

## **The Relationship between Breastfeeding and Dental Caries in Preschool Children in Saudi Arabia: A Systematic Review**

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*Abstract.* The aim of this study was to carry out a systematic review on the existing data within the literature to determine the relation between breastfeeding and caries in Saudi Arabia on preschool children. Using Cochrane search strategy, a search protocol was prepared to review all published data for this study. The search was run on March 2011 in all languages as to identify all eligible studies for our review. Eight articles met the criteria. No significant differences between children with ECC and caries free children regarding the type of feeding. Breastfeeding frequency, feeding on demand, especially during sleep, and late weaning were found to be significant factor in most of the included studies. There were limited number of studies carried out in Saudi Arabia that correlate the possible relationship between breastfeeding and dental caries in preschool children. Therefore, more rigorous investigation in a larger sample size that represents the population, after standardizing and identifying the different confounding factors is required.

*Keywords:* Saudi Arabia, Breastfeeding, Caries, Early childhood caries.

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Accepted for publication: 19 March 2013. Received: 25 September 2012.

## Introduction

Early childhood caries (ECC) is a unique form of rampant decay of the primary teeth that affect young and preschool children worldwide. Early Childhood Caries (ECC) is used nowadays in place of the term baby bottle tooth decay and nursing caries that was used before<sup>[1,2]</sup>. The prevalence of ECC in Saudi Arabia was reported to be high in many studies<sup>[3-13]</sup>. Although the cause of this high prevalence was discussed, it is still unclear. One of the risk factors reported is infant feeding practices including breastfeeding (BF). However, the association between infant feeding practices and ECC still needs further investigations. In some studies done worldwide, breastfed children were found to have low caries prevalence<sup>[14-16]</sup>. Others have suggested that prolonged on demand natural BF especially at night produces caries<sup>[17-20]</sup>. Similarly, the American Academy of Pediatrics (AAP) considers infants who are bottle or breastfed during their sleep are at great risk for dental caries<sup>[21,22]</sup>.

Islam supports and encourages mothers to breast feed their babies up to two years of the baby's life. For that, BF was expected to be the main feeding practice followed in the Islamic communities including Saudi Arabia. Previous studies showed that the duration of BF exceeded 2 years in some areas in Saudi Arabia<sup>[23,24]</sup>. However, the incidence of continuation of BF up to 2 years has dropped from 32 %<sup>[25]</sup> in 1987 to 3.2% in 2000<sup>[26]</sup>. Most recently El-Gilany *et al.*<sup>[27]</sup> reported that only 24.4% of the infants were exclusively breastfed at the age of 6 months. These changes in the infants' nutritional habits were explained by the rapid socioeconomic and industrial developments in the past few decades<sup>[28,29]</sup>. At the same time the drop in BF practices in the last decade comes hand-to-hand with the increase in prevalence of caries.

Therefore, this study aimed to do a systematic review of all the studies carried out in Saudi Arabia that discussed the possible relation between infants' BF practices, and caries development in preschool children.

## Material and Methods

A search protocol on the relation between breastfeeding practices and ECC in Saudi Arabia was prepared and discussed. It included search strategy, search engine and inclusion criteria. The electronic search was run on March 2011 in all languages and from the year 1995 to 2011 to

identify all eligible studies for the review. The search engines used in the research included; Pub Med, Science Direct, Saudi Dental Journal (SDJ), Saudi Medical Journal (SMJ) and Journal of King Abdulaziz University – Medical Sciences. The key words used were; Saudi Arabia, preschool children, caries, decay, ECC, feeding habits, breastfeeding, and dietary habits. They were used separately and combined. The search strategy is available on request with the corresponding authors.

The first search has identified a total of 107 articles. It included; Pub Med (63 hits), Science Direct (16 hits), SDJ (27 hits) and Journal of King Abdulaziz University – Medical Sciences (one hit). From the 107 articles, 42 were excluded due to duplication. The title and the abstract of the remaining 65 articles were screened by the three authors and compared according to the following inclusion criteria:

- 1 Studies that discussed the relation between breastfeeding and ECC.
- 2 Studies that recruited their sample from Saudi Arabia.
- 3 The sample should include medically free preschool children.
- 4 The age of included sample should be younger than six years.
- 5 Studies that explained clearly their methodology.

The exclusion criteria included:

1. Studies carried out outside Saudi Arabia.
2. Studies carried out on children older than 6 years.
3. Studies included medically compromised patients.
4. Studies with no clear methodology.
5. Studies that investigated the prevalence, pattern, or risk factors of caries in preschool children without including breastfeeding as a possible risk factor.

Total numbers of 44 articles were clear not to meet the inclusion criteria of the review. Full copy of the remaining 21 articles were printed and reviewed carefully by each of the reviewers. Then, the references of all the studies were manually searched.

Furthermore, eleven articles were excluded because they were found to determine the prevalence, severity or distribution of ECC without investigating breastfeeding as a risk factor. While, two of the articles were excluded because they investigated factors other than breastfeeding. In the remaining 8 articles, two had the same authors and used the same sample (Al-Malik *et al* 2001 and 2003)<sup>[9,13]</sup>, only one of them was

included in the review Al-Malik *et al.* (2003). The final included articles were 7 articles.

All the authors of the included articles were contacted for grey literature and inquiries on their data. Six of them replied and two provided their raw data. No unpublished data was found.

Data extracted from included studies include:

1. Study characteristics and design.
2. Sample size and its' description.
3. Feeding practices type and their relation to caries
4. Other caries determinant and risk factors mentioned in the studies.
5. Confounding factors and sources of heterogeneity.

All studies were reviewed by two of the authors according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)<sup>[30]</sup> to measure their quality and degree of strength. In case-control studies, the Quality assessment was carried out using Newcastle-Ottawa Quality Assessment Scale (NOS)<sup>[31]</sup>.

## Results

A total number of 7 articles were included in this systemic review. Three of them were case control studies<sup>[24,32,33]</sup> and four were cross sectional<sup>[8,9,34,35]</sup>. Their base populations were recruited from Riyadh<sup>[8,32-34]</sup>, Jeddah<sup>[9,24]</sup> and Tabuk<sup>[35]</sup>.

The definition of ECC varied among the different studies included in the review. In Al-Hussyeen and Al-Sadhan<sup>[33]</sup>, ECC was defined as having at least two carious lesions on the smooth surface of maxillary incisors with absence of caries in the mandibular incisors. While Al-Malik *et al.*<sup>[9]</sup> diagnosed rampant caries when caries was found in the smooth surfaces of two or more maxillary incisors<sup>[9]</sup>. Moreover, Wyne *et al.*<sup>[34]</sup> specified that the two carious lesions have to be on the labial surface. A more specific definition was used by Almushayt *et al.*<sup>[24]</sup> they defined Severe ECC according to the American Academy of Pediatric Dentistry (AAPD 2006-2007)<sup>[21]</sup>. They described Severe EEC as the presence of one or more decayed (non cavitated or cavitated lesions), missing tooth due to caries or filled tooth surfaces in any primary tooth in a child 71 month of age or younger. From age 3 through 5, one or more

cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth, or decayed, missing, or filled score of  $\geq 4$  at age 3,  $\geq 5$  at age 4 or  $\geq 6$  at age 5 .

Samples of the studies included children with ECC or rampant caries, and compared them with caries free children<sup>[8,9,24,32,33]</sup>. However, Al Ghanim *et al.*<sup>[32]</sup> included children with severe caries based on dmft score (dmft 8 or more) and compared them to children with zero dmft score. All the studies included in the systemic review together with their characteristics were illustrated in Table 1.

### ***Type of Feeding (Weather Bottle or BF)***

Al-Hussyeen and Al-Sadhan<sup>[33]</sup>, and Almushayt *et al.*<sup>[24]</sup> compared the type of feeding in children with ECC and children with no caries. They found no significant differences between the two groups. Moreover, Sabbah *et al.*<sup>[35]</sup> reported a lack of association between caries and infant feeding practices including BF.

On the other hand, Wyne *et al.*<sup>[34]</sup> reported that 70.8% of the children with ECC were breastfed. This value was found to be statistically significant. Also, Al-Malik *et al.*<sup>[9]</sup> found a significant relation between BF and caries in young children. They reported that wholly BF was found to be a significant factor associated with caries and rampant caries<sup>[9]</sup>.

### ***Breastfeeding Frequency***

The frequency of BF was reported by Al-Hussyeen and Al-Sadhan<sup>[33]</sup> to have a statistical significant relation to caries. They found that almost half of caries free children had a lower feeding frequency of 3-5 times/day compared to 14% of children with ECC.

### ***On Demand Feeding***

Al-Hussyeen and Al-Sadhan<sup>[33]</sup> reported a significantly associated between feeding on demand, rather than on schedule and dental caries in young children. It was found to be significantly practiced more among children with ECC (84.2%) compared to caries free children (66.7%). A significant association between BF on demand, especially during sleep and ECC was also reported by Wyne *et al.*<sup>[34]</sup>. They reported that 69.6% of children diagnosed to have ECC are breastfed on demand during sleep.

Table 1. Studies that investigated the relation between BF and caries in Saudi Arabia and their characteristics

Reference	Site	Study design	Sample size	Gender	Mean Age	BF**	BF characteristics discussed		
							Frequency	Nocturnal	Weaning
Wyne <i>et al.</i> 1995 [34]	Riyadh	Cross section	96 with ECC	Males:53 Females:43	Unclear < 6y	Yes*		Yes* BF before sleeping and on demands nocturnal BF.	
Al Ghanim <i>et al.</i> 1998[32]	Riyadh	Case-control	446 Study group: 215 Control group: 231	Males:199 Females:247	4.13y				Yes* (p<0.0005) BF more than 13 month was related to ECC
Sabbah <i>et al.</i> 1998[33]	Tabuk	Cross sectiona I	574 With caries	Males:294 Females:280	1-5 years	NO			
Al-Hussveen and Al-Sadhan 2002[33]	Riyadh	Case-control	125 Study group: 58 Control group: 67	Males:75 Females:50	2y	NO	Yes* (p<0.0001)		
Wayne <i>et al.</i> 2002[8]	Riyadh	Cross sectiona I	74 nursing caries children	Males:34 Females:40	5.5y			Yes*	
Al-Malik <i>et al.</i> 2003[9]	Jeddah	Cross section	987 Caries: 720 No caries: 267	Males:511 Females:476	4.3y	Yes*(P<0.01) BF mix or wholly were more related to caries			Yes*(P<0.05) BF longer than 12 months was more related to caries
Almushayt <i>et al.</i> 2009[44]	Jeddah	Case-control	90 Study group: 60 Control group: 30	Males:39 Females:51	4.8y	NO			

\*Statistical significant differences.

\*\* relation between BF and caries

### ***Breastfeeding Weaning***

Al Ghanim *et al.*<sup>[32]</sup> found a significant relation between severe caries and BF weaning at or later than 13 months. They reported that 17.9% of caries free children stopped BF after the age of one year, while 33.3% of high dmft score children did not. In addition, Al-Malik *et al.*<sup>[9]</sup> found that 43% of the children who were breastfed for duration longer than one year were diagnosed to have rampant caries, which was found to be statistically significant.

### ***Breastfeeding before Sleep***

Wyne *et al.*<sup>[34]</sup> reported that 58.3% of the children diagnosed to have ECC were breastfed before sleeping. This value was found to be statistically significant. Another study done by Wyne *et al.*<sup>[8]</sup> showed that two third of the children 65% diagnosed to have nursing caries were found to be breastfed before sleep and similar percentage 60.8% were breastfed during sleep.

### ***Quality Characteristics of included Studies and Risk of Bias: (Table 2)***

All of included studies, except Al-Malik *et al.*<sup>[9]</sup>, used convenient sample. Many confounding factors were not standardized including; gender, child SES, mother's education, time of diet initiation and type, child order and oral hygiene status. However, in Al Ghanim *et al.*<sup>[32]</sup>, gender was matched in the control and oral hygiene status was determined. However, other confounding factors were still not consistent.

The quality of case-control studies was assisted using NOS quality assessment. Their mean score was 8 out of 10.

## **Discussion**

The prevalence of rampant caries in preschool children in Jeddah, Saudi Arabia has increased in the last decade. Affecting 20% of 3-6 years old children as reported by Al Amoudi and Salako in 1996<sup>[4]</sup> to 34% in 2003<sup>[9]</sup>, which is higher than what was reported by other countries such as Sweden<sup>[37]</sup>, Italy<sup>[38]</sup>, India<sup>[39]</sup>, Africa<sup>[40]</sup> and Brazil<sup>[41]</sup>.

Table 2. Quality characteristics of included studies and risk of bias.

Reference	Limitations	Strength
Wyne <i>et al.</i> 1995 <sup>[21]</sup>	<ol style="list-style-type: none"> <li>1. Small convenient sample.</li> <li>2. The gender was not matches.</li> <li>3. The time they started Sample recruitment and the duration was not mentioned.</li> <li>4. Other confounding factors were not standardized.</li> <li>5. No information on method of examination, and number of examiner</li> <li>6. No intra-examiner reliability</li> <li>7. Unclear identification of breast feeding, Mix feeding and bottle feeding</li> <li>8. Oral hygiene level was not determined</li> </ol>	
Al-Ghanim <i>et al.</i> 1998 <sup>[23]</sup>	<ol style="list-style-type: none"> <li>1. Convenient sample.</li> <li>2. Some confounding factors were not standardized in both groups (SES, rank, parents education)</li> <li>3. No radiograph</li> <li>4. No pilot study</li> </ol>	<ol style="list-style-type: none"> <li>1. Random sample.</li> <li>2. Gender was matched</li> <li>3. Single examiner and data recruitment.</li> <li>4. Intra-examiner reliability.</li> <li>5. Oral hygiene level was determined</li> </ol>
Sabbah <i>et al.</i> 1998 <sup>[25]</sup>	<ol style="list-style-type: none"> <li>1. Convenient accessible sample.</li> <li>2. The gender was not matches.</li> <li>3. The time they started Sample recruitment and the duration was not mentioned.</li> <li>4. Other confounding factors were not standardized</li> <li>5. No radiograph.</li> <li>6. No oral hygiene level was determined.</li> <li>7. Not blinded</li> </ol>	<ol style="list-style-type: none"> <li>1. Large sample size</li> <li>2. Inter-examiner readability was done</li> <li>3. The dental examination was carried out by trained personnel.</li> </ol>
Al-Hussyeen and Al-Sadhan 2002 <sup>[23]</sup>	<ol style="list-style-type: none"> <li>1. Small convenient sample.</li> <li>2. No randomization</li> <li>3. Other confounding factors were not standardized.</li> <li>4. No Radiograph</li> <li>5. No intra-examiner reliability test</li> <li>6. Not blinded.</li> <li>7. No pilot study</li> </ol>	<ol style="list-style-type: none"> <li>1. Data recruitment was done by a single personal.</li> <li>2. More than one to one control group.</li> </ol>
Wyne <i>et al.</i> 2002 <sup>[1]</sup>	<ol style="list-style-type: none"> <li>1. Small convenient sample.</li> <li>2. The gender was not matches.</li> <li>3. Time of Sample recruitment was not mentioned.</li> <li>4. Other confounding factors were not standardized.</li> <li>5. No information on method of examination, and number of examiner.</li> <li>6. No reliability test</li> <li>7. Unclear identification of breast feeding, Mix feeding and bottle feeding</li> </ol>	
Al-Malik <i>et al.</i> 2003 <sup>[8]</sup>	<ol style="list-style-type: none"> <li>1. The gender was not matches.</li> <li>2. No radiograph</li> <li>3. Not blinded</li> </ol>	<ol style="list-style-type: none"> <li>1. Large sample size.</li> <li>2. Random sample</li> <li>3. Single examiner.</li> <li>4. Intra-examiner reliability</li> <li>5. Pilot study was done.</li> </ol>
Almushayt <i>et al.</i> 2009 <sup>[24]</sup>	<ol style="list-style-type: none"> <li>1- Small convenient sample.</li> <li>2- Small control group.</li> <li>1- Other confounding factors were not standardized in both groups (gender, oral hygiene, SES).</li> <li>2- No intra-examiner reliability</li> <li>3- Source of Information was not standardized</li> <li>4- Not blind.</li> <li>3- No pilot study</li> </ol>	<ol style="list-style-type: none"> <li>1- Referred children were re-examined to confirm selection criteria.</li> <li>2- Data recruitment was done by a single personal.</li> <li>3- Radiographic diagnosis was included</li> </ol>

At the same time, the continuation of incidences on BF up to 2 years has dropped from 32% in 1987<sup>[25]</sup> to 3.2% in 2000<sup>[26]</sup>. Could this be a coincidence or is there a true relation? Could BF have a protective effect against caries? In order to clarify this dilemma, a systematic review was carried out in the literature to find all articles that studied the relation between BF and caries in Saudi Arabia

In dentistry, controversy still exists whether BF is cariogenic or not. Low caries prevalence among BF children was reported in many studies<sup>[14-16]</sup>. While, some other studies reported development of ECC in children with prolonged BF, or who were BF on demand<sup>[42-44]</sup>.

In Saudi Arabia, few studies were published to investigate the possible association between infant feeding practices including BF and ECC. Most of these studies included small convenient sample<sup>[8,24,32-35]</sup> except in Al-Malik *et al.*<sup>[9]</sup> study who used a large random sample that represented the population.

Moreover, confounding factors were not standardized and most of them included other risk factors that could be the reason for the high caries rather than BF (Table 2). Similarly, most of the studies included children till the age of six. As the child gets older, many risk factors other than BF may mask the actual effect of BF (Table 1).

Four of the included studies were cross sectional<sup>[8,9,34,35]</sup>, while three were case control studies<sup>[24,32,33]</sup>. Although the data from cross sectional studies were considered in the review, more weight must be given to the case control studies. Only two case-control studies studied the relation between BF and caries. Al-Hussyeen and Al-Sadhan<sup>[33]</sup>, and Almushayt *et al.*<sup>[24]</sup>, found no significant differences between the type of feeding (BF or bottle feeding) and ECC. However, they had nonrandomized convenient samples, and the control group in one of them<sup>[24]</sup> was inadequate (Table 2). Nevertheless, their result agreed with Rosenblatt and Zarzar<sup>[45]</sup> study, which investigated the relationships between ECC and breast, bottle, or mixed feeding among Brazilian infants and showed no correlation between the type of feeding and ECC.

In addition, Sabbah *et al.*<sup>[35]</sup> reported no association between different infant feeding practices (including BF) and ECC. This was explained by the delay eruption of teeth observed in the selected population. Therefore, by the time teeth erupt the child had already made the

transition to a more solid food intake<sup>[35]</sup>. This explanation agreed with the Kramer *et al.*<sup>[46]</sup> who conducted a study on a large randomized trial and provided no evidence of beneficial or harmful effects of prolonged and exclusive BF on dental caries at early school age. Moreover, other studies reported that children who were breastfed had lower caries prevalence than those who were bottle fed<sup>[47]</sup>.

On other hand, in Al-Malik *et al.*<sup>[9]</sup>, breastfed children were reported to have significantly higher caries prevalence than bottle fed children. Rampant caries was also found to be more common in children who were breastfed for more than one year. However, Al-Malik *et al.*<sup>[9]</sup> study is a cross sectional study with the oral hygiene, gender and other confounding factors not standardized (Table 2). In addition, the author explained in the text that this could be the possible effect of the social class and mother's education rather than BF. In the same study, they found that fully BF was practiced more and for longer period among low social economic class children with low mother education. These children have been given sweetened dummies more often, and were less likely to have had their teeth brushed at an early age<sup>[9]</sup>. Many studies on children's caries have indicated an association between mothers' education and dental caries<sup>[14,44,50,51]</sup>. In Saudi Arabia mothers' level of education<sup>[9,13,33,35]</sup> and the family socio-economic status<sup>[6,36]</sup> were reported to be risk factors for ECC. This reflects the importance of improving mother's education and social status in order to prevent dental caries in children. Furthermore, the World Health Organization has identified women's educational level and social status as being the major risk factors for child morbidity and mortality<sup>[48,49]</sup>.

Wyne *et al.*<sup>[8,34]</sup> reported that BF before sleeping and nocturnal feeding on demand were considered to be a risk factor significantly associated with ECC. This finding is supported by Matee *et al.*<sup>[52]</sup> who reported a strong association between caries development and the habit of allowing children to sleep with the breast nipple in their mouths. Nocturnal BF was also found to be correlated with ECC in many other studies<sup>[16,51,52]</sup>. Both Al Ghanim *et al.*<sup>[32]</sup> and Al-Malik *et al.*<sup>[9]</sup> reported a significant relation between delay in weaning age and dental caries in young children, which agrees with the previous studies that reported a strong association between delay weaning and ECC<sup>[14,42,44,53]</sup>.

## Conclusion and Recommendations

It could be preliminary indicated from the review that wholly BF with limited nocturnal feeding and early weaning does not cause caries. However, the preferred time of weaning, the possible protective effect of BF against ECC and the exact relation between BF and caries is still unclear. There was limited number of studies carried out in Saudi Arabia that investigated the relation between BF and dental caries in spite the high prevalence of ECC. This relation needs to be investigated through further more rigorous investigation in a younger age group with larger sample size that represents the population, after standardizing and identifying the different confounding factors in a case-control cohort study design.

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## دراسة منهجية للرضاعة الطبيعية كأحد أسباب حدوث التسوس المبكر لدى الأطفال في المملكة العربية السعودية

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*المستخلص.* إن نسبة التسوس في الأطفال قد ارتفع بشكل ملحوظ في السنوات الأخيرة. وأحد الأسباب التي يعتقد أنها أدت إلى ذلك هي طريقة وأسلوب الرضاعة ومنها الرضاعة الطبيعية. لذلك فإن الهدف من هذه الدراسة هو إجراء مراجعة منهجية لجميع الدراسات التي أجريت لدراسة العلاقة بين الرضاعة الطبيعية وتسوس الأسنان في المملكة العربية السعودية على الأطفال دون سن المدرسة. تم استخدام استراتيجيات (Cochrane) لإجراء هذه الدراسة. في مارس من العام ٢٠١١م تم إعداد بروتوكول البحث لاستعراض جميع المقالات المنشورة والتي تدرس هذه العلاقة باستخدام كلمات رئيسية. وكانت النتيجة أنه تم الحصول على ثمانية مقالات تنطبق عليها المعايير المطلوبة. لم توجد فروق ذات دلالة إحصائية بين الأطفال الذين يعانون من تسوس الأسنان والأطفال السليمين فيما يتعلق بنوعية التغذية. أما تكرارية الرضاعة الطبيعية، والرضاعة الطبيعية عند الطلب والبطام المتأخر وجدت أنها عوامل مهمة في معظم الدراسات المشمولة في الدراسة. الخلاصة: مازال هناك احتياج كبير لدراسة العلاقة بين الرضاعة الطبيعية والتسوس في المملكة.