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ORIGINAL ARTICLE

A new halitosis screening tool: halitosis finding score derivation and validation

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ABSTRACT

Objective: The lack of a valid and appropriate halitosis screening survey prompted us to develop and validate a simple, 15-item questionnaire to be used as a screening tool to score halitosis for the daily practise.

Methods: After calculating the sample size, 200 participants were included in the study. All participants filled a 15-item questionnaire with the subsequent measurements of halitosis through the organoleptic scoring system and a halimeter. The application of questionnaire and the halitosis measurements were repeated 15 days after the first control.

Results: Mann–Whitney's *U* test was statistically significant between the halimeter measurements and Halfins scores (p=.000, p<.05). ROC curve is drawn due to halitometer analyses. The cut-off point was determined such as Halfins scores greater than 14 indicated halitosis (65.75 sensitivity, 66.04 specificity). The content validation and concurrent validity were proven successful.

Conclusions: A new halitosis-specific screening tool called Halfins was proven as a valid diagnostic tool for measuring halitosis in the present study. Nevertheless, we believe this questionnaire could be used as complementary tool for the diagnosis of halitosis, seeing as its use alone is not able to firmly conclude the presence of halitosis in all cases, an organoleptic test or VSC assessment would still be necessary.

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Halitosis; patient health questionnaire; validation study

Introduction

Halitosis, also known as bad breath, is an unpleasant condition that causes social restraint [1]. Epidemiologic studies revealed that halitosis affects around 10–30% of the population. In Turkey, the prevalence of halitosis is reported to be 14.5% of the general population [2]. The aetiology of halitosis is classified into real halitosis and pseudo halitosis (a misperception). Of the causes of real halitosis, oral pathologies make up 87% that 51% of cases originate from the tongue, 17% originate from gingivitis, 15% originate from periodontitis and 17% originate from a combination of these causes [3,4].

The diagnosis of halitosis is difficult and self-assessment is not always reliable due to misperception. Organoleptic measurement using the human nose is the gold standard in detecting oral halitosis, but it requires the examiner to sniff the bad odour, which means a chemical/physical contact with the patient's breath. Furthermore, this method requires the examiner to distinguish smells precisely and grade them on a scale, which is a process that not only has a learning curve but is also not standardized among healthcare professionals [5].

Winkel's scoring system focuses on oral bacteria found on the dorsum of the tongue that produce volatile sulphur compounds (VSCs). These bacteria create biofilms that can be observed as a greyish-white plaque that emit a foetid odour. The foetid odour is suggested to be intense if the pink colour of the tongue is concealed by this plaque; however, this is not the sole determining factor [6]. Routine bacterial cultures may not detect the three species commonly associated with halitosis (*Treponema denticola*, *Porphyromonas gingivalis* and *Tannerella forsythia*). These species are suspected to have an enzyme that degrades benzoyl-DL-arginine-naphthylamide (BANA), a synthetic trypsin substrate. BANA test strips are commercially available to detect these bacteria [7].

Halimeter is an objective and quantitative method for the diagnosis of halitosis. The main shortcomings of the halimeter is its inability to detect distal volatile organic compounds (VOCs) and it's high-cost. The chemical sensors in the halimeter can only detect sulphuric compounds. Although oral causes occupy a large percentage of the aetiology, approximately 15% of halitosis occurs due to the respiratory and alimentary tract pathologies or metabolic disorders which can only be detected by the organoleptic method [4,8].

The ideal method for screening halitosis must be practical, simple and fast such as questionnaires. Up-to-date, a few questionnaires or surveys have been developed to clarify this issue; however, we believe, those surveys are impractical or do not meet the needs of the clinician. In the present study, we aimed to propose a new 15-item questionnaire to screen halitosis and named it the halitosis finding score (Halfins) which is validated in Turkish subjects.

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Materials and methods

Between November 2018 and January 2019, a total of 223 subjects were enrolled in the present study, whereas 23 subjects did not complete the study (Table 1). The sample size was calculated according to the 14.5% prevalence rate of halitosis, the length of the study and the number of subjects per month [2,9,10]. According to our calculations, the minimum sample size was 189 subjects [11]. Informed consent was obtained from the subjects and the study protocol was approved by the Ethics Committee of the Okmeydani Training and Research Hospital (project number: 48670771-514.10).

Table 1. Demographics.

		n	%
Age (years)	Min–max (median)	11–79 (39)	
	Mean ± SD	39.64 ± 14.30	
	≤18	12	6.0
	19–30	44	22.0
	31–40	56	28.0
	41–50	51	25.5
	>50	37	18.5
Gender	Female	106	53.0
	Male	94	47.0

SD: standard deviation.

A detailed otolaryngologic examination was carried out for each subject. Suspicious cases were consulted to a senior periodontist to exclude gingivitis/periodontitis (bleeding or exudate from the periodontal pocket, loss of periodontal attachment, pain upon probing) or dental caries. A sinus X-ray and skin prick test were applied to rule out sinusitis and nasal allergy, if necessary. Routine fasting blood tests were completed to rule out metabolic causes of halitosis. The exclusion criteria were: paediatric cases (below the age of 18), smokers, larygopharyngeal reflux, tonsillitis, sinusitis, metabolic acidosis or alkalosis, renal diseases, liver malfunctions, dental brackets or bridges, dental infections and diabetes mellitus. Inclusion criteria were cases older than 18 years, non-smokers, oral causes of halitosis including pseudohalitosis, as well.

Content validity

Halfins was created after the review of the Oral Health Impact Profile (OHIP-14) [12]. Halfins consisted of 15 items and each item was graded on the Likert scale. All questions were close-ended and present respondents with pre-populated answer choices (0 = never, 1 = rarely, 2 = often, 3 = always). The potential scores ranged from 0 to 45, with higher scores indicating higher levels of halitosis (Table 2).

Table 2. Distribution of answers within the Halfins scale.

	Never (0)		Rarely (1)		Often (2)		Always (3)	
	n	%	*n*	%	*n*	%	*n*	%
1. (Do you have bad-breath?) Ağız kokunuz var mı?	2	1.0	29	14.5	60	30.0	109	54.5
2. (Do others say that you have a bad breath?) Ağzı nızın koktuğu etraftan söyleniyor mu?	66	33.0	78	39.0	34	17.0	22	11.0
3. (Do you avoid greeting/kissing?) Selamlaşmak/öpüşmekten kaçınır mısınız?	25	12.5	60	30.0	52	26.0	63	31.5
4. (Do you have changes in taste (decreased taste, etc.) Ağzınızda tat değişimi var mı? (Tat azalması, vb.)	130	65.0	45	22.5	23	11.5	2	1.0
5. (Are you unwilling to breathe through your mouth?) Ağzınızdan nefes vermekte isteksiz misiniz?	19	9.5	63	31.5	48	24.0	70	35.0
6. (Do you avoid mouth-breathing in close interactions) (like dentist or hairdresser) Yakın temaslardan (Diş Hekimi, Kuaför gibi) ağzınızdan solumaktan kaçınır mısınız?	15	7.5	73	36.5	19	9.5	93	46.5
7. (Are you regularly a mouth-breather?) Genelde ağzınızdan mı nefes alıp verirsiniz?	151	75.5	23	11.5	24	12.0	2	1.0
8. (Do you frequently use chewing gum/mouth spray/oral rinse?). Sakız/ağız spreyi/gargara vb. sı kça kullanır mısınız?	34	17.0	92	46.0	34	17.0	40	20.0
9. (Do you avoid social activities?) Sosyal etkinliklerden kaçınır mısınız?	146	73.0	44	22.0	8	4.0	2	1.0
10. (Do you close your mouth with your hand when you are close to other people?) İnsanlara yakı nken elinizle ağzınızı kapatır mısınız?	47	23.5	44	22.0	60	30.0	49	24.5
11. (Do you talk from afar due to bad breath?) İnsanlarla konuşurken yakınlaşmaktan kaçınır mı sınız?	59	29.5	52	26.0	50	25.0	39	19.5
12. (Are you self-distressed due to bad breath?) Kendinizi ağız kokusundan dolayı sıkıntıda hisseder misiniz?	76	38.0	45	22.5	52	26.0	27	13.5
13. (Do you feel embarrassed due to bad breath?) Ağız kokusundan dolayı utanır mısınız?	94	47.0	52	26.0	33	16.5	21	10.5
14. (Do you feel alone due to bad breath?) Kendinizi ağız kokusundan dolayı yalnız hissettiğiniz olur mu?	128	64.0	44	22.0	25	12.5	3	1.5
15. (Do you feel guilty due to bad breath?) Kendinizi ağız kokusundan dolayı suçlu hisseder misiniz?	178	89.0	17	8.5	5	2.5	0	0

Statements in brackets are the non-validated English version of Halfins scale.

The questionnaire was self-administered and the items were written in simple and short manner that could be easily understood by the majority of responders. Items assessing affective responses were not mixed with those that assess behaviour (i.e. not double-barreled). The questionnaire was initially tested on 30 subjects who were not included in the study and Cronbach's alpha was found to be over 0.900 in implying that the test was valid and reliable. The items were revised upon reviewing the results of the preliminary pilot testing.

Exploratory factor analysis together with the Varimax rotation was performed in the statistical analysis of the 15-question Halfins scale. In the factor analysis, all questions were gathered under a single factor and the explanatory coefficient was found as 59.49%. The validity–reliability analysis revealed Cronbach's alpha to be as high as 0.950, indicating a very high degree of internal consistency within the questionnaire. Exploratory factor analysis applicability was measured by the Kaiser–Meyer–Olkin (KMO) sampling adequacy test and Bartlett's test of sphericity (Table 3). As the KMO result reaches to 1, it is postulated that the data group is suitable for factor analysis. The factor analysis of Halfins revealed the factor weighs between 0.507 and 0.919 (Table 4).

Study design

All participants were informed that the study included two controls with a 15-day interval. The participants were not allowed to use deodorant or alcohol one week before the first control. Before the first control, all participants were prohibited from eating, drinking, rinsing their mouth and performing any oral hygiene activity from midnight on. A detailed medical history was taken from the subjects to detect extra-oral causes of halitosis and understand dietary habits. Halfins questionnaire, halimeter and organoleptic assessment were performed after an otolaryngological examination. All participants were scheduled for a second control, 15 days after the initial one, and all measurements were repeated.

Table 3. KMO and Bartlett's test of sphericity results for factor analysis.

Kaiser–Meyer–Olkin test		0.923
Bartlett test of sphericity	Chi-square	2770.233
	Degrees of freedom	105
	Significance	**0.001**

Bold represent *p*-values.

Table 4. Halfins factor analysis.

	Component
Question 1	0.718
Question 2	0.764
Question 3	0.816
Question 4	0.733
Question 5	0.828
Question 6	0.784
Question 7	0.654
Question 8	0.822
Question 9	0.621
Question 10	0.814
Question 11	0.919
Question 12	0.893
Question 13	0.870
Question 14	0.714
Question 15	0.507

Halimeter and organoleptic measurements

A halimeter (Interscan Corp., Chatsworth, CA) was used to record the halitosis objectively in parts per million (ppm) units. Fasting halimeter measurements were applied to each subject in the morning. The sample straw (184 mm × 5.95 mm diameter) was inserted fully into the sample tube connector. The subject was asked to keep the mouth closed for three minutes prior to sampling to allow a full build-up of any VSCs present in the breath sample. Then, the sample straw was inserted into the subject's mouth at a depth of approximately 25–50 mm resting on the back of the tongue. The subject was asked to keep the lips closed and breathe through the nose during the sampling period. Three repeated measurements were performed and the values between 50 and 170 ppm were accepted as normal limits according to the manufacturer's manual. Scores up to 170 ppm were grouped as 0 (no halitosis); 171–236 ppm as 1 (barely noticeable); 237–303 ppm as 2 (slight halitosis); 304–369 ppm as 3 (moderate halitosis); 370–436 as 4 (strong halitosis) and scores more than 437 ppm as 5 (extremely strong halitosis).

Organoleptic scores were obtained by a single physician who was blinded to the halimeter results. The subjects were instructed to breathe in deeply through their nostrils and hold it for a while before breathing out through their mouths while the examiner sniffed the odour at a distance of 20 cm. The severity of odour was classified as 0 = no odour, 1 = barely noticeable, 2 = slight but clearly noticeable, 3 = moderate, 4 = strong and 5 = extremely strong [5].

Concurrent validity

All measurements including Halfins were repeated at the second control for all subjects. The effects of the items that make up the Halfins scale factor on reliability is measured and Cronbach's alpha values showed no increase in the reliability when any item was deleted (Table 5). Halfins test–retest scores, the halimeter and organoleptic score's concordance and confirmatory factor analysis were evaluated through the statistical analysis for the first and second control.

Statistical analysis

Analyses were performed using IBM SPSS Statistics 22 (IBM SPSS, Istanbul, Turkey) and NCSS (Number Cruncher Statistical System 2007, Kaysville, UT). Continuous data were displayed as the mean ± standard deviation. Statistical significance was indicated by a p value lower than .05. A Shapiro–Wilk test showed abnormal distribution of the variables. Mann–Whitney's U test was utilized for the comparison of the abnormally distributed data between the two groups

Table 5. The effects of the items of Halfins on reliability.

	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
Question 1	14.83	100.105	0.684	0.948
Question 2	16.15	96.557	0.719	0.947
Question 3	15.44	94.378	0.786	0.945
Question 4	16.72	100.514	0.687	0.948
Question 5	15.36	94.362	0.803	0.945
Question 6	15.26	94.472	0.754	0.946
Question 7	16.82	101.766	0.600	0.949
Question 8	15.81	94.912	0.791	0.945
Question 9	16.88	103.758	0.577	0.949
Question 10	15.65	93.284	0.785	0.946
Question 11	15.86	90.985	0.905	0.942
Question 12	16.06	92.042	0.869	0.943
Question 13	16.30	93.538	0.838	0.944
Question 14	16.69	100.366	0.664	0.948
Question 15	17.07	107.131	0.460	0.952

Cronbach's alpha values are examined and when the item is deleted from the table, it shows that removing any item from the factor will not increase the reliability. In this framework, the single-item factor structure was preserved.

Table 6. Halfins test–retest scores.

		1. Control	2. Control
Halfins scale total scores	Min–max (median)	0–44 (17)	0–42 (17)
	Mean ± SD	17.21 ± 10.55	17.13 ± 10.44
Paired-samples *t* test	*t*	1.214	
	p	***0.226***	
ICC correlation (95%CI)	*r*	0.997 (95% 0.995–0.998)	
	p	***0.001*****	

SD: standard deviation.
There was no statistically significant difference between test–retest total scores of Halfins scale ($p=.266$; $p>.05$). ICC analysis presents 99.7% agreement between the test–retest scores (ICC: 0.997; $p=.001$; $p<.01$). Paired-samples *t* test. ICC: intraclass correlation coefficient. Bold represent *p*-values.
**$p<.01$.

and to compare the abnormally distributed inter-group comparisons of the descriptive statistical methods (mean, standard deviation and frequency) and the quantitative data. Pearson's chi-square test was used to compare the quantitative data. The validity and reliability of the Halfins scale was assessed by the reliability analysis and the confirmatory factor analysis (Lisrel 8.8; structural equation modelling software). The Kappa coefficient assessed the concordance of the qualitative data, whereas the intraclass correlation coefficient (ICC) assessed the concordance of the quantitative data. The ICC describes how strongly units in the same group resemble each other.

Results

The demographic data of the patients are shown in Table 1.

The halimeter measurements were between 51 and 499 ppm (mean 266.62 ± 139.98) in the first control and 50–500 ppm (mean 268.52 ± 139.32) in the second control. Mann–Whitney's *U* test was statistically significant between the halimeter measurements and Halfins scores ($p=.000$, $p<.05$).

The ICC assessed the concordance of the Halfins scores with the two controls, and the result was strongly correlated, with an ICC value of 0.997 at 95% confidence level (95% 0.995–0.998); $p=.001$) (Table 6). The Kappa coefficient of concordance showed almost perfect agreement between the halimeter scores (Kappa = 0.835; $p=.029$). The organoleptic score variances between the two controls assessed by the

Table 7. Halimeter and Halfins score's concordance.

		Halfins				
		<14		≥14		
		n	%	*n*	%	*p*
Halimeter	Positive (>170 ppm)	46	85.2	7	4.8	**0.001****
	Negative (≤170 ppm)	8	14.8	139	95.2	

A statistically significant relationship was found between the presence of halitosis and 14 cut-off values of the Halfins level ($p=.001$; $p<.01$). The risk of halitosis is 114,179 times higher in patients with Halfins level 14 and above. The odds ratio for Halfins is 114,179 (95% CI: 39,252–332.29). Pearson's chi-square test. Bold represent *p*-values.
**$p<.01$.

Kappa coefficient of concordance showed substantial agreement (Kappa = 0.891; $p=.026$). These statistical results prove that the test–retest validity was acceptable. Halimeter and Halfins score's concordance is presented in Table 7. Confirmatory factor analysis is provided in Table 8. Standardized loads of Halfins Questions is presented in Figure 1.

An ROC curve was drawn for the halimeter analyses. The area under the curve was 0.706 (significantly greater than 0.05; $p=.000$), with a standard error of 0.019 (Figure 2).

The cut-off point was determined as the scores greater than 14 indicated halitosis (95.21% sensitivity, 85.19% specificity).

Discussion

Various studies have reported different prevalence rates for halitosis. The combined prevalence of halitosis was found to

Table 8. Confirmatory factor analysis concordance criteria.

Concordance criteria	Good concordance	Acceptable concordance	Model results	Concordance
RMSEA	$0 < \text{RMSEA} < 0.05$	$0.05 \leq \text{RMSEA} \leq 0.10$	0.102	Acceptable
NFI	$0.95 \leq \text{NFI} \leq 1$	$0.90 \leq \text{NFI} \leq 0.95$	0.96	Good
NNFI	$0.97 \leq \text{NNF} \leq 1$	$0.95 \leq \text{NNFI} \leq 0.97$	0.97	Good
CFI	$0.97 \leq \text{CFI} \leq 1$	$0.95 \leq \text{CFI} \leq 0.97$	0.97	Good
IFI	$0.97 \leq \text{IFI} \leq 1$	$0.95 \leq \text{IFI} \leq 0.97$	0.97	Good
RFI	$0.90 \leq \text{RFI} \leq 1$	$0.85 \leq \text{RFI} \leq 0.90$	0.89	Acceptable
SRMR	$0 \leq \text{SRMR} \leq 0.05$	$0.05 \leq \text{SRMR} \leq 0.10$	0.033	Good
GFI	$0.95 \leq \text{GFI} \leq 1$	$0.90 \leq \text{GFI} \leq 0.95$	0.93	Acceptable
χ^2/df (121.273/40)	$0 \leq \chi^2/\text{df} \leq 2$	$2 \leq \chi^2/\text{df} \leq 3$	3.03	Acceptable

RMSEA: root mean square error of approximation index; NFI: normed fit index; NNFI: non-normed fit index; CFI: comparative fit index; IFI: incremental fit index; RFI: recremental fit index; SRMR: standardized root mean square residual (SRMR) index; GFI: goodness-of-fit index; χ^2/df: degrees of freedom index.

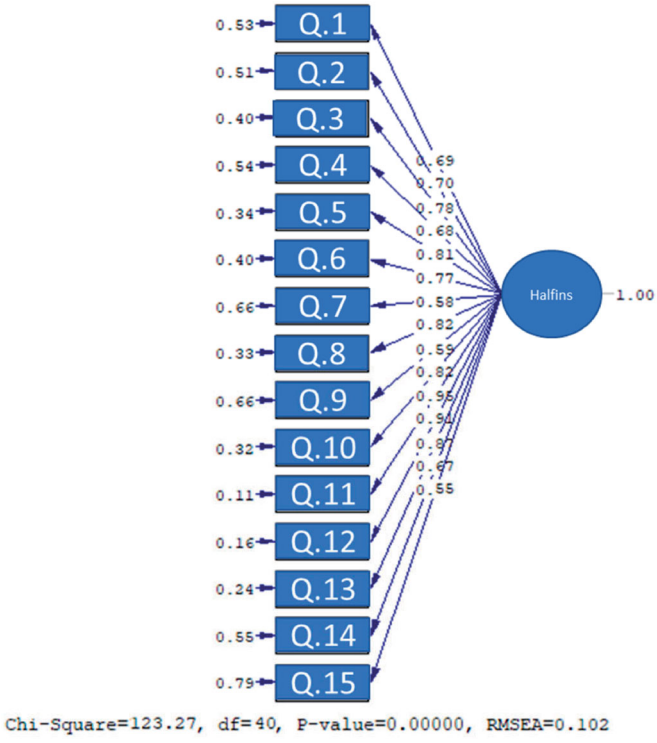

Figure 1. Standardized loads of Halfins Questions. The fit criteria (goodness of fit indices and corrected Chi-square (χ^2/df) value) for the dimensions in the model established to test the model are shown.

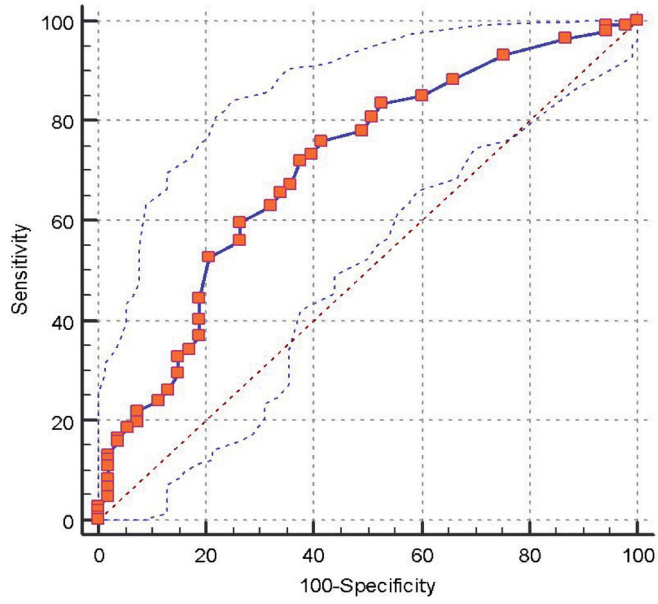

Figure 2. ROC curve is drawn to determine a cut-off point. The cut-off point is 14. Area under the curve is 0.706, standard error 0.019 (p: .000; $p<.05$).

be 31.8%, and an increment in the prevalence of halitosis is pointed [13]. As socioeconomic status and income increases, the prevalence of halitosis increases as self-awareness increases.

The screening of halitosis is a major problem; a wide range of assessment methods are available, but they are expensive, difficult or unattractive to use. A quick and reliable diagnostic tool is essential. To the best of our knowledge, there are various questionnaires available on the websites of dental healthcare professionals, but these are not intended for scientific or academic purposes.

Vast studies have been made to screen halitosis based on quality of life (QOL) surveys, but unfortunately those provided no data within their publications, which made those efforts unproven. A large-scale study was conducted in Brazil in 2017 that studied oral health-related QOL in students, but that publication was unable to present data within the study [14]. Another study explored the association between halitosis and reflux; the authors diagnosed halitosis using a questionnaire, but the questionnaire only had five yes-or-no questions [15]. Conceicao et al. [9] published an article about the psychometric properties of halitosis and its relationship with social anxiety disorder. They used an 18-item survey, the population size was adequate, and they gave a cut-off value for their survey. The aim of the study was to assess the effects of halitosis and compare it to the anxiety levels of the participants. No data were provided in the study, given that the database was based on a previous study.

For years, halitosis and its impacts has only been tested with the general health survey SF-36 and by Orthognathic Quality of Life Questionnaire [16,17]. Nevertheless, those surveys did not meet the requirements of the clinician and the evaluation of treatment could not be monitored by the lack of valid instruments to measure the burden of halitosis on a scale. Reaching 2011, a 20-item Halitosis QOL Questionnaire (HALT) was developed and validated to monitor the effects of treatment [1]. The questionnaire and methods were valuable as they also validated the survey for treatment outcomes for halitosis. Nevertheless, the number of participants was too low to cover the universal sample size prevalence of halitosis. HALT compared the efficacy of two methods to

prevent halitosis and was proven valid. However, it was unable to differ pseudohalitosis from genuine causes. Another drawback of that survey was that it has only been tested on upper airway infections such as chronic tonsillitis. The scoring system we propose, on the other hand, is only a screening tool that has been tested on otherwise healthy individuals. One common point of HALT and Halfins share is, neither of the surveys contains subgroups.

In daily practice, it is quite inconvenient to detect halitosis. As previously mentioned, in order to detect the problem, special instruments or physical contact with the subject's bad breath is essential. The physician's role is twofold: to detect halitosis and make a differential diagnosis and to begin treatment and monitor its outcomes. Hence, we aimed to create a simple 15-item questionnaire that every participant could complete without embarrassment so that false negative answers would not skew the results.

The questionnaire has 15 equally weighted items. All questions are simple and close-ended, and the test takes less than three minutes to complete. The questions are carefully chosen to determine the presence of halitosis and the social restraint of the halitosis on the participant. The four-point scale for each item helps the participant choose correctly without confusion. We refrained from including sources or diseases that cause halitosis since the test is designed to screen halitosis and not its source. We determined the severity of the symptoms and proposed a cut-off value. If the summation of the scores is greater than 14, it can be used as a screening tool for halitosis. As the scores increase beyond 14, the severity of halitosis increases in parallel. We compared the test results to two independent methods to detect halitosis: the halimeter (an objective and globally accepted test) and the organoleptic method (accepted as the gold standard to detect halitosis). The superiority of the organoleptic method comes from detecting the end-product of aromatic molecules, whether sulphur or not. The examiner who conducted the organoleptic method was blinded to the study. The results of the Halfins test and the halimeter/organoleptic scores were consistent and did not change between two consecutive visits.

Some surveys that we mentioned earlier in this discussion section, such as SF-36 has subgroups to detect health and daily activity, difficulty in physical/emotional roles, physical functions, energy and vitality, psychological vitality and social vitality. Although Halfins has no subgroups, it is capable to differ pseudohalitosis from genuine causes; question 1 (Q1) is directed to the patient as he/she has bad-breath whereas Q2 investigates whether other people say he/she has a bad-breath. Discordance between Q1 and Q2 may easily arise suspicion about pseudohalitosis. Q4 is asked to detect some other causes of genuine halitosis such as salivary hypofunction or laryngopharyngeal reflux, therefore, it may facilitate the work of the clinician as a guide for the treatment. Q8 may arise suspicion about the oral causes of halitosis. Q3, Q5, Q6 and Q9, Q10 are directed to find out the physical role challenge of halitosis that affects the QOL of the individual. Q12–Q15 solely investigates the psychological burden of halitosis on the susceptible cases. SF-36 has strictly divided subgroups and the assessment or scoring of it is cumbersome, on the other hand Halfins is simply applied and scored. HALT QOL survey, as ours, has no subgroups as well, nevertheless, it mainly focuses on QOL but unfortunately, we believe, is not a screening tool.

An important question to consider in estimating test–retest reliability was the time period between questionnaire administrations. If the duration between the first and second controls was too short, individuals might remember their responses at the first control, which might affect the test–retest reliability. On the other hand, if the duration between the two controls was too long, individuals' responses might change due to other factors. The duration should be long enough to allow the effects of memory to fade and to prevent fatigue but not so long as to allow changes to take place that might affect the test–retest reliability estimate [18]. Therefore, we thought that 15 days would be appropriate.

Conclusions

A new halitosis-specific screening tool called Halfins is proven valid where a cut-off value of 14 and higher pointed halitosis. Halfins may be used as a screening and/or monitoring tool to detect halitosis in the daily practice, nevertheless, we believe this questionnaire could be used as complementary tool for the diagnosis of halitosis, seeing as its use alone is not able to firmly conclude the presence of halitosis in all cases, an organoleptic test or VSC assessment would still be necessary.

Acknowledgements

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (Okmeydani Training and Research Hospital Ethical 48670771-514.10 reference number) and with Helsinki Declaration of 1975, as revised in 1983 or comparable ethical standards.

Consent to participate: Informed consents were taken from the participants/legal guardians/parents prior to examinations.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Author contributions

Berk Gurpinar (Study design, manuscript preparation); Tolgar Lutfi Kumral (Data analysing, manuscript preparation); Huseyin Sarı (Data collection); Belgin Tutar (Data collection) and Yavuz Uyar (Critical review, finalize).

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Data availability statement

Data collected during the trial, together with the study protocol and statistical analysis plan will be available immediately following the publication for meta-analysis to the researchers who provide a methodologically sound proposal directed to the e-mail address b_gurpinar@yahoo.com.

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