Associations between maternal mental health, child dental anxiety, and oral health of 6- to 12-year-olds in Nigeria

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Abstract: Maternal mental health affects their children's oral health. This study assessed the associations between maternal mental health and dental anxiety level, dental caries experience, oral hygiene, and gingival status among 6- to 12-year-old children in Nigeria. This was a cross-sectional study that recruited mother-child dyad participants through a household survey conducted in Ile-Ife, Nigeria. Data collected included the independent (maternal mental health risk, depressive symptoms, and child's dental anxiety), and dependent (caries experience, oral hygiene status, and gingival health status) variables. Multivariate logistic regression analysis was conducted to determine the associations between dependent and independent variables after adjusting for confounders (mothers' age, child's age, sex, and socioeconomic status). Statistical significance was set at p < 0.05. Of the 1411 mothers recruited, 1248 (88.4%) had low mental health risk, and 896 (63.5%) had mild depressive symptoms. As for the children, 53 (3.8%) had caries, 745 (52.8%) had moderate to high dental anxiety, 953 (63.0%) had gingivitis and 36 (2.6%) had poor oral hygiene. The maternal mental health risk was not significantly associated with the child's caries experience (AOR: 1.012; 95%CI: 0.860–1.190; p = 0.886), poor oral hygiene (AOR:1.037; 95%CI: 0.975–1.104; p=0.250), and moderate/ severe gingivitis (AOR:0.887; 95%CI: 0.764–1.030; p = 0.115). Maternal depression status was not significantly associated with the child's caries experience (AOR: 0.910; 95%CI: 0.802–1.033; p = 0.145), poor oral hygiene (AOR: 1.016; 95%CI: 0.976–1.057; p = 0.439), and moderate/ severe gingivitis (AOR: 0.963; 95%CI: 0.861–1.077; p = 0.509). Maternal mental health risk and depression do not seem to be risk factors for schoolchildren's oral health in Nigeria. Further studies are needed to understand these findings.

Keywords: Mental Health; Oral Health; Dental Anxiety.

Introduction

Maternal mental wellbeing is a predictor of children's oral health.[1] Maternal depressive and anxiety disorders are associated with the dental caries experience and periodontal status of children aged 0–12 years.[2] Studies confirm an association between maternal mental health, higher caries experience,[3,4] poor oral hygiene practices,[5] and poor periodontal health[6]

in children. On the other hand, a few studies have also reported no association.[7] Poor maternal mental health is associated with less positive parenting, less secure and disorganized attachment with the child, greater child avoidance, greater hostility, and conflict in the interactions with children.[8,9] This impairs the child's cognitive and emotional development,[10] as well as their oral health, significantly reducing their overall quality of life.[1]

Mothers are also able to instill oral health-related behaviors in their children[11] such as inculcating dental anxiety through nonverbal anxiety signals and verbal threat information.[12] Fear acquisition models and social learning theories support the plausibility of this pattern.[8,9] Dental anxiety disorders are a huge oral health limiting factor as affected children experience difficulties with oral health care, and rarely seek preventive dental interventions. This results in poor oral hygiene and a high risk of caries and/or periodontal diseases.[8,9]

Poor oral hygiene is a major risk factor for caries and periodontal diseases in children in Nigeria.[10] Prior studies linked these oral health problems to poor tooth brushing practices and high consumption of sugar in-between meals.[12] Although research in Nigeria indicates that maternal mental health is associated with the child's general health status,[13] few studies have investigated the association between maternal mental health and the oral health status of children in Nigeria. Some studies explored the effect of maternal mental health on the caries experience of preschool children.[14] Among school-aged children in Nigeria, another study explored the effect of parental anxiety (mothers and fathers)[15] on the child's oral health. To our knowledge, no study in Nigeria has investigated the association between maternal risk of common mental health disorders, maternal depression status, and their child's oral health status specifically.

The plausibility of an association between maternal mental health and school children's oral health is high because of the dependency of school-aged children on their parents and immediate family for primary socialization.[16] The impact of maternal mental health is also long-lasting.[17] The aim of the study was, therefore, to assess the

associations between maternal mental health, school children's dental anxiety level, dental caries experience, oral hygiene status, and gingival status. We had four research questions: a) what proportion of mothers of children aged 6-12 years in Nigeria have mental health risks and depression?; b) what is the dental anxiety level, caries experience, oral hygiene, and gingival status of children aged 6–12 years in Nigeria?; c) is maternal mental health and depression status associated with the oral health of school-aged children in Nigeria?; and d) what is the association between childhood dental anxiety and the oral health of school-aged children in Nigeria? The study hypothesis was that poor maternal mental health and high child dental anxiety will be significantly related with higher dental caries experience, worse oral hygiene, and gingivitis in the study population.

Methodology

Ethical considerations

Ethical approval for the conduction of this study was obtained from the Ethics and Research Committee of the Institute of Public Health, Obafemi Awolowo University, Ile-Ife, Nigeria (IPH/OAU/12/1887). Parents gave written consent for the participation of their children in the study. All 12-year-old children also gave written consent to participate in the study in accordance with the national research ethics regulations. Written consent was obtained from the mothers for their own participation in the study.

Study design and sample

This cross-sectional survey was conducted in Ife Central Local Government Area of Osun State, a semi-urban community in southwestern Nigeria. Study participants included mothers and their children aged 6–12 years. Critically ill children (such as those showing evidence of malnutrition, fever, or respiratory distress) and those who could not give independent responses to the survey questions were excluded from the study. Data were collected through a household survey conducted between December 2018 and January 2019.

The maximum sample size for the study was calculated with the formula $N = Z^2 P(1-P)/D^2$ suggested by Araoye,[18] where N is the sample size, Z is the statistic corresponding to the level of confidence, P is expected prevalence (that can be obtained from same studies or a pilot study conducted by the researchers), and d is precision (corresponding to effect size). The minimum sample size was computed using a caries prevalence of 13.9%,[19] a 5% margin of error, and a confidence level of 95%. The maximum sample size was 1233 children, however, to reduce the risk of non-response, incomplete response, and the use of a multistage sampling method, we oversampled by 20%. The participants were recruited using a multistage sampling technique. For the first stage, 70 of the 700 enumeration areas in Ife Central Local Government Area were selected using the simple random sampling method. For the second stage, every other household in the selected enumeration areas was identified as eligible for participation. For the final stage, one child and mother pair who met the inclusion criteria were recruited per household for study participation. Households that declined participation were replaced by the next eligible household. In households where there was more than one eligible child, the children were balloted to identify who would be included in the study. The other children were also examined and referred for treatment, but their data were not collected for the study. Recruitment of participants continued until the study sample size was attained.

Data collection

Using a questionnaire administered and read by an interviewer, data were obtained from mothers and their children followed by a brief dental examination of the child. The survey was administered by trained field workers with experience in collecting data for national surveys. The field workers and clinicians were trained on the study protocol, the use of the data collection tools, sample selection (including household listing and selection), and the ethical conduct of research[20]. Data collected included confounding variables (mother's age, mother's educational attainment, child's age at last birthday, sex at birth, and socioeconomic status), independent variables (maternal mental

health status and child's dental anxiety level), and dependent variables (dental caries experience, oral hygiene status, and gingival status).

Confounding variables: We obtained information on the mother's age at last birthday, the child's age at last birthday, the child's sex at birth (male or female), and socioeconomic status. The socioeconomic status was computed using an index developed for use in Nigeria by Olusanya et al.[21] The multiple-item index combines the mother's education with the father's occupation. Each child was allocated into either class I, upper class; class II, upper middle class; class III, middle class; class IV, lower middle class; or class V, lower class. When a child had lost a parent, the socioeconomic status was determined using the status of the living parent. For this study, the five classes were re-grouped into three: high (classes I and II), middle (class III), and low (classes IV and V).[22]

Oral health-related behaviors: Respondents were asked about their daily frequency of tooth-brushing, daily consumption frequency of refined carbohydrates in between meals, and daily use of fluoridated toothpaste using the tool developed by Khami et al[23]. The acceptable level for each component was set as follows: brushing more than once daily, eating refined carbohydrates in between meals less than once a day, use of fluoridated toothpaste always or almost always, and attending a dental check-up within the last year.

Independent variables

Maternal mental health risk: Mothers' mental health risk was assessed using the global health questionnaire (GHQ-12). The GHQ-12 is one of the most widely used mental health screening tools, it is used for detecting individuals with a diagnosable mental health disorder. It comprises 12 items and has been validated for use in Nigeria.[24] Each item of the GHQ-12 had four possible responses, namely: 'not at all', 'no more than usual', 'rather more than usual', and 'much more than usual'. Responses were scored using the bimodal method of 0-0-1-1 respectively. The total possible score on the GHQ-12 was 12, where scores of 3 and below were graded as low anxiety and scores above 3 were graded as high

anxiety. The Cronbach alpha score for the GHQ-12 for this study was 0.828.

Maternal depressive symptoms: The Patient Health Questionnaire (PHQ-9), a nine-item questionnaire with scores for each of the nine DSM-IV criteria, was also used to assess the level of maternal depressive symptoms. Each criterion was scored from "0" (not at all) to "3" (nearly every day). Possible overall scores ranged from 0 to 27. Cutoffs for mild, moderate, moderately severe, and severe depression are 5, 10, 15, and 20, respectively[25]. The Cronbach alpha score for the PHQ-9 in this study was 0.958.

Children's dental anxiety status: The Corah dental anxiety scale is a brief, 4-item Likert scale questionnaire used to assess the child's dental anxiety level. This scale had previously been utilized in a study in Nigeria[15]. The questions were: a) if you had to go to the dentist tomorrow for a check-up, how would you feel about it?; b) when you are waiting in the dentist's office for your turn in the chair, how do you feel?; c) when you are in the dentist's chair waiting while the dentist gets the drill ready to begin working on your teeth, how do you feel?; d) Imagine you are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist or hygienist is getting out the instruments which will be used to scrape your teeth around the gums, how do you feel? Responses to the items ranged from '*not anxious*' = 1 to '*extremely anxious*' = 5. Responses are summed to produce a total score ranging from 5 to 20. Scores 13 and above indicate high dental anxiety, 10–12 moderate anxiety, while scores lower than 9 indicate low dental anxiety[26]. The Cronbach alpha score for the Corah dental anxiety scale for this study was 0.831.

Dependent variables

All participating children received a dental examination to determine their dental caries experience, oral hygiene status, and gingival health status. Each participant was examined by trained dentists, sitting under natural light, with sterile dental mirrors and dental explorers.

Gingivitis: Gingival changes on four areas of six index permanent teeth were assessed (12, 16, 24, 32, 36, and 44) using the gingival index of Löe and Silness.[27] Absent index teeth were replaced with the next adjacent tooth present in the arch. Where the permanent tooth was missing, the corresponding primary tooth was examined using the same scoring criteria. The scores for each point ranged from 0 (no gingival inflammation) to 3 (severe gingival inflammation). The sum of the scores of the four areas of each tooth was calculated and divided by four to determine the gingival index for each tooth. The scores of all teeth were added and divided by six to determine the gingival index for each person. All children with scores greater than 0 were classified as having gingivitis. The severity of the gingivitis was classified by the gingival index scores into healthy (0), mild (0.1–1), moderate (1.1–2), or severe (2.1–3). Gingivitis was further dichotomized into healthy gingiva/mild gingivitis versus moderate/severe gingivitis for the logistic regression analyses.

Oral hygiene status: The oral hygiene status was determined using the plaque index of Löe and Silness[27]. Each child was examined seated, under natural light, with sterile dental mirrors and probes by trained dentists. The plaque index score was based on six numerical values representing the amount of plaque on six index teeth 12, 16, 24, 32, 36, and 44, in the permanent and 51, 55, 65, 71, 75, and 85 in the primary dentition respectively. The mesial, distal, buccal, and lingual surfaces of the index teeth were scored from 0 (no plaque) to 3 (abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin). The mean score for each tooth was obtained and the mean score for the individual was determined by adding the scores for each tooth and dividing by 6 which was the number of teeth examined. Where the permanent tooth was missing, the corresponding primary tooth was examined. The mean score ranged from 0 to 3 and this was classified into 4 categories: 0 = excellent, 0.1–0.9 = good, 1.0–1.9 = fair, 2.0–3.0 = poor. For the logistic regression analysis, oral hygiene status was dichotomized into poor/fair and good/excellent.

Caries status: Teeth were cleaned of debris and dried using a sterile gauze before the assessment for caries. The presence of caries in the primary

and permanent teeth was evaluated by visual examination of the child seated on a chair under natural light, with the chin raised and the neck flexed. The World Health Organization criteria were used to assess caries experience.[28] The number of decayed (d/D), missing (m/M), and filled (f/F) teeth (t/T) was determined and the dmft/DMFT indices were computed. Caries experience was divided into caries experience present (dmft/DMFT > 0) or absent (dmft/DMFT = 0) for the logistic regression analysis.

Standardization of examiners

Clinical investigators were qualified dentists training as pediatric dentists. The three investigators were trained on the study protocol and calibrated for clinical examination. Standardization of the clinical investigators was done by a senior clinical epidemiologist. In total, 10 children were reviewed in the clinic, and they were called back for a second review a week later. The intra- and inter-examiner Cohen's weighted kappa scores for the three dentists were all greater than 0.80 indicating excellent agreement.

Data analysis

Data analysis was conducted using IBM-SPSS statistical software version 28. The mother's age, mental health risk, depression status, and the child's anxiety scores were all treated as numerical variables, while the mother's age category, child's caries experience, oral hygiene levels, and gingival status were considered categorical variables. Univariate analyses were calculated as means and standard deviations for numerical variables or frequencies and percentages for categorical variables.

Associations between the dependent and independent variables were determined. We constructed three unadjusted multivariate logistic regression analysis models – one for each dependent variable – to determine the connections between the child's oral health status and maternal mental health risk, and maternal depressive symptoms. All dependent variables in the regression analysis were categorical, while the independent variables were numeric. The estimated coefficients were expressed as adjusted odds ratios (AOR) and their 95% confidence intervals were calculated. The fit of each model was assessed using Nagelkerke R2 and -2 log likelihood (−2LL).

Results

In total, 1411 mothers and their children participated in the current study. It was found that 859 mothers (60.9%) were between 31 and 40 years old, 856 (60.7%) had low socio-economic status, 1248 (88.4%) had low mental health risk, and 896 (63.5%) had mild depressive symptoms (Table 1). The mean (standard deviation – SD) age of mothers was 36.4 (8.85) years. The mean (SD) maternal mental health risk score was 0.9 (1.85) and that for maternal depression was 10.47 (2.90).

The children in the study had a mean (SD) age of 8.7 (1.94) years. Of the total number, only 53 children (3.8%) had caries in the primary and/or permanent teeth, with a mean dmft score of 0.09 (0.475) and a mean DMFT score of 0.02 (0.196). Also, 745 (52.8%) children had moderate to high dental anxiety, 953 (63.0%) had gingivitis, 383 (27.1%) had fair oral hygiene, and 36 (2.6%) had poor oral hygiene. The mean plaque index score of the 1411 children was 0.48 (0.52), the mean (SD) gingival index score was 1.23 (0.94) and the mean (SD) child dental anxiety score was 10.4 (3.67).

As shown in Table 2, the regression model explained only 1.2% of the variation in the dental caries experience of the children studied. The mother's age, mental health risk, and depression status were not significantly associated with dental caries experience.

As shown in Table 3, the regression models explained 0.5% of the variation observed in the child's oral hygiene status and 0.4% of the variation in the child's gingival status. The mother's age, mental health risk, and depression status were not statistically significantly associated with oral hygiene status or gingival status.

Discussion

The study was undertaken to generate empirical evidence that may inform policies and practices on

Table 1. Characteristics of 6-12-year-old children in southwest Nigeria by sex (N = 1411)

Variables	Total	
	n = 1411 (100.0%)	
	n	%
Child's age in years		
6	235	16.7
7	219	15.5
8	232	16.4
9	229	16.2
10	195	13.8
11	142	10.1
12	159	11.3
Mother's age category		
< 30 years	289	20.5
31–40years	859	60.9
41 years and above	263	18.6
Socioeconomic status		
Low	856	60.7
Middle	350	24.8
High	205	14.5
Maternal mental health risk		
Low	1248	88.4
High	163	11.6
Maternal depressive symptoms		
Mild	896	63.5
Moderate	382	27.1
Moderately severe	93	6.6
Severe	40	2.8
Child's dental anxiety level		
Low	666	47.2
Moderate	353	25.0
High	392	27.8
Dental caries experience		
Present	53	3.8
Absent	1358	96.2
Plaque index score		
Poor	36	2.6
Fair	383	27.1
Good	466	33.0
Excellent	526	37.3
Gingivitis		
No	522	37.0
Mild	848	55.6
Moderate	96	6.8
Severe	9	0.6

school children's oral health and support plans to integrate oral health care into the maternal-child care programs in Nigeria. The study could also provide evidence for integrating maternal mental health into the maternal-child care framework[29]. However, we found that maternal mental health was not associated with the dental caries experience, poor oral hygiene or moderate/severe gingivitis of school-aged children in the study population. The study's findings did not support its hypothesis.

One of this study's strengths was the use of a household survey for data collection. This enabled us to ensure adequate representation of the community in the survey as only about two-thirds of 6–11-year-olds regularly attend school. The sample size was also large enough to provide adequate power for subgroup analysis. Furthermore, our study provides the first set of population-level evidence determining the association between maternal mental health and the oral health of school-aged children in Nigeria. However, the cross-sectional study design limits the ability to determine a causal relationship between the independent and dependent variables. Also, respondents may have provided socially desirable responses to the survey questions. Nonetheless, the study findings provide useful data on the link between maternal mental health, child dental anxiety, and child oral health in Nigeria and could inform future research on this topic in Nigeria and other countries with similar contexts.

First, we found that the prevalence of mothers with mental health risks and depression in this suburban population was high enough to cause concern. We found no prior report on the mental health risk of population samples in Nigeria. Though the mental health profile of mothers does not appear to affect their children's risk of poor oral health, the high prevalence of depression among mothers, howbeit mild depression, should be a source of public health concern. We postulate that environmental factors may have moderated the relationship between maternal mental health status and the oral health status of children in this study population. Many mothers in this setting have access to a network of social support through the extended family support system that provides emotional capital that may make

Table 2. Binary logistic regression of factors associated with dental caries experience among 6–12-year-old children in southwest Nigeria (n = 1411).

Variables	Dental caries experience present	
	AOR (95%CI)	p-value
Maternal age	0.990 (0.957-1.025)	0.573
Maternal mental health risk	0.998 (0.852-1.146)	0.876
Maternal depression	1.000 (0.997-1.003)	0.767
Child's dental anxiety	0.924 (0.855-0.998)	**0.046**
Nagelkerke's R Square	0.012	0.308
-2 Log likelihood	479.723	

Significant p-value in bold fonts.

Table 3. Binary logistic regression of factors associated with oral hygiene status, and gingival status among 6–12-year-old children in southwest Nigeria (n = 1411)

Variables	Poor oral hygiene		Moderate/severe gingivitis	
	AOR (95%CI)	p-value	AOR (95%CI)	p-value
Maternal age	1.003 (0.991-1.016)	0.590	1.002 (0.990-1.014)	0.747
Maternal mental health risk	1.002 (0.945-1.062)	0.952	0.975 (0.923-1.000)	0.374
Maternal depression	1.002 (1.000-1.004)	0.050	0.999 (0.998-1.000)	0.077
Child's dental anxiety	0.997 (0.968-1.027)	0.845	0.995 (0.967-1.023)	0.723
Nagelkerke's R Square	0.005	0.265	0.004	0.322
-2 Log likelihood	1.870.260		2.056.053	

the impact of maternal mental health on children's health less severe.[30]

Second, the prevalence and severity of caries as well as poor oral hygiene among school-age children in the study population is low, though the prevalence of dental anxiety is high, and the prevalence of gingivitis is moderate. The study community is agrarian with low refined carbohydrate consumption, mothers are devoted to child rearing and less involved in the modern labor force that deprives children of daily care.[31] This may explain the low prevalence and severity of caries experience and gingivitis in the children studied.[32] Prior studies conducted in the same community also showed low caries prevalence in preschool[33] and school-aged children.[34]

Third, we found no association between maternal mental health risk status, depressive symptoms, and the oral health of school-aged children in this study. This conclusion was consistent with the findings on the associations between maternal mental health (general anxiety, dental anxiety, sense of coherence, parenting stress, fatalism, social support, depressive symptoms, and executive dysfunction) and oral health status of preschool children in the same study location.[14] The result, however, contrasts with studies conducted in other countries that demonstrated an association between maternal mental health and dental caries experience.[2-4] The non-association observed may be due to low access to factors that can promote poor oral health in the study environment. The agrarian diet, myths, and misconceptions about the ailments associated with the consumption of sugar may further reduce sugar consumption[35], and the high use of fluoridated toothpaste[36] may work against caries and gingivitis in the study's population.[37] Further studies are needed to understand the pathway by which the oral health of school-aged children is protected despite the high prevalence of mental health challenges of mothers in this community.

Finally, we found a significant association between child dental anxiety and dental caries

experience, unlike the findings in prior studies.[8] Anxiety inhibits risk-taking behaviors,[38] which could explain the relationships between anxiety and caries in our study. We found no association between dental anxiety and gingivitis or poor oral hygiene. This may suggest that the low-risk behavior of children with anxiety may be associated with a reduction in sugar intake rather than an improvement in their tooth-brushing habits. A prior study among adults had, however, indicated that high dental anxiety was associated with poor oral hygiene practices and gingivitis.[39] Poor oral hygiene practices are suggested to have resulted from an avoidance behavior due to the association of the practice with dental clinics.[40] Nonetheless, because dental anxiety is a risk factor for poor dental service utilization,[41] further research is needed to understand the factors that promote dental anxiety in school-aged children in Nigeria.

Conclusion

Maternal mental health risk and depression status were not associated with the child's oral hygiene, gingival status, or dental caries experience. The child's dental anxiety level was, however, associated with dental caries experience. We recommend further studies to explore these findings and clarify why the associations in this study population differ from those of other study populations.

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