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Parity, Maternal-Child Oral Interactions and Early Childhood Caries (ECC) among Northern Nigerian Hausa children

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Abstract

Objective: To determine the relationship of parity, maternal-child oral interactions, child socio-demographic characteristics and child oral health behaviours with early childhood caries (ECC). Predisposing factors including mother-child kissing, maternal premastication of food and mother-child sharing of utensils were considered.

Methods: This was a cross-sectional study involving 346 Hausa children less than 72 months of age and their mothers. A structured interviewer-administered questionnaire was used to obtain information on the mother's parity level, mother-child oral transfer behaviours, child socio-demographic factors, child oral health practices, and feeding patterns. Clinical examination was carried out to determine caries experience (DMFT/dmft) in the mother and child and child oral hygiene status (OHI-S). Association with ECC was evaluated through Fisher's exact tests. Binary regression analysis was used to investigate predisposing factors for ECC. Significance was inferred at $p<0.05$.

Results: Hausa children had a low caries prevalence of 3.2% with a mean dmft score of 0.08+0.50 and most had fair oral hygiene scores. Increasing child age, use of fluoridated toothpaste and provision of premasticated food were significantly associated with child caries experience. Mother's parity level and caries experience were not associated with ECC.

Conclusion: The finding that fluoridated toothpaste use and premastication were associated with caries experience in the children suggests that maternal oral health knowledge and mother-child oral interactions influence ECC in children.

Keywords: Parity; Maternal-child oral interactions; Premastication; ECC

Introduction

Maternal oral health status impacts on their children's oral health through several direct and indirect channels. Young children's dietary and oral health practices are determined by the mother or primary caregiver. Mothers with high caries experience (measured by DMFT scores) are likely to have children with caries [1-3], but the nature of that association is not fully understood. Dietary and oral health behaviours shaped by the mother/caregiver may contribute to child oral health status. A key indicator of oral health status in children is the caries experience, which is now a serious public health concern for young children in both developed and developing countries [4]. Early childhood caries (ECC) is the most common chronic oral condition of children [5]. ECC refers to the presence of one or more decayed, missing or filled teeth due to caries in infants and preschool children aged

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less than 72 months [6]. Early childhood caries is a highly preventable disease, yet the majority of cases are untreated [7]. Caries affects both the oral and general health of the child, and impacts negatively on their quality of life. Caries is often associated with pain and infections (from abscess and cellulitis) that disturb sleep and mastication. The broader consequences are absenteeism at school, poor learning, hospital admission, the need for general anaesthesia during treatment, and malnutrition [8-11]. In addition, children with ECC have a high risk of caries in their permanent teeth [12]. The aetiology of ECC is multifactorial, and it is greatly influenced by maternal biological and socio-behavioural factors. Most often the child acquires the primary bacteria implicated in dental caries, Streptococcus mutans, from the mother [13-16]. S. mutans can be transmitted through maternal-child oral interactions such as kissing, sharing of utensils and pre-chewing of food [17]. Mothers with high caries experience have high Streptococcus mutans counts and can easily transmit the bacteria to the child, predisposing them to caries [18,19].

ECC is generally thought to be related to feeding practices, based on studies linking 'inappropriate' use of bottle-feeding and caries [9,20,21] where bottle use involves frequent, extended day and night use of bottles filled with sweetened drinks such as fruit juices. In addition, breastfeeding pattern and duration have been linked to childhood caries experience. Southeast Asian children were found to be likely to suffer from caries when nocturnal breastfeeding was continued after the age of 12 months [22]. Furthermore, among Nigerian children, prolonged age of breastfeeding was significantly associated with caries experience [23]. There is no current agreement on the results of studies regarding breastfeeding and caries. It is not clear how breastfeeding relates to caries although it is posited that breast milk in the presence of sucrose may promote tooth decay [24].

In addition to the factors discussed above, socio-economic status, maternal level of education, oral health knowledge, parental oral health attitudes and diet composition and quality have been linked to ECC. Some studies [25-27] demonstrated a significant association between mother's level of education and ECC. A cohort study of Brazilian children noted that children whose mother's education level was less than 9 years were 1.5 times more likely to have ECC compared to those whose mother had higher education levels [25]. Conversely, another Brazilian study failed to observe a relationship between mother's education level and ECC [28]. Socio-economic status (SES) is a major modifiable determinant of disease conditions through differential access to nutritious foods, oral hygiene products, fluoride exposure and dental visits. There is no consensus on the association of socio-economic status and ECC. Brazilian children of low socio-economic status were 1.3 times more likely to develop caries than children from high status households [29]. Similarly, Chinese children from low-income families had significantly higher caries [30]. However, other studies [28,31] found no link between family income and ECC in children from Sao Paulo, Brazil and Trinidad. The reason for the different findings may be attributable to differences in the methods used to assess socio-economic status.

The reproductive history of mothers has been linked to their oral health. Higher parity women tend to have more caries (higher DMFT scores) and more tooth loss [32-36]. An association was established between parity and tooth loss among US White and Black non-Hispanic women [33]. Higher parity US women experienced more decayed and missing teeth due to caries than lower parity women [34]. Similarly, in Nigeria, higher parity women had significantly higher DMFT scores and greater tooth loss compared to those of lower parity [35,36]. These results suggest that higher parity women may increase the susceptibility of their children to caries. While there are studies on the association between maternal oral health/practices and ECC, there are no investigations that examine ECC from the perspective of maternal parity. The relationship between maternal caries and dental decay in their young children is a component of the parity/oral health picture that warrants further investigation. A large mixed methods study on maternal and child oral health of northern Nigerian Hausa women and their children [35-37] provided an opportunity to investigate the relationship of parity to maternal caries and ECC.

Methods

Clinically healthy Hausa mothers and children were selected for a cross-sectional study through a household survey in the Kumbotso Local Government Area (LGA) of Kano State, Nigeria. A multi-stage random sampling technique was employed. The parity groups comprised of women of all parity levels with children. The women were placed into two parity groups: Group A included women of high parity (5 or more births). The cut point of 5 or more births was selected as it is the level where health risks and morbidity differences are seen [38]. Group B comprised of women who had given birth less than five times. The child sample comprised of the selected women's children who were less than 72 months old, in good general health, and still residing with their mothers. Children with chronic medical conditions, and those who had been on prolonged use of sweetened medications, were excluded. Ethical approval was obtained from the Ethics and Research committee of the Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria (IPHOAU/12/717) and the Health Sciences Research Ethics Committee of the University of the Witwatersrand, Johannesburg (M170343). Local village leaders gave permission to conduct the study. Informed consent was obtained from the husbands of married women living with their husbands. Written informed consent was obtained from

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each participant. The consent form was translated into Hausa and read to participants who were illiterate; women who were illiterate and were willing to participate in the study thumb-printed on the consent form. Only children whose parents gave informed consent participated in the study.

Data collection form for mothers

A structured interviewer-administered questionnaire was used to obtain information on the socio-demographic status and oral health practices of the women. Information on socio-demographics included age, the number of children the women had given birth to, the occupation of the current husband and the occupation of the woman. Other questions included mother-child kissing during the first year of life, provision of premasticated food by the mother to the child, and sharing of utensils in the first year of life.

Data collection form for children

A separate interviewer-administered questionnaire/form was used to collect data on the children. In most cases, the mother provided the information. The captured information on the socio-demographic status of the child included age, sex and birth order. Information pertaining to the oral habits of the child included duration of breastfeeding during the first six months and night-feeding patterns. For the purposes of this study, exclusive breastfeeding is when the mother gives only breast milk without any supplement [39]; almost exclusive breastfeeding is when the mother feeds the child on breast milk with water supplements; and partial or mixed breastfeeding is when other types of food are included with the breastfeeding. Night-feeding practice is defined as feeding the child at nighttime after going to bed [40]. Furthermore, questions were asked regarding daily frequency of refined sugar consumption between meals, frequency of tooth brushing, daily regular use of fluoridated toothpaste and frequency of visits to the dentist.

Assessment of socio-economic status

The household socio-economic status, based on the mother's occupation, was scored according to the Standard Occupation Classification designed by the Office of Population Census and Surveys [41]. The occupations were grouped into the following classes:

Social class I: professional occupations, Social class II: managerial and technical occupations, Social class III (NM): skilled occupations (non manual), Social class III (M): skilled occupations (manual), Social class IV: partly skilled occupations and Social class V: unskilled. The social classes I and II were grouped as high, classes III (NM) and III (M) as middle, and classes IV and V as low.

Intra oral assessment in the women and children

Intra oral examinations were carried out using a sterile dental mirror and probe for each participant in a well-lit environment. Oral hygiene status of the children was evaluated using the Simplified Oral Hygiene Index (OHI-S) of Greene and Vermillion [42]. The index comprises of debris and calculus scores on selected tooth surfaces. The buccal and lingual surfaces of the six index permanent teeth were examined (FDI numbers 11, 16, 26, 31, 36, 46). In children who were yet to emerge the index permanent teeth, the facial and lingual surfaces of the following six index teeth (FDI numbers 51, 55, 65, 71, 75, 85) were examined. Oral hygiene was classified as good, fair, or poor when score ranges were 0.0 – 1.2, 1.3 – 3.0, and >3.0 respectively.

The DMFT/dmft index of the World Health Organization for dental epidemiological studies was used to determine the caries status of the mothers and children respectively [43]. The index includes the following: D/d - number of decayed teeth, M/m – number of extracted teeth due to caries, F/f-number of teeth filled or crowned due to caries and T/t – teeth present. The DMFT/dmft score is a sum of the number of decayed, missing and filled teeth due to caries. Only teeth extracted due to caries were recorded as missing. ECC was classified as severe (S-ECC) if there was any sign of smooth surface caries in children less than 3 years or when children age 36-47 months, 48-59 months and 60-71 months had dmft scores of greater or equal to 4, 5 and 6 respectively [40].

Variables and their categories are found in table S1. The data were statistically analyzed using SPSS (version 16) software for Windows. Analysis included all women at the different levels of parity as well as the children. Descriptive analyses of the child socio-demographic factors (age, sex, birth rank and household SES), oral health practices (oral hygiene status (OHI-S), frequency of daily toothbrushing, use of fluoridated toothpaste (Y/N) and dental visits (Y/N)), oral health behavioral factors (pattern and duration of breastfeeding and frequency of consumption of refined sugar) and maternal predisposing factors to ECC (parity level, caries, mother-child kissing, premastication and sharing of utensils) were done. Associations between socio-demographic factors, oral health practices/behavior and dental caries in the children were determined using regression analysis. Maternal predisposing factors were regressed against ECC in the participants. Statistical significance was inferred at $p<0.05$.

Results

Socio-demographic characteristics of the children

A total of 346 children and their mothers participated in the study. The age distribution of the sample is provided in table 1. The mean age was 22.09+16.23 months, and the ages were distributed similarly between the sexes. The majority of the children were less than 24 months old (57.6%) and there were more females (54.9%) than males (45.1%). Only a small proportion of the children were first born or only children (9.8%). The majority of the children (67.9%) were from middle SES households (Table 1).

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Oral health of the children

The oral hygiene status of the children was generally fair (82.9%), although 11.3% had poor and 5.8% had good oral hygiene. The majority (73.4%) had their teeth cleaned twice or more daily with 22% reporting using fluoridated toothpaste. Virtually all the children (98.8%) had never been to the dentist (Table S2).

Child nutritional data: breastfeeding and sugar consumption

Almost 60% of the children were still breastfeeding beyond their first year of life. Approximately 45.0% of them consumed sugar three or more three times daily between meals (Table S3).

Associations between socio-demographic variables and ECC

The overall ECC experience (absence/presence) among the children was low, with a prevalence of 3.2%. There was no discernable pattern between age and ECC in the children although there were more children aged 36-47 months with ECC (14.3%), followed by those aged 60-71 months (8.0%). None of the children in the cohorts < 11 months and 48-59 months experienced caries. ECC was significantly associated with age group using a Fisher's exact test analysis ($p<0.05$) (Table 2). The overall mean dmft score was low (0.08+0.50) with a range of 0 to 6, and the overall S-ECC rate was 0.9%. The prevalence of ECC was low among these children and there were few cases that were considered to be severe.

Table 1: Socio-demographic characteristics of the children

Variables	N (%) N=346
Age group (months)	
≤11	104 (30.1%)
12-23	95 (27.5%)
24-35	69 (19.9%)
36-47	28 (8.1%)
48-59	25 (7.2%)
60-71	25 (7.2%)
Sex	
Male	156 (45.1%)
Female	190 (54.9%)
Birth rank	
First child/only child	34 (9.8%)
Not first child/only child	312 (90.2%)
Household SES	
Middle	235 (67.9%)
Low	111 (32.1%)

Table 3 provides information on the association between socio-demographic factors (sex, SES and birth rank) and ECC. Only birth order was significantly associated with the presence of ECC (Fisher's exact test, $p<0.05$). None of the children who were the first or only child had caries, unlike 3.5% of the other children ($p=0.00$).

Fisher's exact test analysis did not reveal a statistically significant association between sex, SES and the proportion of children with ECC ($p>0.05$ respectively). More females than males experienced ECC (4.7% vs. 1.3%), and children of low SES had more caries than those of middle SES (3.6% vs. 2.9%) (Table 3).

Association between oral health practices, nutritional parameters and ECC

Interestingly, children who used fluoridated toothpaste had higher caries counts than those who did not (7.9% vs. 1.9%). Only one child of the four who visited the dentist experienced caries compared to the 2.9% who had never visited the dentist. A Fisher's exact test revealed that the use of fluoridated toothpaste and dental visitation were significantly associated with ECC in the children ($p<0.05$ respectively) (Table S4).

Oral hygiene status and frequency of tooth cleaning were not significantly associated with ECC using a Fisher's exact test ($p>0.05$ respectively). None of the children with good oral hygiene experienced caries, yet only 3.5% of children with fair oral hygiene and 2.6% of those with poor oral hygiene had caries. There was little difference in the caries experience of children who cleaned their teeth twice or more and those who cleaned less frequently (Table S4).

Table 2: Frequency of ECC by age group

Age group (months)	N	ECC absent	ECC present	p-value
		N (%)	N (%)	
≤11	104	104 (100.0%)	0 (0%)	0.003*
Dec-23	95	91 (95.8%)	4 (4.2%)	
24-35	69	68 (98.6%)	1 (1.4%)	
36-47	28	24 (85.7%)	4 (14.3%)	
48-59	25	25 (0%)	0 (0%)	
60-71	25	23 (92.0%)	2 (8.0%)	
Total	346	335 (96.8%)	11 (3.2%)	

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Table 3: Association between socio-demographic variables and ECC

Variables	ECC absent	ECC present	Total	p-value
	N (%)	N (%)	N (%)	
Sex				
Male	154 (98.3%)	2 (1.3%)	156 (100.0%)	0.07
Female	181 (95.3%)	9 (4.7%)	190 (100.0%)	
SES				
Middle	228 (97.1%)	7 (2.9%)	235 (100.0%)	0.76
Low	107 (96.4%)	4 (3.6%)	111 (100.0%)	
Birth order				
First child/only child	34 (100.0%)	0 (0%)	34 (100.0%)	0.00*
Not first child/only child	301 (96.5%)	11 (3.5%)	312 (100.0%)	

The duration of breastfeeding was related to caries experience in the children. Children who were breastfed for <12 months (including those who were less than one year old) did not experience caries while those breastfed for more than 12 months (5.3%) had caries. A Fisher's exact test showed a significant association between duration of breastfeeding and ECC (p=0.01).

The frequency of sugar intake between meals was not significantly associated with caries in the children (Fisher's exact test, p>0.05). Children who consumed sugar less than three times daily between meals had higher caries counts than those with increased frequency of sugar consumption (3.8% vs. 2.6%) (Table S5).

Regression analysis between socio-demographic factors and ECC

Binary logistic regression was performed to determine the socio-demographic factors (child's age, sex, SES and birth order) that contributed to caries experience in the children. Model fitting was done and it showed a perfect fit using the Hosmer and Lemeshow test. Only child's age was significantly associated with ECC experience (p=0.04) (Table S6).

Regression analysis between oral health practices and ECC

Binary logistic regression was performed to determine the oral health practices (frequency of tooth cleaning, frequency of sugar consumption between meals, use of fluoridated toothpaste and dental visit) that contributed to caries experience in the children. Model fitting was done and it showed a perfect fit using the Hosmer and Lemeshow test. Only the use of fluoridated toothpaste was significantly associated with ECC experience in the children (p=0.01) (Table 4).

Maternal factors and predisposition to caries in children

Most of the mothers were of low parity (63.0%) and approximately 66.0% of them were caries-free. Mechanisms for mother–child transfer of cariogenic bacteria were assessed through the practices of kissing on the mouth, provisioning with premasticated food, or the shared use of utensils. Mother-child kissing during the first year of life was reported for 57.2% of the dyads, while 39.9% of the mothers fed their child with premasticated food. Almost 60% of the mothers reported sharing utensils (spoons and cups) with the child in the first year of life (Table S7). Thus, while the proportion of mothers with caries was low, the potential for bacterial transfer via kissing or utensils was relatively high.

Association between maternal caries, predisposing factors and ECC

Presence of caries in the mother and feeding of premasticated food were significantly associated with caries experience in the child (Fisher's exact tests p<0.05, respectively). Thirty-four percent of the mothers were caries active. Of these, approximately 6.0% were mother-child dyads with caries. Children whose mothers were caries active experienced ECC more than children whose mothers were caries-free (5.9% vs. 1.8%, p=0.04). Unexpectedly, the proportion of children with caries was significantly greater in children who were not fed premasticated food by their mothers (4.8% vs. 0.7%, p=0.03). Parity, mother-child kissing and sharing of utensils were not associated with ECC using Fisher's exact test analysis (p>0.05). There was no difference in the ECC proportion of children whose mother was of high parity and those of low parity mothers (3.1% vs. 3.2% respectively). The pattern was similar for mother-child kissing. Regarding sharing of utensils, approximately 4.0% of children whose mother did not share feeding utensils had

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caries compared to 3.0% whose mother did share feeding utensils (Table 5).

Binary logistic regression was also performed to determine whether the maternal factors (parity, presence of caries, mother-child kissing, premastication, sharing of utensils), duration of breastfeeding and child oral hygiene status contributed to the caries experience of the children. Model fitting was done and it showed a perfect fit using the Hosmer and Lemeshow test. Only premastication of food was significantly associated with ECC experience (p=0.048) (Table 6). Notably, maternal caries was not associated with caries experience in the children.

Discussion

Most studies on maternal factors that predispose a child to ECC have focused on a number of maternal attributes or behaviours; however, none has considered the relationship between parity and ECC. Higher parity is associated with increased caries experience in mothers, and maternal caries has been related to ECC in several populations. This study investigated the association between parity, maternal caries, child socio-demographic factors and oral health practices and ECC.

The caries experience in the children was overall of low intensity as evident by their caries risk behavior- particularly the levels of high sugar consumption between meals. Generally, caries counts are low among Nigerian children. In a different Nigerian study, a low total prevalence of 6.6% was observed in preschool children [40]. In contrast, studies from Kenya, Uganda and South Africa [44-46] reported ECC in 38%, 45% and 47% of 3-year-olds respectively. Elsewhere the ECC picture is quite different. In Asia, a total prevalence of 56% was observed in Taiwanese preschool children and 85% in a sample of 3-year-old Filipinos [47,48]. Variation

Table 4: Binary regression of oral health practices against ECC

Predictors	B	S.E.	Sig.	Exp(B)	95% CI for EXP(B)	
					Lower	Upper
Dental visits	1.91	1.25	0.13	6.74	0.58	78.06
Tooth brushing 1x/day	-16.98	7513.57	1	0	0	-
Fluoride toothpaste use	1.73	0.69	0.01	5.65	1.47	21.72
Not always consume sugar between meals	17.89	6714.06	1	58634464.58	0	-
Constant	-22.11	6714.06	1	0		

Table 5: Association between maternal caries, predisposing factors and ECC

Variables	ECC absent	ECC present	Total	p-value
	N (%)	N (%)	N (%)	
Parity				
Low <4	211 (96.8%)	7 (3.2%)	218 (100.0%)	0.96
High >5	124 (96.9%)	4 (3.1%)	128 (100.0%)	
Maternal caries present				
Yes	112 (94.1%)	7 (5.9%)	119 (100.0%)	0.04*
No	223 (98.2%)	4 (1.8%)	227 (100.0%)	
Mother-child kissing during 1st year				
Yes	192 (97.0%)	6 (3.0%)	198 (100.0%)	0.86
No	143 (96.6%)	5 (3.4%)	148 (100.0%)	
Feeding premasticated food during 1st year				
Yes	137 (99.3%)	1 (0.7%)	138 (100.0%)	0.03*
No	198 (95.2%)	10 (4.8%)	208 (100.0%)	
Sharing of utensils during 1st year				
Yes	196 (97.0%)	6 (3.0%)	202 (100.0%)	0.79
No	139 (96.5%)	5 (3.5%)	144 (100.0%)	

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Table 6: Binary regression of maternal caries, predisposing factors and child oral hygiene status against ECC

Predictors	B	S.E.	Sig.	Exp(B)	95% CI for EXP(B)	
					Lower	Upper
Parity	-0.03	0.14	0.838	0.97	0.74	1.28
Presence of caries	0.15	0.09	0.1	1.16	0.97	1.38
Mother-child kissing	0.52	0.7	0.459	1.68	0.43	6.62
Feeding of premasticated food	-2.23	1.13	0.048	0.12	0.01	0.98
Sharing of utensils	0.2	0.72	0.784	1.22	0.3	4.97
Duration of breastfeeding	0.01	0.02	0.684	1.01	0.98	1.04
Oral hygiene status (fair)	-17.21	8619.2	0.998	0	0	.
Oral hygiene status (poor)	0.53	1.08	0.626	1.7	0.2	14.12
Constant	-3.93	1.29	0.002	0.02		

in diagnostic criteria for caries and study design may explain some of the observed differences in ECC. While most studies from Africa [44-46] were school based, our study and another Nigerian study [40] were household surveys, which are highly representative of the sample population. Furthermore, the consumption of traditional starch-rich diets that are associated with low caries experience [49] may be more characteristic of Nigerian children.

The use of fluoridated toothpaste was significantly linked to caries experience among the Hausa children. This result was unexpected, and should be further investigated. There is substantial evidence that fluoride in toothpaste prevents and reduces caries. A systematic review on the use of fluoride toothpastes for caries prevention in children and adolescents noted that frequent use of fluoride toothpaste was associated with marked reduction in caries [50]. Similarly. a meta-analysis of 96 randomized control trial studies on the effectiveness of toothpaste of different fluoride concentrations for preventing caries in children observed a dose-dependent reduction in caries in relation to the fluoride concentration [51]. The use of fluoridated products was not found in most of our study population. Furthermore, it is possible that the fluoride concentration in locally available products was inadequate for caries prevention. Daily use of optimally fluoridated toothpaste of 1000 ppm or greater is crucial to the reduction of tooth decay in children [52]. However, the fear of dental fluorosis from ingestion of fluoride in toothpaste has led to the production and recommendation of non-fluoride and low fluoride concentration toothpastes specially for children. Interestingly, most parents use these brands because they are made for children, even though they are not aware of the optimal fluoride dose in the toothpaste and the appropriate level for use in children. Healthcare professionals recommend a small smear of optimally fluoridated toothpaste for children less than 3 years while for those 3 years and above, pea size is prescribed [52]. It is important to educate parents on the use of fluoridated toothpaste in children for optimal effectiveness against caries while preventing dental fluorosis.

Provision of premasticated food was significantly associated with caries in the children. Prechewing of food was an age-old tradition documented globally in many societies [53]. In contemporary times, it remains a common practice in Africa, especially in Nigeria where approximately 80% of babies are fed premasticated food [54]. Prechewed food by mothers/caregivers is offered to children as a solution to providing them with solid food before the emergence of teeth [55]. Also, it is posited that because breast milk and saliva share many similar substances, saliva in prechewed food may aid digestion and protect against disease [53]. However, premasticated food has been linked to the transmission of caries, HIV, hepatitis B and syphilis from the caregiver to the infant [55]. Among Chinese children under 4 years old, 39% of those with S-ECC had prechewed food compared to only 2% of those without caries [56]. Similarly, a longitudinal study reported that Japanese children aged 1.5 years who received prechewed food from their mothers had significant increases in caries [57]. Furthermore, a retrospective cohort study of 25-30-month-old Southeast Asian children documented that all those who were fed rice prechewed by the mothers had caries compared to those without caries [22]. It is important to educate caregivers, especially mothers, about the potential effects of premastication on their children's oral health.

Parity and maternal caries were not associated with caries experience in the children. This may be due to the generally low caries observed in both mothers and children in our study, making it difficult to detect a relationship. Family factors, most especially maternal transmission of cariogenic bacteria to young children, are thought to play an important role in caries formation. It is suggested that mothers who are caries active are more likely to have children with caries but this remains an area requiring further research and comparable study designs. Three studies of US, Turkish and Thai mother-child dyads reported a positive association between mothers' caries status and caries experience in children [1-3]. The studies varied in their designs, and this makes direct comparisons difficult. The US case-control

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study involved a purposively selected small sample of 3-5 year-olds with and without caries. The hospital-based Turkish study included children aged 15 to 35 months and the prevalence of ECC was 9%. The Thai longitudinal study of 9-18 month-old children did not report the prevalence of caries at baseline, but they reported a great increase in ECC during the follow up period. Interestingly, a Japanese study of mothers presenting for health care checkups with their 3 year-olds found no significant association between maternal caries experience and caries status although there was a high child caries prevalence of 35.4% [58]. These conflicting results suggest that more mother-child dyad studies are needed to clarify the complex circumstances leading to EEC. This study had a cross-sectional design and therefore a cause and effect relationship cannot be deduced between parity, maternal caries, oral health practices and ECC among Hausa children. A longitudinal study of higher parity women with caries is required to verify any causal effect of parity and maternal caries in ECC. Additionally, the data were limited only to those children present in the household during the data collection.

Conclusion

This study investigated the relationship of parity, maternal caries, child's socio-demographic factors and oral health practices with ECC. This is the first study to consider the link between parity along with other confounding variables and caries experience in children less than 72 months of age. A low caries prevalence was observed among Hausa children. Increasing age in the participants was significantly associated with caries experience. The use of fluoridated toothpaste and prechewed food were positively related to caries in the children. However, parity and maternal caries were not related to ECC in Hausa children.

Conflicts of interest

The authors have no conflicts of interest to declare.

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Supplimentary files

Tables S1- S7

Table S1: Categorization of variables

Variable	Category
Parity	
≤5	Low
≥5	High
***Household SES**	
Social classes I & II	High
Social classes III (NM) & III (M)	Middle
Social classes IV & V	Low
Duration of breastfeeding	
≤12 months	Normal
>12 months	Extended
Form of breastfeeding during first 6 months	
Breast milk without any supplement	Exclusive
Breast milk with water supplements	Almost exclusive
Breast milk with other types of food	Partial or mixed
Frequency of daily toothbrushing	
Tooth brushing 1x/day	Fair
Tooth brushing ≥2x/day	Standard
Frequency of sugar consumption between meals	
≥3x per day	Always
<3x per day	Not always
****Child oral hygiene index score (OHI-S)**	
0.0 – 1.2	Good
1.3 – 3.0	Fair
>3.0	Poor

* Office of Population Census and Surveys [41]
** Simplified Oral Hygiene Index (OHI-S) of Greene and Vermillion [42]

Table S2: Oral health practices of the children

Variables	N (%) N=346
Oral hygiene status	
Good	20 (5.8%)
Fair	287 (82.9%)
Poor	39 (11.3%)
Frequency of tooth brushing	
Twice or more daily	254 (73.4%)
Less than twice a day	92 (26.6%)
Use of fluoridated toothpaste	
Yes	76 (22.0%)
No	270 (78.0%)
Dental visit	
Yes	4 (1.2%)
No	342 (98.8%)

Table S3: Breastfeeding duration and frequency of sugar consumption between meals

Variables	N (%) (N=346)
Duration of breastfeeding	
≤12 months	140 (40.5%)
>12 months	206 (59.5%)
Frequency of sugar consumption between meals	
≥3x per day	154 (44.5%)
<3x per day	192 (55.5%)

Table S4: Association between oral health practices and ECC

Variables	ECC absent N (%)	ECC present N (%)	Total N (%)	p-value
Oral hygiene status				
Good	20 (100.0%)	0 (0%)	20 (100.0%)	0.67
Fair	277 (95.5%)	10 (3.5%)	287 (100.0%)	
Poor	38 (97.4%)	1 (2.6%)	39 (100.0%)	
Frequency of tooth brushing				
Twice daily or more	246 (96.9%)	8 (3.1%)	254 (100.0%)	1.71
Less than twice daily	89 (96.3%)	3 (3.3%)	92 (100.0%)	
Fluoridated toothpaste use				
Yes	70 (92.1%)	6 (7.9%)	76 (100.0%)	0.01*
No	265 (98.1%)	5 (1.9%)	270 (100.0%)	
Dental visits				
Yes	3 (75.0%)	1 (25.0%)	4 (100.0%)	0.01*
No	332 (97.1%)	10 (2.9%)	342 (100.0%)	

Table S5: Association between breastfeeding duration, frequency of sugar intake and ECC

Variables	ECC absent N (%)	ECC present N (%)	Total N (%)	p-value
Duration of breastfeeding				
≤12 months	140 (100.0%)	0 (0%)	140 (100.0%)	0.01*
>12 months	195 (94.7%)	11 (5.3%)	206 (100.0%)	
Frequency of sugar consumption between meals				
≥3x per day	150 (97.4%)	4 (2.6%)	154 (100.0%)	0.35
<3x per day	185 (96.4%)	7 (3.8%)	192 (100.0%)	

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Table S6: Binary regression of socio-demographic factors against ECC

Predictors	B	S.E.	Sig.	Exp(B)	95% CI for EXP(B)	
					Lower	Upper
Male	-1.20	.80	.13	.30	.06	1.44
Birth order	-.09	.13	.47	.91	.71	1.18
SES (middle)	-.19	.65	.77	.83	.23	2.96
Age	.03	.02	.04	1.03	1.00	1.07
Constant	-3.47	.89	.00	.03		

Table S7: Maternal caries and predisposing factors

Variables	N (%) (N=346)
Parity group	
Low parity ≤4	218 (63.0%)
High parity ≥5	128 (37.0%)
Maternal caries present	
Yes	119 (34.4%)
No	227 (65.6%)
Mother-child kissing during 1st year	
Yes	198 (57.2%)
No	148 (42.7%)
Feeding premasticated food during 1st year	
Yes	138 (39.9%)
No	208 (60.1%)
Sharing of utensils during 1st year	
Yes	202 (58.4%)
No	144 (41.6%)