

# Parental Perception of Oral Halitosis in Their Children and Its Effect on Oral Health-Related Quality of Life: A Cross-Sectional Study

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**Purpose:** Halitosis, or oral malodor, is an oral condition characterized by unpleasant smells that exceed socially acceptable limits. Oral malodor is quite a frequent condition in the pediatric population. This study aimed to determine the prevalence and the impact of oral halitosis on oral health-related quality of life among children and adolescents based on parental perception in Saudi Arabia.

**Patients and Methods:** This study was conducted among parents or caregivers of children and adolescents aged 5–14 in Saudi Arabia. An online questionnaire link, provided in Arabic and English, was disseminated via different social media platforms targeting the eligible parents/caregivers of children visiting dental clinics. Subsequently, participants were recruited for this research using the snowball sampling approach. The questionnaire comprised of three sections: socio-economic information, parental perception of oral halitosis in their children, and oral health-related quality of life. The Child Oral Health Quality of Life Questionnaire (COHQoL) evaluated the children's oral health-related quality of life (OHRQoL). A Chi-square test, binary logistic regression analysis, and Spearman correlation tests were applied to determine the relationship between different variables and halitosis.

**Results:** A total of 1416 parents participated in this study. The prevalence of parental-perceived halitosis in their children was 74.1% (n=1049). A total of 563 (53.7%) male children and 486 (46.3%) female children were reported unpleasant breath odor without any significant difference ( $X^2=0.200$ ,  $df=1$ ,  $p=0.654$ ). A significant negative correlations were observed between halitosis and oral symptoms ( $r=-0.214$ ,  $P<0.001$ ), emotions ( $r=-0.152$ ,  $p<0.001$ ), Family environment ( $r=-0.178$ ,  $p<0.001$ ), and overall OHRQoL of the children ( $r=-0.198$ ,  $p<0.001$ ).

**Conclusion:** The parent perceived prevalence of oral halitosis among children aged  $8.04\pm3.5$  years was very high in Saudi Arabia. The presence of oral halitosis among children and adolescents negatively impacted OHRQoL. Age, nationality, fathers' education and occupation were the significant predictors of OHRQoL among children.

**Keywords:** halitosis, children, parental perception, oral health-related quality of life, OHRQoL, social media, oral symptoms, child emotions, family environment

## Introduction

Oral health is directly linked to an individual's overall health and quality of life.<sup>1</sup> In Saudi Arabia, parents indicated a high prevalence of unmet oral health needs in children. The multifaceted problem of access to dental care identified education as an important factor. The main barriers to obtaining dental treatment and attending appointments, despite the child's need, were the expenses associated with visits and challenges related to the dental appointments. A significant occurrence of toothache and oral symptoms in children were associated with age, parental education, and inadequate oral hygiene practices, eventually resulting in a decline in their oral health-related quality of life (OHRQL).<sup>2–4</sup> The OHRQoL is a comprehensive measure that includes subjective evaluations of oral health, emotional and functional well-being, and self-esteem. The term has been employed to characterize the results of oral health disorders and interventions in

children.<sup>5</sup> Assessing the impact of oral health on children's daily lives is crucial since dental disorders not only restrict their present physical, social, and psychological well-being but also hinder their future growth and scholastic success.<sup>6</sup>

Halitosis (oral malodor, bad breath, foetor oris, foetor-ex-ore) is a general term used to describe an oral health condition characterized by foul-smelling breath originating from the oral cavity. Halitosis is a common complaint affecting many individuals of all ages, ranking 3rd among the most prevalent complaints about dental services, with tooth decay and periodontal disease in first and second place, respectively.<sup>7</sup> Risk factors for halitosis encompass being in a rural locale, possessing a low monthly income, insufficient oral hygiene, tobacco use, and the presence of dental caries.<sup>8</sup> Poor oral health, characterized by tongue coatings and periodontal disorders, was positively correlated with halitosis across several populations.<sup>9–11</sup> Despite the multifactorial etiology, halitosis is mainly associated with the anaerobic bacteria's proteolytic activity in the oral cavity. Volatile Sulfur Compounds (VSCs) are the leading halitosis-forming gases, including hydrogen sulfide, methyl mercaptan, and dimethyl sulfide. Volatile aromatic compounds such as indole, skatole, and organic acids also significantly influence halitosis formation.<sup>7</sup>

Halitosis is a very consequential condition commonly thought of lightly by most individuals as a minor annoyance rather than a condition requiring medical intervention. Halitosis is a common condition. Silva et al reported that the prevalence of halitosis in the general population is 31.8%, with a range of 2.4% to 55%.<sup>12</sup> Oral malodor is quite a frequent condition in the pediatric population; however, only a few studies have reported the prevalence among children across several countries ranging from 8% to 45%.<sup>13,14</sup>

Halitosis negatively impacts overall health and self-esteem.<sup>15</sup> Studies have shown that bad breath adversely affects social relations with others.<sup>16</sup> Oral malodor is the most important condition that can create a wrong first impression on others.<sup>17</sup> Halitosis significantly impacts youths' social relations and employment prospects.<sup>18</sup> A Brazilian study found that teenage boys who thought they had halitosis felt humiliated and tense and avoided social contact.<sup>19</sup> Furthermore, previous research suggests that bad breath the most significant oral issue impacting their quality of life concerning oral health among teenagers.<sup>18,20</sup>

The healthcare delivery system in Saudi Arabia has significantly improved, promoting preventive health initiatives and providing comprehensive therapeutic services through specialized healthcare providers. However, challenges remain, including disparities in access to treatment, a high prevalence of dental caries and other oral health issues in children, and inadequate oral health knowledge among parents. Consequently, these issues continue to be of utmost importance in the governmental and community service sectors. Evaluating parental viewpoints on their children's oral concerns and the Oral Health-Related Quality of Life (OHRQoL) is the first step in guiding future policies, governmental strategies, and community health initiatives. Hence, this study aims to determine parental/caregivers' perceptions and factors associated with halitosis among children. Secondly, to assess the impact of halitosis on children's OHRQoL based on parental/caregiver perception.

The null hypothesis of this research posits that there are no statistically significant variations in OHRQoL among children with halitosis as perceived by their parents. Secondly, there is no statistically significant relationship between the socioeconomic predictor variables and the OHRQoL.

The study findings may help to increase parents' awareness of halitosis as an essential health condition for making the right decision to seek medical intervention in the early stages. It is an essential first step toward increasing the awareness of healthcare professionals about halitosis prevalence and its effect on children requiring proper treatment.

## Materials and Methods

A descriptive, cross-sectional study was conducted among parents/caregivers of children aged 5–14. Ethical approval was obtained from the Research and Innovation Centre of Riyadh Elm University, Riyadh, Saudi Arabia (FPGRP/2020/522/329/324). The study's objectives, data collection techniques, and potential risks and benefits were thoroughly elucidated to the parents/caretakers in an online questionnaire. Implied informed consent for participation in the study was acquired from the parents/caretakers by the submission of the completed online survey form. The participation of parents and caregivers in the study was voluntary.

A minimum required sample of ( $n = 935$ ) was calculated based on the following formula:

$n = \frac{Z^2 P(1-P)}{d^2}$  Where n is the sample size, Z is the statistic corresponding to the level of confidence (1.96), P is the prevalence of halitosis among children in Saudi Arabia as reported by AlMadhi et al (2021),<sup>21</sup> (58.4%) and d is precision 0.01 corresponding to effect size.

Parents/caretakers (Saudi and Non-Saudi nationals) residing in Saudi Arabia who have at least one child aged between 5 and 14 years were included in the study. In contrast, parents/caretakers did not reside in Saudi Arabia. Parents/caretakers of children older than 14 and younger than five years were excluded from the study.

After reviewing published literature, a structured, close-ended, and self-administered questionnaire was prepared. The questionnaire comprised three sections: The first included the socio-demographic information, and the second consisted of items on parental perception of oral halitosis in their children.<sup>21</sup> The third section mainly consisted of oral health-related quality of life using the Child Oral Health Quality of Life Questionnaire COHQoL.<sup>22,23</sup> The domain items of OHRQoL are scored on a 5-point Likert scale as never = 0, once or twice = 1, sometimes = 2, often = 3, and every day or almost every day = 4. A “do not know” response was also permitted and was scored as 0.<sup>22</sup>

## Validation and Reliability

The questionnaire was pretested on 10 parents to ensure practicability, cogency, and rendition of answers. The questionnaire items included in this study have shown well-established validity in previous studies. Moreover, the face validity of the questionnaire was established by taking expert opinions from pedodontists and Dental public health professionals REU faculty.

The reliability of the questionnaire was evaluated by twice administering the survey to 10 same parents/caregivers at an interval of 10 days who were seeking dental care for their children in the dental clinics of REU. The level of agreement of the responses to questionnaire items was calculated using Cronbach's alpha statistics (alfa=0.82), indicating adequate reliability of the questionnaire.

## Questionnaire Administration

A subscription to the Survey Monkey program was made in February/2021. The survey questionnaire included 33 items distributed into four domains with the introductory message and informed consent to participate in the study. The Survey Monkey program was used to prepare an online questionnaire in Arabic and English. A digital link to the questionnaire (<https://www.surveymonkey.com/r/6XBKPXC>) and a printed barcode were distributed to the parents/caregivers of eligible children at the dentistry clinics of REU for their responses. Utilizing the snowball sampling method, parents who received the online questionnaire link were asked to disseminate it to their contacts with children aged 5 to 14 years residing in Saudi Arabia for the purpose of response collection. Thus, parents/caregivers on social media (WhatsApp, Snapchat, and Facebook) participated in the survey. Data was collected from February/2021 to April/2021 from the parents/caregivers and subjected to statistical analysis. All duplicate responses were detected and removed utilizing a Statistical Package for Social Sciences (IBM-SPSS version 25, Armonk, NY:USA) statistical software.

## Statistical Analysis

All the responses recorded in the Survey Monkey program were downloaded as a Statistical Package for Social Sciences (IBM-SPSS version 25, Armonk, NY:USA) data file. Descriptive frequency distribution and percentages statistics were calculated for socio-demographic information, Parental Perception of Oral Halitosis, and Oral Health-Related Quality of Life sections. Similarly, mean and standard deviation scores were calculated for the different domains of OHRQoL: Oral symptoms (13 items), Emotional well-being (5 items), and family impacts (14 items). Presence and absence of halitosis is recorded to assess the prevalence of halitosis.

The highest possible total score of all the parental perception of OHRQoL domains was 128 (32 × 4). Furthermore, OHRQoL was further categorized into good, for whom score was less than 60% of the total possible score (<77), and poor for whom score was more than or equal to 60% of the total possible score (≥77). A high score indicates poor OHRQoL.

Chi-square test was applied to determine the influence of socioeconomic variables on halitosis of the children. A binary logistic regression analysis was performed to predict the socioeconomic factors related to halitosis. All the data were analyzed using SPSS version 25 (Armonk, NY: USA). The value of p<0.05 was considered significant for all the statistical analyses.

## Results

A total of 1416 subjects participated in this study and completed the online questionnaire. The majority of participants were mothers 1019 (72.0%), with Saudi nationals 1219 (86.1%), and having a family income of 4,001–10,000 SAR/month 465 (32.8%). A significant number of fathers, 707 (49.9%), and mothers, 914 (64.5%), attained a bachelor's degree as their highest level of education. A significant portion, 771 (54.4%) of fathers, were engaged in the government sector, whereas 838 (59.2%) of the mothers were not participating in the workforce. The majority of the study participants resided in urban areas, 1329 (93.9%), while those from rural areas were only 87 (6.1%). The socioeconomic variables of the study participants are presented in (Table 1). The total number of children reported by parents or caregivers varied from 1 to 12, with an average of 3 children. The average age of the children was found to be  $8.04 \pm 3.5$  years.

**Table 1** Socioeconomic Variables of the Study Participants (n=1416)

Child relation	Mother	1019	72.0%
	Father	93	6.6%
	Other	304	21.5%
Nationality	Saudi	1219	86.1%
	Non-Saudi	197	13.9%
Family income/month (SAR)	<4,000	203	14.3%
	4,001–10,000	465	32.8%
	10,001–16,000	329	23.2%
	>16,001	419	29.6%
Highest education of the father	Elementary or less	53	3.7%
	Middle or High school	425	30.0%
	Bachelor	707	49.9%
	Postgraduate	231	16.3%
Highest education of the mother	Elementary or less	52	3.7%
	Middle or High school	264	18.6%
	Bachelor	914	64.5%
	Postgraduate	186	13.1%
Residence	Urban	1329	93.9%
	Rural	87	6.1%
Father's occupation	Do not Work.	101	7.1%
	I am private or self-employed	544	38.4%
	I am a government employee	771	54.4%
Mother's occupation	I do not Work	838	59.2%
	I am private or self-employed	246	17.4%
	I am a government employee	332	23.4%

**Abbreviation:** SAR, Saudi Arabian Riyals.

## Oral Halitosis Perception

Among the surveyed parents/caregivers, 1049 (74.1%) reported observing unpleasant breath odor in their children. The findings indicated a parent's perception of the prevalence of unpleasant breath odor. Fewer than one-quarter of parents reported no unpleasant breath odor in their children. Most parents/caregivers, 452 (31.9%) were aware of their children's bad breath for over a year. In most cases, 1028 (72.6%) parents/caregivers found their children's bad breath. Almost 91 (6.4%) parents noticed that the child is having problems communicating due to his /her oral bad breath. Meanwhile, 119 (8.4%) parents/caregivers noticed the child was covering his/her mouth while speaking due to bad oral breath. Nearly 302 (21.3%) parents/caregivers took their children for the examination of bad breath by their dentist, and 104 (7.3%) were found to be diagnosed with bad breath. A significant differences were observed in parental perception with regards to noticing of the unpleasant bad breath ( $p<0.001$ ), awareness of the presence of malodor ( $p=0.029$ ), self-identification of presence of bad breath ( $p<0.001$ ), child's communication problem ( $p<0.001$ ) and covering mouth during speaking due to oral bad breath as shown in ([Supplementary file Table 1](#)).

## Children's Oral Health-Related Quality of Life

### Oral Symptoms

The oral symptoms domain of OHRQoL showed that 567 (40.10%) children complained of pain in the teeth, lips, jaw, and mouth. While bleeding gum 198 (13.90%), oral ulcers 225 (15.90%), food impaction in palate 113 (7.90%), food accumulation in between teeth 776 (54.70%), troubled chewing 325 (23.00%), breathing from mouth 582 (41.10%) was reported by the parents. Similarly, sleep difficulty 402 (28.40%), speaking difficulty 234 (16.60%), taking longer time to eat than others 572 (40.40%), difficulty eating hot or cold foods 390 (27.50%), difficulty in opening mouth 76 (5.40%) and difficulty in drinking with a straw 34 (2.50%) were reported by the parents/caregivers. All the reported oral symptoms differed significantly among parents and caregivers ( $p<0.05$ ) ([Supplementary file Table 2](#)).

### Child Emotions

Most parents/caregivers reported that their child gets troubled or frustrated 1059 (74.90%), gets shy or embarrassed 970 (68.50%), worries from others about their teeth 219 (15.50%), felt different from others 200 (14.10%) and felt not good looking or decent in appearance 236 (16.70%) due to oral health-related problems. All the child emotion items of the OHRQoL of children showed a significant difference among parents and caregivers ( $p<0.05$ ) ([Supplementary file Table 3](#)).

## Family Environment

Fourteen items were assessed in the family environment of the OHRQoL. Due to the oral health problems of one of the parents, they took a day off or more to stay with the child 360 (25.40%). Almost 632 (44.60%) reported that their child asked for more attention. Nearly half, 681 (48.20%) of the parents did not find enough time for him/her or the rest of the family.

A total of 578 (40.80%) parents expressed sleep disturbance. Almost 426 (30.10%) parents reported that their family activities affected their child's oral health problems. About 542 (38.20%) parents were upset by the child's health condition. Around 528 (37.20%) parents felt guilty about the health condition of their child's teeth. Some 238 (16.70%) parents feared their child would face fewer opportunities in life. Some 187 (13.20%) parents felt discomfort with their child's company in public places. More than half of the parents, 738 (52.10%), mentioned that it is a habit for the child to over-argue with them. Almost 563 (39.70%) parents reported that their child felt jealous of one of the family members. Nearly 195 (13.80%) mentioned that their child's health status caused disagreement or argument in the family. Almost 223 (15.70%) reported that their child blamed either or both parents. Only 111 (7.80%) parents reported that their child's condition caused financial difficulties for the family. All the reported items of family environment component of OHRQoL showed a statistically significant difference among parents and caregivers ( $p<0.05$ ). ([Supplementary file Table 4](#)).

The relationship between socioeconomic factors and parent-perceived OHRQoL of halitosis children is presented in [Table 2](#). Of all the factors, child relations showed a statistically significant association with the OHRQoL of halitosis children. A significantly higher proportion of the mothers, fathers, and others perceived good OHRQoL of their halitosis children ( $p<0.001$ ). Similarly, the mother's educational level showed a significant association with OHRQoL of halitosis

**Table 2** Socioeconomic Factors and OHRQoL of Halitosis Children

Variables		Total (1049)	Good (n=723)		Poor (n=326)		p
			n	%	n	%	
Child relation	Mother	784	510	65.1	274	34.9	<0.001
	Father	53	35	66.0	18	34.0	
	Other	212	178	84.0	34	16.0	
Nationality	Saudi	894	617	69.0	277	31.0	0.876
	Non-Saudi	155	106	68.4	49	31.6	
Family income/month (SAR)	<4,000	164	120	73.2	44	26.8	0.374
	4,001–10,000	334	235	70.4	99	29.6	
	10,001–16,000	254	167	65.7	87	34.3	
	>16,001	297	201	67.7	96	32.3	
Father's education	Elementary or less	46	33	71.7	13	28.3	0.536
	Middle or High school	335	240	71.6	95	28.4	
	Bachelor	510	342	67.1	168	32.9	
	Postgraduate	158	108	68.4	50	31.6	
Mother's education	Elementary or less	43	35	81.4	8	18.6	0.006
	Middle or High school	188	144	76.6	44	23.4	
	Bachelor	695	469	67.5	226	32.5	
	Postgraduate	123	75	61.0	48	39.0	
Residence	Urban	977	671	68.7	306	31.3	0.531
	Rural	72	52	72.2	20	27.8	
Father's occupation	Do not Work	82	63	76.8	19	23.2	0.243
	Private or self-employed	383	258	67.4	125	32.6	
	Government employee	584	402	68.8	182	31.2	
Mother's occupation	Do not Work	638	446	69.9	192	30.1	0.481
	Private or self-employed	178	116	65.2	62	34.8	
	Government employee	233	161	69.1	72	30.9	
Child gender	Male	563	400	71.0	163	29.0	0.109
	Female	486	323	66.5	163	33.5	

**Abbreviations:** SAR, Saudi Arabian Riyals, OHRQoL, Oral Health Related Quality of Life.

children. A large proportion of mothers from all educational levels perceived good OHRQoL of their halitosis children compared to poor OHRQoL ( $p=0.006$ ). In contrast, none of the other sociodemographic variables exhibited significant association with parent-reported OHRQoL.

Table 3 displays the overall OHRQoL and its component scores in children with halitosis, compared across various sociodemographic characteristics. The relationship between children and their mothers, fathers, and other caregivers

**Table 3** Components and Overall OHRQoL Scores Across Different Socioeconomic Variables

Variables		Symptoms		p	Emotions		p	Family Environment		p	Overall OHRQoL		p
		Mean	SD		Mean	SD		Mean	SD		Mean	SD	
Child relation	Mother	21.02	22.47 <sup>A</sup>	<0.001 <sup>#</sup>	11.03	7.24 <sup>A</sup>	<0.001 <sup>#</sup>	27.76	21.82 <sup>A</sup>	<0.001 <sup>#</sup>	59.81	39.54 <sup>A</sup>	<0.001 <sup>#</sup>
	Father	15.06	20.76 <sup>B</sup>		12.13	7.06 <sup>A</sup>		30.92	22.07 <sup>A</sup>		58.11	38.82 <sup>A</sup>	
	Other	11.45	19.6 <sup>B</sup>		8.43	7.65 <sup>B</sup>		16.15	22.09 <sup>B</sup>		36.03	38.22 <sup>B</sup>	
Nationality	Saudi	18.75	22.19	0.932 <sup>¶</sup>	10.57	7.38	0.931 <sup>¶</sup>	25.95	22.38	0.105 <sup>¶</sup>	55.27	40.14	0.427 <sup>¶</sup>
	Non-Saudi	18.98	22.06		10.52	7.47		23.39	22.35		52.88	41.53	
Family income in Saudi Arabian Riyals/month	<4,000	16.87	21.63	0.423 <sup>#</sup>	9.84	7.40	0.225 <sup>#</sup>	22.82	21.75 <sup>A</sup>	0.020 <sup>#</sup>	49.53	39.26	0.099 <sup>#</sup>
	4,001–10,000	19.70	22.17		10.51	7.43		23.05	22.42 <sup>A</sup>		53.26	40.66	
	10,001–16,000	19.78	22.33		10.48	7.35		27.73	22.46 <sup>B</sup>		57.99	40.16	
	>16,001	17.97	22.30		11.09	7.39		28.07	22.25 <sup>B</sup>		57.13	40.53	
Father's education	Elementary or less	17.20	21.98	0.230 <sup>#</sup>	9.67	7.46	0.334 <sup>#</sup>	23.74	23.88	0.125 <sup>#</sup>	50.61	42.80	0.133 <sup>#</sup>
	Middle/High school	17.61	21.73		10.15	7.34		23.73	21.99		51.49	39.72	
	Bachelor	20.04	22.58		10.70	7.48		26.95	22.44		57.69	40.45	
	Postgraduate	17.70	21.72		11.23	7.20		25.58	22.49		54.51	40.25	
Mother's education	Elementary/less	10.00	18.61 <sup>A</sup>	0.001 <sup>#</sup>	8.84	7.65 <sup>A</sup>	<0.001 <sup>#</sup>	21.93	23.42 <sup>A</sup>	0.001 <sup>#</sup>	40.77	39.65 <sup>A</sup>	<0.001 <sup>#</sup>
	Middle/High school	14.81	20.95 <sup>A</sup>		8.59	7.48 <sup>A</sup>		20.73	22.16 <sup>A</sup>		44.13	40.23 <sup>A</sup>	
	Bachelor	20.20	22.4 <sup>B</sup>		10.89	7.35 <sup>B</sup>		26.09	22.36 <sup>B</sup>		57.18	39.79 <sup>B</sup>	
	Postgraduate	19.97	22.53 <sup>B</sup>		12.33	6.75 <sup>B</sup>		31.28	21.08 <sup>B</sup>		63.58	39.95 <sup>B</sup>	
Residence	Urban	18.98	22.22	0.218 <sup>¶</sup>	10.58	7.36	0.887 <sup>¶</sup>	25.86	22.31	0.283 <sup>¶</sup>	55.42	40.16	0.151 <sup>¶</sup>
	Rural	16.17	21.25		10.26	7.82		21.64	23.25		48.07	42.36	
Father's occupation	Do not Work.	15.44	21.73	0.252 <sup>#</sup>	9.63	7.23	0.377 <sup>#</sup>	22.09	21.55 <sup>A</sup>	0.022 <sup>#</sup>	47.16	38.53	0.184 <sup>#</sup>
	Private or self-employed	20.23	22.33		10.64	7.40		24.41	22.21 <sup>A</sup>		55.28	40.65	
	Government employee	18.31	22.08		10.64	7.42		26.82	22.56 <sup>B</sup>		55.77	40.33	
Mother's occupation	I do not Work	18.66	22.01	0.132 <sup>#</sup>	10.32	7.51	0.594 <sup>#</sup>	24.24	22.70 <sup>A</sup>	0.036 <sup>#</sup>	53.22	40.55	0.267 <sup>#</sup>
	Private or self-employed	21.30	22.87		10.84	7.10		25.82	21.68 <sup>A</sup>		57.96	39.94	
	Government employee	17.22	21.96		11.01	7.29		29.02	21.77 <sup>B</sup>		57.25	40.00	

Notes: # Indicates Kruskal-Wallis test, Mann-Whitney U-test.

Abbreviation: SD standard deviation, OHRQoL=Oral Health Related Quality of Life.



exhibited a statistically significant variation in perceived oral symptoms ( $p<0.001$ ), emotional responses ( $p<0.001$ ), family environment ( $p<0.001$ ), and overall OHRQoL scores ( $p<0.001$ ). Other caregivers consistently demonstrated significantly lower scores in oral symptoms, emotional responses, family environment, and overall OHRQoL compared to the mothers and fathers indicating a better perception of OHRQoL among children with halitosis. Similarly, mothers' education revealed statistically significant differences in perceived oral symptoms ( $p<0.001$ ), emotional responses ( $p<0.001$ ), family environment ( $p<0.001$ ), and overall OHRQoL scores ( $p<0.001$ ). Mothers with educational levels of elementary/less and middle/high school showed lower scores in all components and overall OHRQoL of children with halitosis compared to the mothers with bachelor's and postgraduate degrees. Thus, indicating mothers with lower educational levels perceive better OHRQoL of children with halitosis.

The family environment aspect of OHRQoL was significantly influenced by family income ( $p=0.020$ ), the father's occupation ( $p=0.022$ ), and the mother's occupation ( $p=0.036$ ). Parents and caregivers with incomes below 4,000 and between 4,001 and 10,000 Saudi Arabian Riyals exhibited significantly lower scores on the family environment component of OHRQoL when compared to higher income groups. This suggests a more favorable perception of the family environment component in children experiencing halitosis. Mothers and fathers with government employment revealed significantly higher family environment scores indicating lower perception compared to those with no work status and working in the private sector or self-employed (Table 3).

## Predictor Variables of Halitosis Among Children

A binary logistic regression indicated that the relation to the child ( $p=0.003$ ), nationality of the children ( $p=0.031$ ), age of the children ( $p<0.001$ ), father's education ( $p=0.022$ ), father's occupation ( $p=0.002$ ), and oral symptoms ( $p<0.001$ ) were found to be the significant predictors of halitosis among the children (Table 4).

**Table 4** Predictor Variables of Halitosis Among Children

Variables		B	S.E.	Wald	df	p	Exp(B)	95 C.I.	
								Lower	Upper
Step 1a	Relation to the child	-0.376	0.125	9.059	1	0.003	0.686	0.537	0.877
	Nationality of the child	0.618	0.287	4.632	1	0.031	1.855	1.057	3.258
	Family income/month	-0.061	0.105	0.334	1	0.563	0.941	0.765	1.157
	Father's education	-0.329	0.144	5.248	1	<b>0.022</b>	<b>0.719</b>	0.543	0.954
	Mother's education	0.155	0.170	0.828	1	0.363	1.167	0.837	1.629
	Residence	0.401	0.428	0.878	1	0.349	1.493	0.646	3.455
	Father's Occupation	0.492	0.159	9.539	1	<b>0.002</b>	<b>1.636</b>	1.197	2.236
	Mother's occupation	-0.192	0.122	2.460	1	0.117	0.825	0.649	1.049
	Number of children	0.037	0.057	0.426	1	0.514	1.038	0.928	1.161
	Age of the child	0.103	0.029	13.003	1	<0.001	1.109	1.048	1.172
	Gender of the child	-0.068	0.183	0.136	1	0.713	0.935	0.653	1.339
	Symptoms	-0.020	0.005	19.353	1	<0.001	0.980	0.972	0.989
	Emotions	-0.003	0.015	0.053	1	0.818	0.997	0.968	1.026
	Family environment	-0.005	0.005	1.265	1	0.261	0.995	0.985	1.004
	Constant	0.083	0.969	0.007	1	0.931	1.087		

**Notes:** Dependant variable=Halitosis (Yes).



A significant negative correlation was observed between halitosis and oral symptoms ( $r=-0.214$ ,  $P<0.001$ ), emotions ( $r=-0.152$ ,  $p<0.001$ ), Family environment ( $r=-0.178$ ,  $p<0.001$ ) and overall OHRQoL of the children ( $r=-0.198$ ,  $p<0.001$ ). Hence it can be observed that halitosis affects all the domains of the OHRQoL of children.

## Discussion

Oral malodor is a critical condition, especially in children and young adults, because it may lead to social restrictions, lower quality of life, and other consequences. Hence, diagnosis and assessment of oral halitosis are essential to dental care. The available data on the prevalence of oral halitosis in Saudi Arabia and its effects on the quality of life is limited. The present study assessed the parental perception of oral halitosis in their children and its effects on oral health-related quality of life. The present study is the first parent-perceived report on children's oral halitosis and its effect on OHRQoL conducted on a large sample in Saudi Arabia.

The accuracy of self-assessment and parental reports of halitosis are controversial subjects in the literature. Many reports estimate no consistent relationship between self-reports or parental perception of oral malodor and the presence of oral malodor clinically.<sup>24,25</sup> On the contrary, several other studies showed that self-estimation of halitosis positively correlates with objective measurement of halitosis.<sup>26,27</sup> Moreover, Villa et al (2014) found that self-reported halitosis was a more accurate predictor of halitosis than both the halimeter device and the organoleptic test. Self-reported halitosis has been proposed as a reliable indicator of halitosis.<sup>13</sup> It was suggested that self-reported halitosis is a good indicator of halitosis, favoring a potential role in diagnosing halitosis objectively. Interestingly, a study evaluated the parent's perceptions of halitosis in their children to the presence of halitosis clinically, and results showed that the parents perceived halitosis in 58.2% of their children, while it was objectively detected in 86.6%. This illustrates the importance of parental perception of halitosis despite its subjectivity.<sup>21</sup>

In the present study, the parent-perceived prevalence of oral halitosis in children was 74.1%. It closely resembles a study conducted by Mubarak et al (2019), in which the incidence of oral halitosis was estimated using organoleptic measurement among Saudi Children. The results showed that more than 50% of the study sample were suffering from oral halitosis.<sup>28</sup> Another report estimated parental perceived halitosis in 58% of the children in Saudi Arabia.<sup>21</sup> Moreover, Lin et al observed similar findings from a questionnaire study in which 61% of mothers reported halitosis in their children.<sup>29</sup> Nonetheless, the prevalence of halitosis in our study is considered high in comparison with most prevalence reports in the pediatric population, ranging from 8 to 45%.<sup>13,14,30,31</sup>

Many factors could influence the difference between the reports, such as the sample size, culture, parent's olfaction, parents to the child contact, and emotional condition of the parents. Our finding could be related to the high caries prevalence in Saudi Arabia. The available data shows that caries lesions are strongly associated with oral halitosis, indicating a poor oral hygiene level.<sup>32</sup> The global prevalence of caries in primary teeth in children was 46.2%, but in Saudi Arabia, it was estimated to be 80% for the primary dentition with a mean DMFT score of 5.0 and 70% for the permanent dentition with a mean DMFT score of 3.5. These high dmft/DMFT scores in the population may indicate poor oral hygiene, irregular tooth brushing, cariogenic diet, and many more that could lead to food putrefaction and oral halitosis. A recent analysis has shown a global increase in the incidence of halitosis, as evidenced by research released after 2007. These studies have reported that the occurrence of oral malodor is now twice as high as in studies published before 2007.<sup>12</sup>

Our findings illustrate no significant difference in oral halitosis between male and female children. Some contradictory results demonstrated that men have an oral halitosis prevalence nearly three times higher than women.<sup>33</sup> Others demonstrated a higher prevalence of halitosis in women.<sup>13,21</sup> In general, halitosis has been reported to be similarly prevalent in females and males.<sup>34</sup> However, it was observed that chronic caseous tonsillitis and tonsillolithiasis (tonsil stones) are highly associated with halitosis.<sup>35</sup> Al-Ansari et al reported that chronic sinusitis and gastrointestinal tract disorders were significantly associated with self-reported oral malodor.<sup>33</sup>

Our results showed that most parents did not notice that their child's communication and social interaction were affected by halitosis. Similar results were demonstrated in a study published by Almadhi et al.<sup>21</sup> This finding could be explained by observing that the mean age reported by the participants in the present study was (8.04±3.5). The knowledge and awareness of children about oral conditions and symptoms by this age group of children are limited.

It was reported in the literature that adolescents rate halitosis as the most important oral condition, impacting their oral health-related quality of life having negative impact.<sup>20,36</sup> Exploring this association in the pediatric population is still limited. The present study has investigated the impact of halitosis on OHRQoL in children in Saudi Arabia using (COHQoL) as a quality-of-life measure.

The overall OHRQoL score of children was 59.39, which is less than half of the maximum score of 128.00, illustrating the likelihood of the negative impact of halitosis on children's OHRQoL. Similar results were demonstrated in a study by Ueno et al and Motta et al, where they observed the negative effect of halitosis on the child's physiological and social aspects of life, possibly leading to isolation and avoidance in the community.<sup>14</sup>

Moreover, other studies evaluated self-reported halitosis and its impact on adolescents' OHRQoL in New Zealand and Brazil, and they found a significant negative association between them.<sup>18</sup> Furthermore, the domains of children's OHRQoL had different scores, including oral symptoms and functional limitations (21.17), emotional conditions of the child (11.04), and the family environment (27.18). These scores represent half or less than half of the maximum scores, illustrating that each domain was scored fairly or fairly to poor scores of OHRQoL separately. Among the study sample, a high number of children suffered from food accumulation in between the teeth (776 or 54.70%), breathing from the mouth (582 or 41.10%), taking longer time to eat than other (572 or 40.40%), and 567 or 40.10% of children were complaining from pain in teeth, lips, and jaw which was the most frequent item in the oral symptoms and functional limitations domain. Moreover, regarding the children's emotional conditions, most parents reported that their child gets troubled or frustrated (1059 or 74.90%) or gets shy or embarrassed (970 or 68.50%). Besides, in family environment questions, almost 632 (44.60%) reported that their child asked for more attention, and nearly half (681 or 48.20%) of the parents did not find enough time for him/her or the rest of the family. More than half of the parents (738 or 52.10%) mentioned that it is a habit for the child to over-argue with them. The highest number documented in all the domains was being troubled or frustrated and getting shy or embarrassed, a finding that indicates halitosis has a high psychological impact on these children. In this study, parents reported oral symptoms, emotions, and family environment components of child's OHRQoL differ significantly. Hence, the null hypothesis positing no statistically significant difference in OHRQoL among children with halitosis as perceived by their parents has been rejected.

With binary regression analysis, it has been demonstrated that the relation to the child, nationality, age, father's education, father's occupation, and oral symptoms were significant predictors of halitosis among the children. Pani et al found that Saudi mothers have a comparatively better understanding of their children's oral health, and Saudi fathers appear to be inept proxies for their children in assessing OHRQoL.<sup>22</sup> In most cases, mothers are the primary caregivers for their children. Many reports in the literature have investigated the relationship between age and halitosis, and it was established that the increase in bad breath is correlated with the increase in age.<sup>13,32</sup>

In this study, father's education and occupation were significant predictors associated with the perception of halitosis in their children. Hence, the second null hypothesis positing no significant relationship between the socioeconomic predictor variables and the OHRQoL has been rejected. Thus, reflecting father's knowledge and awareness regarding oral health conditions and the importance of routine dental care and oral hygiene practices in their children. In line with this study, Almadhi et al<sup>21</sup> reported no significant association between parents educational level and their perception of halitosis in children while Puthiyapurayil et al observed education and occupation as the significant factors influencing parental perception of their children's oral health conditions.<sup>37</sup> In a similar study, Nembhwani and Varkey noted that the education and occupational status of the mother are directly correlated with her knowledge and attitude toward the child's oral health.<sup>38</sup> Among all OHRQoL domains, oral symptoms were the most significant predictors of halitosis in children related to food stagnation, mouth breathing, oral ulcers, and oral pain that could directly relate to oral halitosis.

## Clinical Implications

Halitosis can be assessed subjectively through parental perception using a self-administered questionnaire or objectively using a portable gas chromatograph in a clinical setting. The outcomes of this study indicate that, in the absence of an objective testing method for halitosis, parental perception may be utilized in diagnosing halitosis and taking appropriate treatment measures to improve the OHRQoL their children. Additionally, Parental perception can be utilized to evaluate the effectiveness of halitosis treatment and monitor changes in the OHRQoL of children in clinical settings.

Multiple etiological factors contribute to halitosis in children, with oral causes being a prominent component. Halitosis is linked to inadequate oral hygiene, particularly tongue care, while other potential reasons such as otorhinolaryngological and respiratory or even gastric diseases remain plausible. Establish a timely diagnosis by administering a questionnaire, conducting intra and extra oral examinations, and involving a multidisciplinary team to identify the underlying causes and develop an effective treatment plan. Inadequate oral hygiene, tongue coating, dental cavities, gingivitis, and periodontal conditions can lead to halitosis due to bacteria. Hence, measures to reduce microbial biofilm load through proper oral hygiene practices like toothbrushing, flossing, tongue cleaning, and mouth rinses should be undertaken. Swishing the mouth after eating should be taught to children at an early age to reduce food lodgment, microbial load, and dietary-related halitosis.

After parental perception of the halitosis in their children effort should be made to objectively diagnose the condition and identify the source of halitosis to control halitosis and to improve OHRQoL. An advisory and counselling session should be undertaken to explain the advantages of good oral hygiene regimen, dietary modifications, hydration, visit to dental office for examination and teeth cleaning, and possible medical consultation.

The extensive questionnaire utilized in this study has shown useful in assessing halitosis-related quality of life in Saudi children. The questionnaire exhibited high face validity and test-retest reliability for identifying halitosis among children. The study findings suggest the necessity for cultural adaptation of parent-reported child's halitosis outcome measures in additional languages following modification.

## Limitations of the Study

One of the limitations of our study is the high subjectivity due to the parental perception and study's questionnaire-based design. The study's conclusions were dependent on self-reported data, which raises the possibility of participant bias. The questionnaire was offered in both Arabic and English. While Arabic being the predominant language of the study participants, English may have been a barrier for those who were not proficient, affecting their responses. Furthermore, technological issues such as website crashes or slow loading web pages may have hindered participants' completion of the online survey. The study exclusively comprised persons actively participating in social media, which may introduce a selection bias that could affect the generalizability of the findings. Initially, snowball sampling was implemented to select a sample that did not truly represent the Saudi population. This may be regarded as a possible limitation. Moreover, the diagnosis of halitosis was solely based on parental perception and not supported by any objective assessment. Also, it was not easy to prove that the impact on OHRQoL observed among children was solely due to their halitosis status. Thus, we acknowledge that this study has shown association and not causality.

## Future Research

The future research should consider both subjective and objective methods in studying prevalence of oral halitosis among children. Future research should focus on validating the instrument across diverse languages and exploring new items to enhance its cultural specificity, thereby contributing to improved assessment of halitosis-related quality of life in other similar cultural contexts. In addition, questionnaire should be made more comprehensive by inclusion of the parental attitude towards resolving halitosis by considering check up or it is self limiting on its own or proper oral hygiene.

Further investigations are necessary to clarify the association between several oral disorders in children, including dental caries, periodontal diseases, and tongue coatings, and their impact on halitosis. The OHRQoL of children should be evaluated prior to and following potential interventions, including oral hygiene practices, tongue cleaning, and dental rehabilitation.

## Conclusions

It can be concluded that the oral halitosis among children based on parental perception is very high in Saudi Arabia. The child's age, nationality, relationship with parents or caretakers, as well as the father's educational and occupational positions, were factors associated with the children's halitosis. Oral halitosis adversely impacted OHRQoL in children and adolescents, and oral symptoms were found to be the significant predictors of halitosis. Therefore, suitable preventive and control interventions for halitosis should be considered to improve OHRQoL by addressing the risk factors in children.

## Data Sharing Statement

The data sets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Ethics Approval

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Research and Innovation Center of Riyadh Elm University (IRB No: FPGRP/2020/522/329/324).

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## Disclosure

All authors declare no conflicts of interest.

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