

ORIGINAL RESEARCH

Oral health related knowledge, attitude and behavior among group of mothers in relation to their primary school children's oral health: a cross-sectional study

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Abstract

The etiology of oral diseases in children is complex and multifactorial. The oral health of children can be influenced by various factors, including parental knowledge, attitudes and behaviors, as well as socioeconomic status. The objective of this study was to assess, among mothers of children aged 6–12 years, (1) mothers' knowledge about their children's oral health, (2) mothers' attitude toward their children's oral health, and (3) mothers' dental behavior concerning their oral health and to evaluate their influence on their children's dental caries. This cross-sectional study involved three questionnaires to be filled in by mothers of primary school children in addition to an oral examination of their children to measure decayed, missing, filled teeth for primary (dmft) and permanent (DMFT) dentitions. The mother-child pairs were recruited through multistage stratified random sampling of primary schools in Jeddah, Saudi Arabia. The questionnaire was comprised of four sections: 1—demographic characteristics and socioeconomic status 2—Hiroshima University Dental Behavioral Inventory (mothers' attitudes and behavior pertaining to their oral health) 3—mothers' knowledge regarding the oral health of their children 4—mothers' attitude toward their children oral health. A total of 1496 mother-child pairs completed the study. The mean values of dmft were 4.08 ± 3.47 ; DMFT was 1.82 ± 2.07 ; total dmft and DMFT were 5.65 ± 4.05 . According to the questionnaire results, mothers in private schools had a more favorable attitude and behavior toward their oral health, as well as a more favorable knowledge and attitude toward their children's oral health. The multiple linear regression model revealed that children's dmft/DMFT scores were significantly related to mother education, mother questionnaire scores, and the Simplified Oral Hygiene Index. Children's oral health is significantly impacted by oral health-related knowledge, attitude and behaviors of their mothers in addition to income status and education level.

Keywords

Oral health; Mothers; Children; Knowledge; Attitude; Behavior; Primary schools; Dental caries; Oral hygiene index

1. Introduction

Oral health is an essential part of overall health and well-being, with growing data suggesting an association between oral and systemic health for serious disorders including cancer, mild cognitive impairment, arthritis, diabetes and cardiovascular disease [1]. Even though oral health has made enormous strides, the burden of oral health disorders is still quite high globally. This may be primarily due to a lack of healthy oral behaviors that are essential in managing the most prevalent oral diseases, such as dental caries and periodontal disease, with a prevalence rate of up to 47.6% or more in school children around the globe [2].

Dental caries is a childhood illness that is preventable as well

as manageable. But public health initiatives are impeded by a lack of knowledge of related variables in vulnerable groups [3]. Children in Arab nations experience significant rates of dental caries, both in terms of prevalence and severity. In the Arabian Gulf Countries, the overall mean number of permanent teeth that are decayed, missing or filled is 2.57, while the prevalence of dental caries is 64.7% of 6–16 years of age children [4]. In Saudi Arabia, the prevalence of dental caries remained high reaching 84% as recently reported [5]. Dental caries is quite common in nations where preventive strategies for oral diseases have not yet been put into place. In research on the prevalence of dental caries in school children, aged 12 to 14 years in Riyadh, it was found that just 6.3% of the entire sample was caries-free, with an estimated 93.7% caries frequency

[6]. According to another study carried out in Saudi Arabia, school children had inadequate periodontal health knowledge and behavior [7]. Saudi students' oral health knowledge, attitudes and behavior are still little understood. Therefore, the Saudi community as well as international organizations like the World Health Organization (WHO) and health authorities would benefit from knowing the related causes for dental caries in Saudi children. This will help them focus their mitigation efforts on susceptible groups like children.

The association between parents and their children's oral health has been investigated since 1946 with a stronger association among mothers than fathers [8]. Parents are the primary regulators of their children's nutritional intake [9]. The lack of parental knowledge and inconsistency between the parent's dental knowledge and their actual practice were reported as major risk factors for dental caries [10]. Adherence to healthy oral habits, such as twice-daily teeth brushing with fluoride toothpaste and minimizing intake of sugary foods and beverages, is essential for the prevention of childhood dental caries [11]. The reality is that understanding these signals by children on their own seldom results in long-lasting behavioral change in people. Simple oral hygiene practices are intertwined with more complicated daily routines, which are significantly influenced by a wide range of psychological, environmental and economic factors [12]. Hence, mothers' knowledge, attitude and behavior toward oral health need to be optimum to maintain their own and their children's oral health.

Another important risk factor that might affect dental caries among children is the socioeconomic status of the family. The association between dental caries and socioeconomic status is well-established [13]. Children of fathers with higher socioeconomic status and non-working mothers were found to have lower caries prevalence compared to those with lower socioeconomic status [14, 15]. Previous studies reported a higher prevalence of poor oral health in children of mothers with low educational levels [16]. Additionally, it was reported that mothers with lower educational levels had poorer knowledge regarding their children's oral health leading to an increased incidence of early childhood caries [17]. Although the majority of Saudi children suffer from oral disorders, notably dental caries, little is known about the extent and variables influencing dental caries, oral hygiene habits and behavior throughout most of the nation, particularly in the study location of Jeddah city. The purpose of this study was to gather baseline data on the mother's knowledge, attitude and behavior of their primary school children, aged 6 to 12 years, concerning oral health, and to assess its influence on the oral health status of their children in terms of dental caries experience.

2. Materials and methods

2.1 Study population

The primary schools in Jeddah, Saudi Arabia consist of a total of 737 schools (public and private), segregated by gender into 344 male and 393 female schools, according to the country's regulations. The registered number of male and female students in the academic year 2017–2018 were 147,525 and 145,848, respectively, accounting for a total of 293,373

children.

2.2 Sampling methodology

A multistage stratified random sampling technique was adopted to select the participants from primary schools in each district from Jeddah City, Saudi Arabia. For stratification purposes, three criteria were undertaken:

- District-wise (west, east, north, south), resulting in four strata.
- Each district strata were divided into public or private, producing 8 strata.
- Finally, each of the 8 strata was stratified by gender into boys and girls, resulting in 16 strata.

Schools in each of the 16 strata were listed and numbered and one school from each stratum was selected using a software (random number generator) resulting in 16 primary schools. A sample size of the children was calculated based on previous research [18]. A two-sided 95% confidence interval for a single proportion using the large sample normal approximation modified for a finite population of size 300,000 will stretch 3% from the observed percentage for an expected proportion of 50% when the sample size is 1529. A slightly greater number of questionnaires (1728) were to be distributed to compensate for any dropout of study participants, incomplete questionnaires or the child's absence/resistance to the oral examination. Six classes were chosen from each school, one from each grade. The bowl technique was employed for the random selection of each class, in which class numbers were written on paper slips, placed in a bowl and then blindly drawn out. From each of the six classes, 18 children from each class were randomly selected by the class instructor, along with their mothers. In the case of a small number of children in the school (less than 108), all children in the school were included in the sample.

2.3 Inclusion and exclusion criteria

This survey included mother-child pairs. The inclusion criteria of the children were: Saudi children (aged 6–12 years) with good general health, according to the American Society of Anesthesiologists (ASA) classification [19]. The included mothers had to be Saudi nationals and capable of filling out self-administered questionnaires. Children who resisted oral examination and incomplete questionnaire responses were excluded.

2.4 Questionnaire design

An Arabic self-administered questionnaire, comprising four sections and a total of 49 questions, was used for this study to be completed by mothers. The questionnaire had a cover letter describing the aim of the study and the informed consent was attached to this section. Section I was structured to record the demographic characteristics like child gender, mothers' age (40 years or less, 41 years or more), educational level (High school or less Diploma/University), and monthly family income (low, medium or high). Section II employed the Hiroshima University-Dental Behavioral Inventory (HU-DBI) questionnaire which consisted of 20 items to evaluate the

attitudes and behaviors of mothers pertaining to their oral health [20]. A score was calculated based on the sum of agree/disagree responses by giving one point to each favorable response of good oral health. High scores indicate good oral health attitudes and behaviors. Section III was a questionnaire adapted from Prabhu *et al.* [21] to evaluate mothers' knowledge about their children's oral health. The questionnaire consisted of 12 questions which mothers selected the best response from multiple choices. To calculate a score, one point was given for each correct answer. Section IV, a questionnaire adopted from Lenčova *et al.* [22], was used to assess the mothers' attitudes toward their children's oral health. It was composed of 13 agree/disagree questions where one point was given for each correct answer to calculate a total score.

2.5 Translation and validation

Arabic Translation of the questionnaires was carried out by two certified linguists. Forward and back-translation were used. The first linguist, who is fluent in both Arabic and English languages, translated the questionnaire from English to Arabic. The other linguist translated back the Arabic version into the English language. Then, a dental public health professor who was also fluent in Arabic and English compared the two English questionnaires (the original one and translated one) and made modifications after discussion with the two linguists until the final Arabic-translated version was formulated.

Test-retest Reliability of the Arabic questionnaire was done. The final Arabic version of the questionnaire was completed twice with two weeks intervals by a group of mothers ($n = 30$) not included in the study. The results were compared using Pearson's correlation coefficient (Pearson's r) as a reliability test and was found to equal 0.90 which was considered excellent. Moreover, internal consistency was done to reflect the inter-correlation between items in the questionnaire and was quantified using Cronbach's alpha to be 0.86.

Content validity of the Arabic-translated version of the questionnaire was performed to recognize if the questionnaire items were representative of the entire theoretical construct that the questionnaire was proposed to measure. A panel of experts in pediatric dentistry were asked to rate each item in the questionnaire concerning relevance, clarity, simplicity and ambiguity on a four-point Likert scale. The Content Validity Index (CVI) was calculated according to the methodology of Lynn [23] and was found to be 0.84.

2.6 Data collection

The schools were visited thrice. The purpose of the first visit was to distribute the questionnaire to the selected children in the class to take home to their mothers. Each questionnaire was assigned a serial number which was matched with an examination sheet for confidentiality purposes. The second visit was carried out after one week, for the collection of the questionnaires and clinical oral examination for the children who had permission from their mothers to assess dental caries experience using dmft and DMFT indices [24]. Oral health examination as undertaken in the school classroom. The research examiners used sets of sterile instruments (community periodontal index (CPI) probe and mirrors) in addition to

artificial lighting.

The oral hygiene status of the children was assessed using the Debris Index component (DI) of the Greene and Vermillion Simplified Oral Hygiene Index (OHI-S) [25]. A brief report was sent to the mothers describing the oral health status of their children and instructions for improvement and/or maintaining the oral health condition. The examination was conducted by four examiners (two male examiners for the boys' schools and two female examiners for the girls' schools). Before the commencement of the study, the four examiners were trained and calibrated for dental caries and oral hygiene assessment. Inter and intra-rater reliability tests were done for calibration and training of the examiners. Kappa statistic was calculated and found excellent (0.93 for female and 0.95 for male examiners). The inter-rater reliability between the examiners was evaluated using the Intra-class Correlation (ICC) and was found to be 0.96. On the third school visit, mother-child pairs were gathered in the school for an oral health education lecture and distribution of oral health instruction pamphlets to increase their awareness of the proper oral health knowledge, attitude and behavior regarding themselves and their children.

2.7 Statistical analysis

Data was entered, coded and analyzed using the Statistical Package for Social Science SPSS (IBM Statistics for Windows, Version 23.0 Armonk NY, USA: IBM Corp). The responses to the three questionnaires from public schools were compared to private schools using a chi-square test. The association between the demographic variables and questionnaire score, DMFT and OHI-S was evaluated using an independent t -test or Analysis of Variance (ANOVA) test which was followed by *post hoc* analysis. Multiple linear regression was modeled to assess the effects of all the significant independent variables on the DMFT (dependent variable). The significance level was set as $p < 0.05$.

3. Results

3.1 Descriptive statistics

The research comprised a total of 1496 mother-child pairs out of the 1728 distributed questionnaires (a response rate of 86.57%). A little over half were from private schools (50.2%). About half (53.8%) of the children were aged 6–9 years and 46.2% were aged 10–12 years. Male children accounted for 47.1% and female children for 52.9%. Mothers' age has been distributed according to the following figures: 56.2% were aged 40 years or less and 43.8% were aged 41 years or older. Only 44.3% of mothers had a high school education or less whilst 55.7% had a diploma or university education. Less than a quarter of mothers had a low monthly income (22.4%), less than half had a medium-income (46.7%), and less than one-third had a high income (30.9%). Table 1 shows the demographic characteristics of children and mothers. Concerning the children's oral health, the average dmft was 4.08 ± 3.47 ; DMFT was 1.82 ± 2.07 ; total dmft and DMFT was 5.65 ± 4.05 ; and the Debris Index was 1.17 ± 0.94 .

TABLE 1. Demographic features of the research sample children and their mothers.

Variable	Category	Frequency (%)
School type	Public	745 (49.8)
	Private	751 (50.2)
Child age	6–9 yr	805 (53.8)
	10–12 yr	691 (46.2)
Child gender	Male	704 (47.1)
	Female	792 (52.9)
Mother's age	40 or less	841 (56.2)
	41 or more	655 (43.8)
Mother's education	High school or less	663 (44.3)
	Diploma/University	833 (55.7)
Monthly Income	Low	335 (22.4)
	Medium	698 (46.7)
	High	463 (30.9)

3.2 Attitude and behavioral practices of participating mothers

The replies of the mothers to the HU-DBI questionnaire are shown in Table 2. When comparing mothers of children in public vs. private schools, there was a statistically significant difference in 16 out of the 20 questions. Regarding replies to questions 6, 8, 9 and 16, the differences were not statistically significant between mothers who enrolled their children in public schools vs. those in private schools. Mothers in public schools had much higher favorable replies to questions 3, 4 and 13 compared to mothers in private schools. Mothers at private schools tended to provide more favorable replies to questions 1, 2, 5, 7, 10, 11, 12, 14, 15, 17, 18, 19 and 20.

3.3 Mothers' knowledge regarding child oral hygiene

In Table 3, public and private school mothers held different views on oral health and good oral hygiene. When it comes to mothers' awareness of oral health and oral hygiene habits, mothers of children in private schools had better results compared to mothers of children in public schools. However, when questioned about the optimum quantity of toothpaste to be used and about their position when brushing their children's teeth, the replies of mothers in public schools were superior to mothers in private schools.

3.4 Mothers' attitude toward child's oral health

Table 4 shows disparities in the replies between public and private school mothers on the mother's attitude questionnaire. Of the 13 assertions, replies to 4 statements (3, 5, 11 and 12) out of the 13 statements showed no statistically significant difference between mothers in public and private schools. In their replies to the 9 reminiscent statements (1, 2, 4, 6, 7, 8, 9, 10 and 13), the attitude of mothers at private schools was significantly higher than that of mothers at public schools.

3.5 Factors affecting oral health in public and private schools

Table 5 shows the relationships between dmft/DMFT and children's and mothers' demographics, as well as questionnaire scores in public and private schools. Children of younger mothers (40 years or less) had substantially higher mean dmft scores (6.0 ± 4.0) than children of mothers 41 years or older (4.5 ± 4.1) in public schools ($p < 0.001$). The mean DMFT of private school children of younger mothers (3.8 ± 3.4) was substantially lower than that of children of older mothers (5.9 ± 3.9) ($p < 0.001$). Furthermore, dmft and DMFT mean scores in both public and private schools were significantly higher among children of mothers with a high school education or less compared to mothers with university education; children of families with lower monthly incomes compared to higher incomes; children of mothers with lower questionnaire scores compared to higher scores; and children with poor or fair oral hygiene compared to children with good oral hygiene.

Two multiple linear regression models (adjusted) were used to quantify the impacts of the questionnaire scores on the dmft/DMFT index (dependent variable) controlling for confounding (Table 6). Overall, 39.0% and 44.7% of the data variability was accounted for by the dmft/DMFT model in public and private schools, respectively. Children of mothers with lower HU-DBI questionnaire had higher dmft/DMFT on average by 1.7 (95% confidence interval (CI), 1.1–2.3) in public schools and 1.3 (95% CI, 0.8–1.9) in private schools controlling for confounders. Children of mothers in public schools with lower scores in attitude towards their children's oral health had significantly higher dmft/DMFT by 1.2 (95% CI, 0.7–1.8) after controlling for confounding.

4. Discussion

This descriptive survey gave a detailed explanation of various influences on the oral health practices of children (aged 6–12 years) from the viewpoint of their mothers in Jeddah, Saudi Arabia. This survey employed an acceptable sample size, chosen at random from both genders of primary school (public and private) students who are in a period of developing their health habits [12], in contrast to prior interventions targeting newborns [26] and preschool children [27], whose oral health is mostly taken care of by their parents. To our knowledge, this is the first study implemented to examine both mothers' perceptions of the factors that influence their children's important oral health habits as well as their opinions regarding oral health support. Prior descriptive research done in Saudi

TABLE 2. Comparison between public and private schools of mothers' answers to the Hiroshima University-Dental Behavioral Inventory (HU-DBI)-questionnaire.

Items	The correct answer	Public n = 745 n (%)	Private n = 751 n (%)	p-value
1 I don't worry much about visiting the dentist	Agree	246 (33.0)	385 (51.3)	<0.001
2 My gums tend to bleed when I brush my teeth	Disagree	495 (66.4)	601 (80.0)	<0.001
3 I worry about the color of my teeth	Agree	554 (74.4)	379 (50.5)	<0.001
4 I have noticed some white sticky deposits on my teeth	Agree	82 (11.0)	31 (4.1)	<0.001
5 I use a recommended-sized toothbrush	Agree	690 (92.6)	745 (99.2)	<0.001
6 I think that I cannot help having false teeth when I am old	Disagree	48 (6.4)	32 (4.3)	0.061
7 I am bothered by the color of my gums	Disagree	602 (80.8)	673 (89.6)	<0.001
8 I think my teeth are getting worse despite my daily brushing	Disagree	441 (59.2)	426 (56.7)	0.333
9 I brush each of my teeth carefully	Agree	630 (84.6)	653 (87.0)	0.186
10 I have never been professionally taught how to brush	Disagree	169 (22.7)	297 (39.5)	<0.001
11 I think I can clean my teeth without using toothpaste	Agree	125 (16.8)	223 (29.7)	<0.001
12 I often check my teeth in a mirror after brushing	Agree	494 (66.3)	598 (79.6)	<0.001
13 I worry about having bad breath	Agree	166 (22.3)	84 (11.2)	<0.001
14 It is impossible to prevent gum disease without toothbrushing alone	Disagree	214 (28.7)	309 (41.1)	<0.001
15 I put off going to the dentist until I have a toothache	Disagree	63 (8.5)	148 (19.7)	<0.001
16 I have used a dye to see how clean my teeth are	Agree	22 (3.0)	18 (2.4)	0.505
17 I use a toothbrush that has hard bristles	Disagree	573 (76.9)	670 (89.2)	<0.001
18 I don't feel I've brushed well unless I brush with strong strokes	Disagree	370 (49.7)	463 (61.7)	<0.001
19 I feel I sometimes take too much time to brush my teeth	Agree	358 (48.1)	545 (72.6)	<0.001
20 I have had my dentist tell me that I brush very well	Agree	127 (17.0)	276 (36.8)	<0.001

p-value < 0.05 significant difference.

TABLE 3. The comparison between public and private school mothers' answers to the questionnaire of mothers' knowledge about their children's oral health.

Items	The correct answer	Public n = 745	Private n = 751	p-value
1 How often should you brush your child's teeth	Twice daily	350 (47.0)	434 (57.8)	<0.001
2 Size of brush best for your child	Small	398 (53.4)	430 (57.3)	0.136
3 Quantity of paste to be used	Pea size	362 (48.6)	225 (30.0)	<0.001
4 Your position to brush your child's teeth	By the side of the child	418 (56.1)	299 (39.8)	<0.001
5 Does your child's toothpaste have fluoride	Yes	460 (61.7)	639 (85.1)	<0.001
6 The fluoride content of child paste	1000 to 1450 ppm	59 (7.9)	151 (20.1)	<0.001
7 Four of the following cause tooth decay. ○ Chocolate ○ Cheese ○ Biscuits ○ Sweets ○ Soft drink	○ Chocolate ○ Biscuits ○ Sweets ○ Soft drink	651 (87.4)	686 (91.3)	0.013
8 Best time to give sugary snacks	Mealtime	64 (8.6)	121 (16.1)	<0.001
9 Has the child used a sweetened baby bottle or honey-dipped pacifier	No	540 (72.5)	609 (81.1)	<0.001
10 Importance of decay in baby teeth	Very important	667 (89.5)	738 (98.3)	<0.001
11 Child's first dental visit	On getting the first baby tooth	50 (6.7)	80 (10.7)	0.007
12 If baby teeth decayed, what treatment would you prefer	Fill it	545 (73.2)	682 (90.8)	<0.001

p-value < 0.05 significant difference.

TABLE 4. Comparison between public and private schools of the answers from the mothers' attitudes towards their children's oral health questionnaire.

Items	The correct answer	Public n = 745	Private n = 751	p-value
1 We feel it is important that we check our child's teeth for decay	Agree	732 (98.3)	750 (99.9)	0.001
2 I don't know how to brush my child's teeth properly	Disagree	358 (48.1)	499 (66.4)	<0.001
3 We feel it is important to check if our child has brushed his/her teeth	Agree	717 (96.2)	727 (96.8)	0.552
4 We don't have time to help brush our child's teeth daily	Disagree	247 (63.4)	537 (71.5)	0.001
5 It is the responsibility of the dentist to prevent our child from getting tooth decay	Disagree	220 (29.5)	252 (33.6)	0.094
6 If our child gets tooth decay, it is by chance	Disagree	412 (55.3)	584 (77.8)	<0.001
7 It would not make any difference to our child getting tooth decay if we helped him/her brush every day	Disagree	169 (22.7)	265 (35.3)	<0.001
8 It is worthwhile to give our child sweets/biscuits to behave well	Disagree	312 (41.9)	463 (61.7)	<0.001
9 Tooth decay is a serious problem in baby teeth	Agree	406 (54.5)	540 (71.9)	<0.001
10 As parents, it is our responsibility to prevent our child getting tooth decay	Agree	648 (87.0)	700 (93.2)	<0.001
11 We can prevent tooth decay in our child by reducing sugary foods and drinks between meals	Agree	732 (98.3)	732 (97.6)	0.374
12 If we brush our child's teeth daily, we can prevent our child from getting tooth decay in the future	Agree	537 (72.1)	570 (75.9)	0.092
13 If our child uses fluoride toothpaste, it will prevent tooth decay	Agree	623 (83.6)	701 (93.5)	<0.001

p-value < 0.05 significant difference.

TABLE 5. Associations between the demographics and questionnaire scores and the dmft and DMFT scores in public and private schools.

	Public schools		Private schools	
	dmft/DMFT	<i>p</i> -value	dmft/DMFT	<i>p</i> -value
Child gender				
Male	7.0 ± 4.2	0.031	4.4 ± 3.2	0.219
Female	6.4 ± 4.0		4.8 ± 4.1	
Mother's age				
40 years or less	6.0 ± 4.0	<0.001	3.8 ± 3.4	<0.001
41 years or more	4.5 ± 4.1		5.9 ± 3.9	
Mother's education				
High school or less	8.0 ± 3.8	<0.001	7.2 ± 3.4	<0.001
Diploma/University	4.4 ± 3.6		3.8 ± 3.5	
Monthly income				
Low	8.8 ± 3.5 a	<0.001	0	<0.001
Medium	5.1 ± 3.7 b		6.5 ± 3.6	
High	4.0 ± 4.1 b		3.2 ± 3.2	
Questionnaire 1 score				
Low	8.1 ± 3.7	<0.001	7.2 ± 3.6	<0.001
High	3.9 ± 3.3		3.2 ± 3.0	
Questionnaire 2 score				
Low	7.8 ± 3.8	<0.001	6.3 ± 3.8	<0.001
High	4.6 ± 3.7		3.6 ± 3.4	
Questionnaire 3 score				
Low	7.9 ± 3.8	<0.001	6.3 ± 3.4	<0.001
High	4.4 ± 3.5		3.3 ± 3.5	
Debris index				
Poor	8.4 ± 3.5 a	<0.001	7.4 ± 3.3 a	<0.001
Fair	6.1 ± 3.5 b		5.1 ± 3.1 b	
Good	4.1 ± 4.0 c		2.3 ± 2.8 c	

dmft: decayed, missing, filled primary teeth; *DMFT*: decayed, missing, filled permanent teeth. Means sharing the same alphabetical letter are not statistically different from each other at $p < 0.05$ using post hoc pairwise comparisons. Means that have different alphabetical letters are statistically different from each other at $p < 0.05$ using post hoc pairwise comparisons. Questionnaire 1: Hiroshima University-Dental Behavioral Inventory (HU-DBI)-questionnaire to evaluate attitudes and behaviors of mothers pertaining to their oral health. Questionnaire 2: Mothers' knowledge about their children's oral health. Questionnaire 3: Mothers' attitudes towards their children's oral health. p -value < 0.05 significant difference.

TABLE 6. Model of the impacts of different variables on dmft and DMFT (multiple linear regression).

Independent variables	Public schools ($R^2 = 0.390$)			Private schools ($R^2 = 0.447$)		
	$\beta \pm SE$	(95% CI)	<i>p</i> -value	$\beta \pm SE$	(95% CI)	<i>p</i> -value
Mother's age						
40 years or less	0.1 ± 0.3	(-0.4–0.6)	0.561	-0.4 ± 0.2	(-0.8–0.1)	0.098
41 years or more		Reference			Reference	
Mother's education						
High school or less	1.0 ± 0.3	(0.4–1.6)	0.002	0.4 ± 0.3	(-0.2–0.9)	0.241
Diploma/University		Reference			Reference	
Monthly income						
Low	1.1 ± 0.7	(-0.3–2.4)	0.114		NA	
Medium	-0.5 ± 0.6	(-1.7–0.7)	0.412	1.2 ± 0.3	(0.7–1.7)	<0.001
High		Reference			Reference	
Questionnaire 1 score						
Low	1.7 ± 0.3	(1.1–2.3)	<0.001	1.3 ± 0.3	(0.8–1.9)	<0.001
High		Reference			Reference	
Questionnaire 2 score						
Low	0.5 ± 0.3	(-0.1–1.1)	0.089	0.3 ± 0.3	(-0.2–0.8)	0.308
High		Reference			Reference	
Questionnaire 3 score						
Low	1.2 ± 0.3	(0.7–1.8)	<0.001	0.4 ± 0.3	(-0.1–0.9)	0.124
High		Reference			Reference	
Debris index						
Poor	1.8 ± 0.3	(1.1–2.4)	<0.001	3.3 ± 0.3	(2.8–3.9)	<0.001
Fair	1.0 ± 0.3	(0.3–1.7)	0.005	2.2 ± 0.3	(1.6–2.7)	<0.001
Good		Reference			Reference	

SE standard error; CI confidence interval. Questionnaire 1: Hiroshima University-Dental Behavioral Inventory (HU-DBI)-questionnaire to evaluate attitudes and behaviors of mothers pertaining to their oral health. Questionnaire 2: Mothers' knowledge about their children's oral health. Questionnaire 3: Mothers' attitudes towards their children's oral health. p-value < 0.05 significant difference.

Arabia focused on the dental literature that had a narrow focus on tooth-brushing behavior [28]. This study has the advantage that this data permits a comprehensive and elaborate examination of the indirect procedures involved in the behavioral adoption, whereas quantitative data is sometimes limited to investigating direct correlations between measurable and predetermined factors. A qualitative study that examines parents' opinions on the impacts of childhood dental caries might help us better understand the factors that contribute to tooth decay in children. It is crucial to record their opinions since families have a significant influence in developing children's oral hygiene practices and also because parents are the primary regulators of their children's nutritional intake. Additionally, parents might express their thoughts on the coaching required to enhance these oral hygiene practices. When creating strategies to prevent dental caries, both factors are crucial to take into account [29].

Literature reports that oral health knowledge and awareness are extremely low and that there are significant disparities in

oral hygiene practices based on age and educational attainment. Studies carried out in Kuwait and Spain revealed a link between greater knowledge and improved dental health [30, 31]. Good oral hygiene habits can be developed primarily through self-inflicted behaviors such as maintaining dental hygiene, restricting one's diet, especially reducing consumption of sugary foods and beverages, using fluoridated products, and also with the aid of dental services that are readily available, such as scheduling routine dental checkups, using primary and preventive care, and receiving dental health education [10].

The findings of this survey revealed that mothers whose children attend private primary schools have higher significant questionnaire scores on average (Oral health behavior; HU-DBI, knowledge and attitude) as compared to mothers of public primary school children. The study's findings can be ascribed to the fact that private schools provide the healthiest environments and are linked to decreased risks of oral diseases because they are small, safe and have superior teacher monitoring of students, high resources, parental involvement and community

activities. As opposed to public schools, many private schools in Jeddah encourage children to brush their teeth after breakfast and stay away from sugary food. Children who attend private schools also have better status of monthly incomes and more educated parents than children who attend public schools. Due to the easy availability of sugary meals, children at public schools are more prone to develop dental caries. Additionally, the lack of oral health education in public schools and the financial struggles of the families of these students are the main barriers to the prevention of dental caries in students attending public schools. Thus, the school environment matters for student outcomes and affects their health and well-being [32]. Furthermore, these arguments are supported by a study done by Al Saffan in 2017 conducted in Riyadh, which indicated that oral health educational sessions in private schools improved schoolchildren's oral health awareness [33]. In contrast to our findings, an Indian study found that the majority of mothers of children in private schools had a mediocre understanding of oral health [34]. In addition, an Iranian study indicated that mothers of children in public schools had a good understanding and attitude toward dental health [35]. However, neither study revealed the participants' socioeconomic background, which could have a substantial confounding effect on the relationship between school type (private vs. public) and oral health-related knowledge, attitudes and behavior. Interventions that concentrate on the school environment as opposed to just specific components may be successful in avoiding dental caries [36], particularly in lowering socioeconomic disadvantages.

The current study also brought to light a statistically significant difference between children attending public and private schools regarding their dmft/DMFT and DI mean scores. Children in private primary schools have lower dmft/DMFT and DI mean scores on average than children in public primary schools, according to our research. Children who attended public schools had higher debris indices and caries severity ratings. Children that attend the same school are likely to have a similar impact on these characteristics because they have common contextual variables [37]. The results are in concordance with a 2021 study conducted among public and private primary school students in Iran, which recorded that the mean dmft index in private school students was significantly lower than that of public schools [38]. Similarly, a 2016 study in Nigeria, found that children in private schools scored lower on the DMFT than children in public schools [39]. In India, it was discovered in 2016 that children in private schools (12–13 years old) had a lower DMFT mean score than kids in public schools with a statistically significant difference [40]. Similar results were reported from Karachi, Pakistan, with a statistically significant difference [41]. In Brazil in 2004, children in public schools had higher dmft/DMFT than children in private schools, with a statistically significant difference [42]. On the contrary, there was no statistically significant difference in dmft/DMFT scores between public and private school students in Port Harcourt, Nigeria, despite private school students having lower dmft/DMFT scores [43].

The present study revealed that mothers with higher education and/or income had significantly better oral health-related knowledge, attitudes and behavior, and their children had fewer cavities and lower DI as compared to mothers with lesser

education and/or income. These results could be explained by the fact that mothers have a significant role in their children's dental health and that their high levels of education enable them to seek out the best oral hygiene practices. Mothers with a higher level of education can use the internet, social media and electronic periodicals to find reliable oral health information thus they are likely to be more aware of the risks of neglecting oral health and the oral disorders that may harm their children. Higher-educated mothers recognize the necessity of teaching their children how to brush their teeth and examine them thereafter. This may motivate children to brush their teeth thoroughly and maintain good oral hygiene. Another possibility is that children of mothers with higher levels of education and income have more frequent dental checkups. In the current study, most highly educated mothers and those with higher levels of income took their infants to the dentist when they were six to twelve months old, whereas the majority of illiterate parents took their children to the dentist only when they were in pain. This practice can be ascribed to the absence of suitable oral health education initiatives, which may have rendered dental care redundant. According to another study [44], children's oral health is directly related to their monthly family income, and children of low-income mothers use fewer dental services than children of high-income mothers. Also, our results are consistent with an Egyptian study that showed a statistically significant difference between mothers' knowledge, socioeconomic status and education level on the dental caries status of their children [45]. Similarly, our findings are also in line with various studies conducted in different cities of Saudi Arabia that found a link between educational and financial levels, as well as oral hygiene knowledge and attitudes [46–48]. However, some studies showed no link between mothers' education levels and the dmft scores of their children [49]. The key to a motivated and informed public lies in significant oral hygiene practices and knowledge.

The clinical implication of this study was to underline the need for mothers' and children's oral health education to increase oral health awareness and implement school oral health promotion programs in the primary care center and the social media. Primary-level students serve as the ideal target group to acquire initial organized intervention because, at this stage, the molding of behaviors is quite simple. This leads to accurate knowledge as well as a positive attitude, which is essential to modify their oral hygiene practices. Moreover, Oral health awareness programs are to be adopted by the Ministry of Health and implemented in the primary school curriculum at different school levels. Furthermore, oral health campaigns should focus on public schools. However, if health initiatives can't directly influence attitudes and don't take into account numerous socioeconomic and environmental aspects of the targeted population, their effectiveness will be restricted. Thus, effective policies require to be drafted to minimize the burden of dental caries among children attending primary schools. Since children's oral health-related practices and behaviors are significantly impacted by oral health-related behaviors of both parents, therefore, further investigation of the association between the father's income status and education level needs to be conducted to shed a clearer light upon the results of this survey and finally to get a comprehensive and elaborate view

of the issue at hand.

5. Conclusions

This survey provides background information to get an insight into the degree of oral health-related knowledge, attitude and behavior among mothers of primary school children. The study results revealed that the level of oral health-related knowledge, attitudes and behavior of the mothers toward their own and their children (6–12 years), with greater educational level and income, were higher and consequently their children had better oral health status. In addition, the results of the survey indicate that mothers with children enrolled in private primary schools exhibit higher scores on questionnaires related to oral health knowledge, attitude and behavior, in comparison to mothers of children attending public primary schools.

AVAILABILITY OF DATA AND MATERIALS

If a reasonable request is made, the corresponding author will consider sharing the datasets used and/or analyzed in this article.

AUTHOR CONTRIBUTIONS

NOB, EAEA, NMA and DKQ—contributed to the study design. DKQ—was in charge of the data collection. OMF—performed the statistical analysis. DKQ and OMF—interpreted the results. RAA, OMF, NOB and EAEA—were involved in writing the manuscript. NOB, EAEA, NMA, DKQ, RAA and OMF—critically reviewed the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The research protocol of this cross-sectional survey was approved by The Research Ethics Committee at the Faculty of Dentistry, King Abdulaziz University with proposal number (008-16). In addition, approval was obtained from the local School Health and Education Directorate Authority, Ministry of Education to provide the primary schools' lists in Jeddah city districts and to implement the research among the schools. Written parental informed consent was obtained by participating mothers, before implementation of the study. Throughout the research process, ethical issues were addressed in conformity with the Helsinki Declaration.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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