breath	V1≈V2	Bad breath	
11. Problems concentrating / halitosis	V1≈V2	Bad breath	
12. Embarrassed / halitosis	V2		Shameful situations
13. Spending time / halitosis	V3	Waste of time	
14. Talking from afar / halitosis	V1=V2	Bad breath	
15. Avoid going out / halitosis	V1=V2	Bad breath	Avoid contact with other people
16. Communication problems / halitosis	V1=V2	Bad breath	
17. Mentioned / halitosis	V3	Speak up / Bad breath	
18. Suffer financial loss / halitosis	V1=V2	Have a loss / Bad breath	
19. Suffer social/personal loss / halitosis	V1=V2	Have a loss / Bad breath	
20. Reduced life satisfaction / halitosis	V1≈V2	Bad breath	

V1, first translated version selected; V2, second translated version selected; V3, selection of a modified version; V1 = V2, equality between the two versions; V1≈V2, similarity between the two versions, with specificity for the second one.

To assess the cultural equivalence of the HALT, V3 was applied to 13 students selected through a draw of the authorization forms obtained in the pre-test. In each question, the options “did not understand” or “not applicable” were included to identify the questions that were not understood. Table 2 shows the distribution of adolescents at each phase of the pre-test. In the first phase, the majority of the sample was male (53.8%), aged 14 years (76.9%), with a level of incomprehension higher than 15% for items 2, 12 and 15. The terms “amygdala”, “embarrassments” and “avoid going out” were replaced, respectively, by “throat”, “shameful situations” and “avoid contact with other people”. In the second phase, there was a predominance of females (61.5%), approximately half of the sample were 14 years old (46.2%), with a comprehension level above 85% for all questions. With this, the HALT was considered to be socioculturally adapted for the adolescent population.



**Table 2. Distribution of subjects at each study phase.**

Variables	Pre-test		Validation	Reproducibility
	1 <sup>st</sup> Phase (n=13)	2 <sup>nd</sup> Phase (n=13)	(n=56)	(n=25)
	N (%)	N (%)	N (%)	N (%)
Sex				
Male	7 (53.8)	5 (38.5)	20 (35.7)	9 (36.0)
Female	6 (46.2)	8 (61.5)	36 (64.3)	16 (64.0)
Age (Years)				
12	-	-	15 (26.8)	1 (4.0)
13	2 (15.4)	2 (15.4)	10 (17.9)	3 (12.0)
14	10 (76.9)	6 (46.2)	23 (41.1)	15 (60.0)
15	1 (7.7)	5 (38.5)	8 (14.3)	6 (24.0)
Item "I did not understand"				
n° 2	3 (23.1)	-	-	-
n° 12	4 (30.8)	-	-	-
n° 15	2 (15.4)	-	-	-

Table 3 shows the results of descriptive statistics, internal consistency and reproducibility of the HALT. The scores ranged from 0 to 62 points, with mean of 10.1 ( $\pm 13.4$ ). There was no ceiling effect and only 5.4% of the sample presented floor effect. Cronbach's alpha coefficient and ICC values were 0.92 and 0.59, respectively.

**Table 3. Descriptive statistics, internal consistency and reproducibility of the HALT (n = 56).**

	HALT
Number of Items	20
Possible Score Variation	0-100
Score Variation Observed	0-62
Floor Effect*	3 (5.4)
Ceiling Effect**	0 (0.0)
Mean ( $\pm$ SD)	10.1 (13.4)
Cronbach's Alpha Coefficient	0.92
Intraclass Correlation Coefficient (95% CI) (N = 25)	0.59 (0.26-0.80)

HALT: Halitosis Associated Life-Quality Test; SD: Standard Deviation; CI: Confidence Interval; \*Number and percentage of subjects with score "zero"; \*\*Number and percentage of subjects with maximum score.

Table 4 shows the results of the discriminant validity. Males presented, on average, a higher HALT score than females (14.9 vs. 7.5), but with no significant difference ( $p = 0.155$ ). The HALT scores did not differ significantly between the ages ( $p = 0.311$ ), with the highest average found in 13-year-olds ( $12.2 \pm 11.4$ ) and the lowest in 15-year-olds ( $4.8 \pm 4.5$ ). Although not significant, an upward trend of the HALT mean score was observed in the presence of teeth with visible biofilm, bleeding and/or calculus. Subjects with "excessive" tongue coating in the posterior tongue region presented, on average, a higher HALT score than those with mild and/or moderate coating (6.0 vs. 3.0;  $p < 0.001$ ). In addition, subjects with "excessive" tongue coating in the anterior region also showed a greater HALT score, although it did not differ significantly from those with mild and/or moderate tongue coating.

The criterion validity can be found in Table 5. Subjects who perceived oral odor as "moderate smell" and "no smell" presented, on average, higher and lower scores, respectively (15.4

vs. 6.7), but with no significant differences. The correlation coefficient between the total score of the single question and the HALT score was 0.19, with p value = 0.152.

**Table 4. Construct validity: Relationship between the HALT scores and sample characteristics.**

Variables	N	Mean ( $\pm$ SD)	p-value
Sex			
Male	20	14.9 (16.4)	0.155*
Female	36	7.5 (10.8)	
Age (Years)			
12	15	11.7 (17.6)	0.311*
13	10	12.2 (11.4)	
14	23	10.1 (13.4)	
15	8	4.8 (4.5)	
Visible Biofilm			
Absent	5	3.6 (3.6)	0.349**
1 to 2 teeth	7	8.1 (7.1)	
3 to 4 teeth	44	11.2 (14.7)	
Community Periodontal Index			
Score 0	2	-	0.697**
Score 1 to 4	12	9.1 (7.8)	
Score 5 to 8	26	10.2 (15.6)	
Score 9 to 12	16	11.9 (14.2)	
Posterior Tongue Coating			
Absent	0	-	0.0002*
Present	51	3.0 (0.0)	
Present (in excess)	5	6.0 (0.0)	
Anterior Tongue Coating			
Absent	9	7.8 (8.9)	0.570**
Present	43	9.9 (13.7)	
Present (in excess)	4	18.3 (19.3)	

HALT: Halitosis Associated Life-Quality Test; SD: Standard Deviation; \*Mann-Whitney test; \*\*Kruskal-Wallis test.

**Table 5. Criterion validity: relationship between the HALT scores and sample characteristics.**

Single Question on Self-Perceived Halitosis	N	HALT	
		Mean ( $\pm$ SD)	r <sup>a</sup>
Response Options			
No Smell	18	6.7 (10.6)	
Questionable Smell	9	14.4 (18.9)	
Mild Yet Easily Perceivable Smell	19	8.0 (11.0)	
Moderate Smell	8	15.4 (16.7)	
Strong Smell	2	-	
Extremely Bad Smell	0	-	
Total Score	56		0.19
p-value		0.316*	0.152**

HALT: Halitosis Associated Life-Quality Test; SD: Standard Deviation; <sup>a</sup>Spearman's Correlation Coefficient; \*Kruskal-Wallis test; \*\*Spearman's Correlation Test.

Table 6 shows the results of multiple linear regression analysis. The male sex was significantly related to higher HALT scores ( $p < 0.05$ ). There was no significant relationship between the HALT score and the other independent variables.

**Table 6. Predictive validity: Relationship between independent variables and the HALT scores (n=56).**

Dependent Variable	Independent Variables	$\beta$	p-value	Significance of the Model		
				R <sup>2</sup>	F	p-value
	Sex (0=Male, 1=Female)	-2.13	0.038			
	Age (Years)	-1.31	0.196			
	Visible Biofilm Score	0.35	0.726			
HALT	CPI Score	0.97	0.332	0.096	2.186	0.051
	Posterior Tongue Coating Score	-0.42	0.672			
	Anterior Tongue Coating Score	1.63	0.107			
	Self-Perceived Halitosis Score	1.09	0.279			

HALT: Halitosis Associated Life-Quality Test; CPI: Community Periodontal Index.

## Discussion

The mouth odor is part of the individual's body and self-image. Its self-perception and the criticism of other people can significantly affect one's quality of life [25]. The HALT questionnaire, originally developed in English, is a specific research instrument designed to assess halitosis-related quality of life [5], a rather important issue today [25]. As it is an international questionnaire, the HALT should be adapted prior to being used in other languages and cultures [26].

The translated questionnaire should have the same effect as the original one on the culture into which it is being adapted [26]. The semantic assessment during cultural adaptation of foreign instruments must have a conceptual foundation and be based on a carefully defined methodology [17,18]. In a previous study [26], a model was suggested by French researchers [17] to minimize losses resulting from change of language. This was the model of choice in the present study for translation, backtranslation and cultural adaptation of the HALT into Brazilian Portuguese. In order for the translations to achieve a high level of quality, two translators and two independent backtranslators participated in this process, thus allowing a comparison between versions, identifying errors in some questions and choosing the most appropriate terms. In view of semantic equivalence, the analysis of more than one translated version allowed the use of items from different versions and the choice for a third alternative when none of the two versions proved appropriate [18].

The expert committee analyzed the semantic, idiomatic and cultural aspects of the questionnaire not to limit its translation to the corresponding literal meaning. It is worth noting that the pre-test sample size was adequate and exceeded that recommended by the American Academy of Orthopedic Surgeons/Institute for Work and Health (AAOS/IWH), which determines the recruitment of 5-10 subjects with the same characteristics of the target population at each pre-test phase [27]. The original study proposes that the HALT be self-applied, requiring the respondent to carefully read the instructions before answering the questions [5]. In the pre-test, the examiner read the initial instructions to ensure that the rules for completing the questionnaire were fully understood.

The translation and cultural adaptation of a halitosis-related quality of life foreign instrument should follow careful methods. This is due to the fact that subtle differences in diverse cultures can cause misunderstandings and affect its psychometric properties [26]. To assess the

criterion validity of the Brazilian Portuguese version of the HALT, a single question on perception of halitosis was included in this study. There was a positive yet non-significant correlation between the total score of the single question and the HALT score; the subjects who perceived their oral odor as "moderate smell" and "no smell" presented higher and lower scores, respectively, although with no statistical significance. The self-perception of halitosis is not well defined in the literature, since the veracity of malodor self-reports does not commonly correspond to the objective presence of halitosis; this may be due to the difficulty of the individual in evaluating their own mouth air [12]. However, the subjective evaluation of halitosis correlates well with self-perception or analysis by examiners [28].

In the construct validity, adolescents with greater amount of posterior tongue coating had a higher HALT score than those in the other categories. The literature reports that oral hygiene issues play a role in the onset of oral malodor in both adults and children [9,29], mainly upon biofilm accumulation and gingival bleeding [29]. In addition, it has been suggested that the microbial composition of the tongue coating, as well as its thickness and extension, influence the production of malodor [3,14,29,30], which favors VSC production on the tongue dorsum [3,13,30]. As observed in this study, the relationship of halitosis with oral hygiene is more significant when tongue coating is present. Even in people with a healthy periodontium, halitosis can be caused by the impaction of food, bacteria, leukocytes and epithelial cells on the dorsum of the tongue, which is a site with extensive surface and high retentive capacity [13].

Multiple regression analysis revealed that the male sex was the only variable showing a significant relationship with higher HALT scores. These findings corroborate previous studies showing predominance of halitosis in male children aged 6 to 9 years, 6 to 16 years [10] and 7 to 15 years [9]. However, a study carried out in Israel [29] showed no difference between the sexes in the 5 to 14 age group, nor was there a difference in the adult population [13,30].

It is known that adolescents with self-reported halitosis have a negatively impacted quality of life [15,31], mainly in their social life, due to the constraints of daily communication [13]. Preventive measures aimed at oral hygiene education may help prevent halitosis.

Lastly, the following limitations of this study should be taken into account: sample size, although previously estimated, was relatively small; the sample consisted only of adolescents attending public schools, so that the clinical results associated with halitosis may not be extrapolated to the general adolescent population. Future studies utilizing organoleptic analysis and/or gas chromatography are encouraged to confirm the results observed in this study. In addition, further research should relate the self-perception of halitosis with normative data so that to increase the validity of the questionnaire.

## Conclusion

The Brazilian Portuguese version of the Halitosis Associated Life-quality Test was easily understood by adolescents. Those with greater tongue coating accumulation reported more frequently the presence of halitosis, which was only associated to male sex.

**Acknowledgements:** The authors thank the study volunteers.

**Financial Support:** Brazilian National Council for Scientific and Technological Development - Institutional Scientific Initiation Scholarship Program (PIBIC/CNPq).

**Conflict of Interest:** The authors declare no conflicts of interest.

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