



ORIGINAL ARTICLE

Knowledge and perception of parents regarding halitosis in their children in Saudi Arabia

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Abstract Objective: To evaluate parents' knowledge about halitosis, and to compare parents' perception of halitosis in their children to the presence of halitosis clinically.

Methods: Children between 3 and 8 years attended to Dental University Hospital, King Saud University, were screened. Children satisfying inclusion criteria and their parents agreed to participate were included. Questionnaires regarding parents' knowledge and perception about halitosis in their children were filled by attending parents. Then, the assessment of halitosis in the participating children carried out by portable gas chromatograph device (OralChroma™).

Results: A total of 67 children (44 girls and 23 boys) were included in this study with a mean age of 5.3 years (SD = 1.7). The majority of the questionnaires (n = 44, 65.7%) were filled by accompanying fathers. One in two (52.2%) parents obtained high knowledge score about halitosis. Parents' knowledge was significantly associated with the mean age of the children (P = 0.02). Thirty-nine (58.2%) parents perceived halitosis in their children. Gender, child's age, parents' education level, or family income were not associated with parents' perception of halitosis. Halitosis was detected clinically in 58 children (86.6%). Thirty-eight (57%) of parents' perception of halitosis was in consistency with OralChroma™ readings; however, there was no significant association between parents' perception and the OralChroma™ score.

Conclusion: Half of the parents had good knowledge about halitosis and 6 in 10 parents perceived halitosis in their children which is quite less than the presence of halitosis detected clinically. Moreover, parents' perception was not associated with the OralChroma™ score.

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1. Introduction

Halitosis and many other terms like bad breath, and oral mal-odor are used to explain the unpleasant breath emitted from the mouth. It is well known that halitosis is a multifactorial condition that involves oral and non-oral origin (Miyazaki et al., 1995; Tangerman, 2002; Van Den Broek et al., 2008). Oral origin constitutes 90% of halitosis cases (Miyazaki et al., 1995; Tangerman, 2002; Van Den Broek et al., 2008). In the oral cavity, halitosis arises from the production of volatile sulfide compounds (VSCs) by the action of wide range of oral anaerobic organisms in breaking down components of epithelial cells, salivary and serum proteins, and food debris on the tongue dorsum, in the saliva and in the periodontal pockets (Bollen and Beikler, 2012; Cortelli et al., 2008). The most objective methods detect the VSCs are gas chromatography which considered as the gold standard of measurement of oral halitosis (Tangerman, 2002). OralChroma™ is a portable gas-chromatograph device that was developed to measure VSCs levels inside the mouth providing high sensitivity and practicality (Tangerman and Winkel, 2008). Other diagnostic methods of halitosis include; organoleptic examination by odor judges, and hydrogen sulfide monitoring (Tangerman, 2002).

Most of the halitosis researches have concentrated on adult population where pediatric population received less attention (Lin et al., 2003). Few studies reported the prevalence of halitosis in children in different countries and found the prevalence ranged between 8% and 45% using different assessment techniques (Kanehira et al., 2004; Patil et al., 2014; Ueno et al., 2018; Villa et al., 2014; Yoshida et al., 2001). Other studies assessed the association of halitosis in children with different oral findings such as; caries experience, gingival health, tongue coating, oral hygiene, mouth breathing, abscesses, oral ulcers, bone diseases, and hyposalivation (Amir et al., 1999; Gholami et al., 1999; Nałçacı and Sönmez, 2008; Motta et al., 2011; Villa et al., 2014; Keceli et al., 2015; Costacurta et al., 2019). In Saudi Arabia, few studies conducted on halitosis and assessed self-perceived halitosis in adults; they reported self-perceived halitosis between 21% and 44% (Al-Zahrani, 2011; AlSadhan, 2016; Alshehri, 2016; Alzoman, 2020; Mubayrik et al., 2017; Nazir et al., 2017). Only one study assessed halitosis in 4–7 years old children using organoleptic method and reported halitosis in 55% of participants (Mubaraki, 2019).

Evaluation of parents' knowledge and perception of halitosis in their children considered an important finding that can help healthcare providers in promoting good oral health (Aliyu and Lawal, 2018; Momeni et al., 2017; Motta et al., 2011). Momeni et al. (2017), found in their qualitative study that some Iranian mothers were familiar with the causes of halitosis and the association between halitosis and oral health. On the other hand, Aliyu and Lawal (2018) reported poor knowledge of Nigerian parents about halitosis and only 12% of them perceived halitosis in their children (Aliyu and Lawal, 2018).

In the literature, it has been noticed that there are no studies assessed the knowledge of Saudi parents regarding halitosis nor their perception of halitosis in their children. Moreover, according to our search there is no study compared the parents' perception of halitosis in their children to presence of halitosis clinically by assessing the level of volatile sulfur compounds using OralChroma™ device which is considered

as the most objective method and gold standard to measure halitosis. Therefore, the aims of this study were to evaluate parents' knowledge about halitosis, and to compare their perception of halitosis in their children to the presence of halitosis clinically.

2. Materials and methods

2.1. Research approval

The study was approved by the Institutional Review Board of King Saud University (KSU), (IRB. No. E-18-3456), followed by the approval of the College of Dentistry Research Center (CDRC. No. PR 0085). Informed consent containing details of the study were obtained from all parents of the children agreed to participate in the study.

2.2. Sample selection and study protocol

Parents of pediatric patients who were scheduled for early morning screening appointment in the general anesthesia clinic at the Dental University Hospital (DUH), in KSU were recruited. Risks and benefits of participating the study were explained by phone, then, initial verbal approval was obtained prior to participating in this study. Instructions were given to the parents regarding breath sample test (child must refrain from eating, drinking, brushing teeth or mouth rinsing at least two hours before appointment). Seventy-two children were screened and a total of sixty-seven children were included who met the following criteria: healthy (ASA I and II), aged between (3–8) years old, cooperative during the clinical examination and breath sample test with no history of tonsillitis, upper respiratory infection, allergic rhinitis or gastrointestinal disorders and parents agreed to participate in this study. Children with candida infections or antibiotics usage one month prior to the study were excluded.

2.3. Questionnaire

A specially designed self-administered questionnaire about parents' knowledge and perception of halitosis in their children was completed by one of the parents. The questionnaire consists of 22 questions divided into 3 sections as following; (demographical data, parents' perception of halitosis in their children and parents' knowledge).

2.3.1. Validity and reliability of the questionnaire

The questionnaire was developed in English language then it was translated into Arabic. The content validity of the questionnaire was assessed by two experts in dental public health. Experts were asked about each question in relation to appropriateness, importance and phrasing. To attain face validity; the questionnaire assessed by 10 parent's representatives of the population being sampled and not involved in the study to evaluate their understanding and comprehension. The agreement of the questionnaire results was assessed using Cohen kappa (κ) statistic and the reliability using Cronbach's alpha (α), which resulted with an average of ($\kappa = 0.859$) and ($\alpha = 0.89$) indicating that the questionnaire showed good repeatability and consistency.

Each questionnaire was reviewed by the primary investigator (NA) to ensure all questions answered and patient fulfilled inclusion criteria before proceeding to the halitosis clinic equipped with the OralChroma™ device.

2.3.2. Knowledge score

Overall, there were 10 statements in the questionnaire directed toward measuring parents' knowledge about halitosis. Those gave correct answer scored (1) and those gave wrong answer or (do not know) scored (0). If all questions answered correctly, (10) scoring points were awarded. The score achieved by each parent counted out of 10; then the median of the sample (=6) was used as a cutoff point; where the value below the median labelled "low knowledge level" and the values at the median or above labelled "high knowledge level" (DeCoster et al., 2011).

2.4. Breath sample analysis

The level of volatile sulfur compounds in the breath samples was assessed using portable gas chromatograph (OralChroma™ CHM-2, Nissha FIS, Inc. Abimedical Corporation, Osaka, Japan). In the halitosis clinic, the parents and the child watched a video illustration explaining how breath sample will be collected and analyzed using OralChroma™ device. All breath samples were collected by the primary investigator (NA). To obtain the breath sample, patient was instructed to breathe through the nose while keeping the mouth closed for 60 s. After that, 1 ml of breath sample was obtained using disposable plastic syringe. The collected breath sample was then injected immediately into OralChroma™ device after removing any remnant saliva from the tip of the plastic syringe using tissue paper. The concentration and cognitive threshold of the following gases; Hydrogen sulfide (H₂S) \geq 112 part per billion (ppb), Methyl mercaptan (CH₃SH) \geq 26 ppb, and Dimethyl sulfide (CH₃SCH₃) \geq 8 ppb, were recorded. Halitosis considered present clinically if one or more gases equal or higher than the threshold (Schemel-suárez et al., 2017).

2.5. Sample size

The sample size was calculated at a power of 90%, with 80% level of agreement between parents' perception and clinical halitosis and with a 0.05 level of significance (Schemel-suárez et al., 2017; Tamaki et al., 2011). The required sample size was approximately 62. Five more patients were added to the sample to overcome any shortage happened during the sample collection which resulted in a total of 67 children participated in this study.

2.6. Statistical analysis

Data were analyzed using Statistical Package for Social Science (SPSS) software version 22.0 (IBM Inc., Chicago USA). Descriptive statistics (mean, standard deviation, frequencies and percentages) were used to describe the quantitative and categorical variables. Parents perception and clinically detected halitosis were dichotomized as (0 = no halitosis, 1 = halitosis). Chi square and Fisher's exact tests were used

to assess the association between categorical variables includes demographic data, parents' perception, knowledge, and concentration of VSCs. A p-value of 0.05 was used to report the statistical significance of the results.

3. Results

3.1. Demographic data

Sixty-seven Saudi children between 3 and 8 years of age participated in this study; the mean age was 5.3 (SD = 1.7). There were 23 (34.3%) boys and 44 (65.7%) girls. All questionnaire (n = 67) were filled by accompanying parents; forty-four (65.7%) by accompanying fathers and 23 (34%) by mothers. More than half of the participating parents had a university degree and income of more than 12,000 SR (58.2%, 59.7% respectively).

3.2. Parental knowledge about halitosis

Thirty-five (52.2%) of the participated parents correctly answered more than 6 questions which reflects a high knowledge level about halitosis. The median knowledge score of the participating parents was 6 and the interquartile range was (IQR = 3–7) (Table 1). The most correctly answered question (64.2%) was the association of dental caries and halitosis. Other questions were correctly answered by approximately half of the parents except for the association of diet (28.4%) and gum diseases (41.8%).

The association between parents' knowledge and demographic data of the participants showed no significant association except for the age of the child ($P = 0.02$) and family income ($P = 0.05$) (Table 2). The mean age of children was higher for parents with good knowledge (5.81 ± 1.70) in comparison to the parents of lower knowledge level (4.86 ± 1.51).

3.3. Parents' perception of halitosis

Parents perceived halitosis in 39 (58.2%) children (28 girls and 11 boys); 24 of them were aware of this issue more than

Table 1 Parents' knowledge about halitosis (n = 67).

| Questions | Correct answer |
|---|----------------|
| | Frequency (%) |
| Oral bad breath relation to poor oral hygiene | 35 (52.2%) |
| Oral bad breath relation to dental caries | 43 (64.2%) |
| Oral bad breath relation to diet | 19 (28.4%) |
| Oral bad breath relation to silver (stainless steel) crowns | 31 (46.3%) |
| Oral bad breath relation to white restorations | 36 (53.7%) |
| Oral bad breath relation to tooth extractions | 34 (50.7%) |
| Oral bad breath relation to gum diseases | 28 (41.8%) |
| Oral bad breath relation to bacterial or fungal oral infections | 33 (49.3%) |
| Oral bad breath relation to tonsillar infection | 31 (46.3%) |
| Oral bad breath relation to tooth abscess | 37 (55.2%) |
| Median knowledge score, (IQR) | 6 (3–7) |

Table 2 Association between Parents' knowledge score and demographic variables (n = 67).

| Demographic findings | Knowledge score | | P-value |
|-------------------------|-----------------|-------------|---------|
| | High (%) | Low (%) | |
| Child gender | | | 0.99 |
| - Male | 12(34.3) | 11(34.4) | |
| - Female | 23(65.7) | 21(65.6) | |
| Questionnaire filled by | | | 0.44 |
| - Male (Father) | 25(71.4) | 20(62.5) | |
| - Female (Mother) | 10(28.6) | 12(37.5) | |
| Parent education | | | 0.50 |
| - School education | 16(45.7) | 12(37.5) | |
| - University education | 19(54.3) | 20(62.5) | |
| Family income | | | 0.05 |
| - Less than 12,000 SR | 18(51.4) | 9(28.1) | |
| - 12,000 SR or more | 17(48.6) | 23(71.9) | |
| Age child: Mean ± SD | 5.81 ± 1.70 | 4.86 ± 1.51 | 0.02 |

Table 3 Parents' perception of halitosis in their children.

| Questions | Frequency (%) |
|---|---------------|
| Has your child experienced oral bad breath? | |
| - Yes | 39 (58.2) |
| - No | 28 (41.8) |
| If yes, answer the followings: | |
| When did you become aware that your child had oral bad breath?* | |
| - Six months or less | 15 (38.5) |
| - More than six months | 24 (61.5) |
| How did you find out that your child is having oral bad breath?* | |
| - By yourself. | 37 (94.9) |
| - Other | 2 (5.1) |
| Have you noticed that your child is having problems in communicating due to his/her oral bad breath?* | |
| - Yes | 2 (5.1) |
| - No | 34 (87.2) |
| - Don't know | 3 (7.7) |
| Have you noticed that your child is covering his/her mouth during speaking due oral bad breath?* | |
| - Yes | 5 (12.8) |
| - No | 33 (84.6) |
| - Don't know | 1 (2.6) |
| Has your child had an examination for bad breath by his/her dentist?* | |
| - Yes | 1 (2.6) |
| - No | 38 (97.4) |
| Has your child diagnosed with oral bad breath? * | |
| - Yes | 0 (0) |
| - No | 39 (100) |

* (n = 39).

6 months (Table 3). Most of the parents (95%) perceived halitosis by themselves. Two parents (5.1%) noticed that halitosis affected their children communication, and 5 parents noticed that their children covers their mouths during speaking. None of the children have been diagnosed previously with halitosis and only one parent consulted a dentist regarding halitosis. No statistically significant association was detected between

parents' perception and demographic variables, nor between the parents' perception of halitosis and knowledge level ($P = 0.76$).

3.4. Presence of halitosis clinically and parental perception

Halitosis was detected clinically in 58 (86.6%) children using OralChroma™. Thirty-eight (56.7%) parents were in agreement with presence of halitosis clinically, however; there was no statistically significant association between the parents' perception of halitosis and concentration of VSCs in breath samples ($P = 1$) (Table 4).

4. Discussion

Halitosis is a condition of great importance among pediatric population that didn't receive a lot of attention in the literature. This study was conducted to evaluate parents' knowledge of halitosis, and to compare their perception of halitosis in their children to the presence of halitosis clinically.

Half of the parents in this study showed good knowledge about factors associated with halitosis; this finding was similar to Momeni et al. (2017), but it was higher than Aliyu and Lawal (2018) who reported 60% of Nigerian parents have poor knowledge regarding the causes of halitosis. One in 2 parents answered most questions correctly except for the association of diet with halitosis it was 1 in 3. Surprisingly, this association could not be figured out by most of the parents as they may assume that their kids do not eat food that cause offensive smell. In the present study, parents of older children reported a high level of knowledge; which could be explained by the possibility of the parents became more involved and experienced about their child health, or even the possibility of the learning from raising elder siblings. Interestingly in this study, parents of low income have better knowledge than parents of high income, which could be related to unequal distribution of the sample according to parent's income.

In this study, more than half of the parents perceived halitosis in their children. This finding is in agreement with previous study on similar population where 50% of children have halitosis utilizing organoleptic test (Mubaraki, 2019). Similar

Table 4 Association between parents' perception and clinical halitosis (OralChroma™) (n = 67).

| | | Clinical halitosis | | | P* |
|--------------------|-------------------------|--------------------|--------------|------------------|----|
| | | Halitosis | No halitosis | Total number (%) | |
| Parents perception | Halitosis | 34 | 5 | 39 (58.2) | 1 |
| | No halitosis | 24 | 4 | 28 (41.8) | |
| | Total number (%) | 58 (86.6) | 9 (13.4) | 67 (100) | |

* Fisher exact test.

to this, Kanehira and Yoshida in Japanese population reported 44% and 45.7% respectively of parents perceived halitosis in their children obtained from questionnaire (Kanehira et al., 2004; Yoshida et al., 2001). Also, Lin et al., reported similar results from a questionnaire where 61% of mothers reported oral malodor in their children (Lin et al., 2003). In contrast, Aliyu and Lawal (2018) found only 12% of Nigerian parents perceived halitosis in their children (Aliyu and Lawal, 2018). The difference between reports influenced by many factors such as; sample studied, culture influence, olfactory sensation of parents, intimate contact of parents to the child and emotional status of parents. Another factor to be considered is that perception was evaluated over a period of time, while in other studies the evaluation of the perception was evaluated in a specific time as when performing an organoleptic test (Nalçaci and Sönmez, 2008).

The effect of halitosis on the social life has been investigated in adult population, and many studies reported that halitosis affected the patient's quality of life negatively (Almufarrij et al., 2019; AlSadhan, 2016; Alshehri, 2016; Mckeown, 2003). Ueno M. et al and Motta et al, reported in their studies the negative effect of halitosis on the child physiological and social aspects which can lead to isolation and avoidance of community (Motta et al., 2011; Ueno et al., 2018). In our study, the sociodemographic investigation results showed that most of the parents did not notice that their child communication and social interactions were affected by halitosis. This finding can be explained by looking to the age of the participants in this study (3–8); children in this age group are less aware about their peer's unseen and not sensible conditions (Rubin et al., 2007), another reason that may contribute to these findings is that more than half of the questionnaires were answered by fathers as the accompanying parents to the dental appointment. Fathers closeness and involvement in daily life activities of children in comparison to mothers is a matter of conflict, and can be affected by cultural backgrounds (Rubin et al., 2007).

A study on adult population showed a significant association between knowledge and self-perception of halitosis (Alshehri, 2016). However, this is not the case in this study as there is no association detected between parents' knowledge and their perception of halitosis in their children since only one parent in our sample consulted a dentist regarding halitosis. It seems this is effected by parents' perception of halitosis as a condition that does not deserve seeking professional consultation, which in agreement with other report (Aliyu and Lawal, 2018).

Halitosis can be evaluated subjectively or objectively. In this study halitosis was evaluated subjectively by using a self-administered questionnaire and objectively by OralChroma™.

This portable type of gas chromatograph is small, compact and allows breath examination on chairside. Also, It is less complicated and does not require special knowledge or operator to use it (Hanada et al., 2003; Laleman et al., 2020). The majority of the children in this study were found to have halitosis according to the OralChroma™, higher than previous studies that evaluated halitosis in children utilizing organoleptic method or sulfide monitoring devices (Aliyu and Lawal, 2018; Kanehira et al., 2004; Lin et al., 2003; Motta et al., 2011; Mubarak, 2019; Nalçaci and Sönmez, 2008). This result could be attributed to the fact that children in this study were considered high caries risk patients with poor compliance and they are in the waiting list of general anesthesia. Moreover, the OralChroma™ device, was reported to have the ability to detect halitosis in children as in adults and similar to other methods like the organoleptic test and β -galactosidases activity (Costacurta et al., 2019).

This is the first report that looked into the association of presence of halitosis in pediatric patients and their parents' perception. Our results indicate that there is no significant association between parents' perception and the presence of halitosis clinically. Our findings are in agreement with previous studies which compared self-perceived halitosis with other objective evaluation methods (Amir et al., 1999; Hammad et al., 2014; Lin et al., 2003). On the other hand, villa et al. reported that self-reported halitosis was a good predictor for halitosis in comparison with Halimeter device and organoleptic test (Villa et al., 2014).

Like other studies; convenient sample selected in this study which could not reflect the Saudi population can be considered as a possible limitation. Questionnaire based study to documents parents' perception considered as another limitation. On the other hand, this is the first study investigated knowledge of Saudi parents and assessed their perception in young age group. Added to that, halitosis in children was measured objectively by using the OralChroma™, which is the gold standard method to detect VSCs.

Further areas of research could be conducted to investigate for the prevalence of halitosis in Saudi children utilizing objective methods such as gas chromatographic or sulfide monitoring devices, also the association of clinical parameters like dental caries, tongue coating and gingival health with halitosis in children. The possible intervention for such age group targeting the causes such as oral hygiene, tongue cleaning and dental rehabilitation worth to be investigated.

5. Conclusion

In this study half of the parents' reported good knowledge about halitosis; however, only one participating parent con-

sulted dentist regarding their child halitosis. Moreover, parents' perception about halitosis in their children is lower than the presence of halitosis clinically. Lack of association between parents' perception and presence of halitosis clinically needed to be considered before diagnosis or carried any treatment.

Disclosures

Nothing to disclose.

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Ethical statement

This study was approved by the Institutional Review Board of King Saud University (KSU), (IRB. No. E-18-3456). Approval was also gotten from the College of Dentistry Research Center (CDRC. No. PR 0085).

CRedit authorship contribution statement

Noura A. Almadhi: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Writing - original draft, Project administration. **Ayman M. Sulimany:** Methodology, Writing - review & editing. **Hamad A. Alzoman:** Investigation, Writing - review & editing. **Omar A. Bawazir:** Conceptualization, Methodology, Writing - review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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