

Prevalence and determinants of caries among 1-5 year-old Saudi children in Tabuk, Saudi Arabia

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تهدف هذه الدراسة إلى قياس نسبة التسوس بين الأطفال من منسوبي مستشفى القوات المسلحة بالشمال الغربية من عمر سنة إلى خمس سنوات. وقد تم اختيار عينة من 574 طفل للمشاركة في الدراسة، وتم تدريب عدد 7 من أخصائيي صحة الفم والأسنان لفحص تسوس الأسنان وفقاً لمعايير منظمة الصحة العالمية. كما قام أولياء الأمور بإكمال استبيان عن العوامل الاقتصادية والسلوكية المرتبطة بالتسوس. ولقد وجد أن نسبة التسوس 26.5%، ووجد فرق بسيط بين الإناث والذكور. وقد وجدنا أن بعض العوامل مرتبطة إحصائياً بالتسوس وتتضمن معدل دخل الأسرة، درجة تعليم الوالدين، تناول الحلوى بكثرة، تناول المشروبات المحلاة، درجة اهتمام الوالدين بصحة الفم، والصحة العامة للطفل. ولقد أثبتت هذه الدراسة أن العوامل الاجتماعية المرتبطة بتسوس أسنان الأطفال السعوديين متشابهة لمثيلاتها بالدول الأخرى. وقد يعزى عدم ارتباط التسوس بالرضاعة الصناعية أو الطبيعية في هذه الدراسة إلى تأخر ظهور الأسنان عند الأطفال في هذه المنطقة. ولقد أكدت نتائج هذه الدراسة على أهمية استمرار وتكثيف برامج التوعية بصحة الفم والأسنان للأمهات، والحوامل.

The purpose of this study was to measure prevalence of dental caries and identify risk factors among 1-5 year-old Saudi children served by the Northwest Armed Forces Hospitals. A sample of 574 children was selected to participate in the study. Five dental therapists and two hygienists were trained and assessed for inter-examiner reliability using the World Health Organization criteria for diagnosis of caries. Parents completed a questionnaire on relevant socio-economic and behavioural factors. The prevalence of dental caries was 26.5%. Males were slightly more affected than females, but the difference was not statistically significant. Income, parents' education, frequency of eating candies, sweetened beverages, perceived importance of oral health and child's general health were significantly associated with the disease. In the Logistic Regression analysis, eating candies, perceived importance of oral health, and mothers' education were independently associated with the disease. The determinants of dental caries in Saudi children were generally similar to those reported in other countries. The lack of association with bottle-feeding and breast-feeding may be attributed to the late deciduous teeth eruption observed in this region. The overall results of the study indicated that mothers' education was the most important determinant of early childhood caries and supported implementation of health promotion strategies that target new and expectant mothers.

Introduction

Early childhood caries (ECC) is a multi-factorial disease that affects infants and toddlers, affecting their general health, growth patterns and quality of life.^{1,2} The disease also affects parents' lives as they are obliged to take time off work to look after the children and take them to the dentist.³ At the same time, treatment of the disease is very costly, complicated and time-consuming.⁴

Studies on ECC have identified several risk factors associated with this condition, such as high *Streptococcus mutans* counts, diet, feeding habits, family income, education of the mother and parental attitude towards oral health.⁵⁻¹⁰ In Saudi Arabia, Wyne *et al.* examined a number of socio-economic and behavioural characteristics of the children with ECC and recommended that studies should be conducted to measure prevalence of the disease and compare the characteristics of those with and without the condition.¹¹

In the community served by the Northwest Armed Forces Hospitals (NWAFFH), Tabuk, Saudi

Arabia, Stewart *et al.* (2000) reported that more than 92% of 6-year-old children had caries in primary teeth.¹² No other studies examined dental caries among younger children, but observation suggested that the caries problem starts much earlier. Therefore, it was important to examine prevalence of dental caries and assess the risk factors among younger children in the NWAFFH community to help make decisions regarding selecting and implementing appropriate preventive interventions.

This study aimed at assessing the prevalence of ECC among 12- to 60-month-old children attending the Well Baby Clinic (WBC) in NWAFFH for vaccinations, and examining the behavioural and socio-economical risk factors associated with this disease.

Methods

In a preliminary assessment of the prevalence of dental caries among children attending WBC for vaccination in the NWAFFH, Tabuk, Saudi Arabia, it was found that approximately 20% of the children

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between 12 to 60 months had the disease. A sample size for the estimation of proportion was calculated using the equation: $n = z^2 \pi (1 - \pi) / \sigma^2$ where 'n' is the sample size, ' π ' the estimated proportion (20%), 'z' the probability (95%) and ' σ ' the standard error (5%). Although the estimated sample size was approximately 350, the actual sample was 574, which provided an even better representation of the whole population.

A questionnaire on the socio-economic and behavioural factors associated with ECC was developed, and dental health educators working in the NWAFFH, Oral Health Promotion Unit were trained to administer and help parents to complete the questionnaire, if necessary. A paediatric dentist trained five dental therapists and two dental hygienists to examine oral health status and assess the prevalence of dental caries in the children according to World Health Organization criteria for the diagnosis of caries.¹³ The dmft index was used, only extracted teeth were counted as missing, non-erupted teeth were not included in the index. All clinicians involved in the study, including the paediatric dentist, examined 40 patients to test for inter-examiner reliability. Kappa statistics were calculated to measure reliability.

A convenient sample was selected from 12 to 60-month-old children attending the NWAFFH, WBC for vaccinations, and dental auxiliaries examined children while parents completed the questionnaires.

Data regarding the prevalence of dental caries and data collected from the questionnaires were entered in a computer database and analysed using the Statistical Program for Social Sciences (SPSS version 7.5). Chi-square and Odds Ratios were used to identify factors with significant association with dental caries, and Logistic Regression was used to identify factors which had an independent association with the disease. Since children's eating habits and oral hygiene practices might change as they grow up, separate tests of association were conducted for the whole sample, 12- to 25-month and 26- to 60-month-old children.

Results

The average reliability in diagnosing children dental caries for all the examiners and the paediatric dentist was high, average kappa = 0.84.

Of the 574 children included in the study, 51.2% were males. Approximately 99% of the children had at least one erupted tooth. The prevalence of

dental caries was 26.5% with males slightly more affected (male 29.6%, female 23.6%), but the difference was not statistically significant. The mean dmft was 1.17, with a range 0-19 (Table 1). Approximately, 13% of children between 12 to 30 months, 50% of children aged 31 to 59 months and 76.7% of children at age 60 months had the disease (Table 2).

Table 1. Percentages with dental caries and dmft index

Sample number	Percent with dental caries	Min	Max	Mean dmft	Std Error
Total (n=574)	26.5%	0	19	1.17	0.11
Males (n=294)	29.6%	0	13	1.32	0.15
Females (n=280)	23.6%	0	19	1.01	0.15

Table 2. Percentages with dental caries and dmft index by age group.

Age group	Percent with dental caries	Min	Max	Mean dmft	Std Error
Age 12-30 months (n=382)	12.8%	0	12	0.49	0.008
Age 31-59 months (n=162)	50.0%	0	13	1.98	0.22
Age 60 months (n=30)	76.7%	0	19	5.40	0.90

Table 3 shows the factors significantly associated with dental caries in the Chi-square analysis. These factors included lower family income, lower level of mother/father education, eating normal diet, having milk with sugar in the bottle, eating sweets, drinking sweetened fluids, parent's perception of oral health as less important than general health, children's perceived poor general health, and parent's perceived poor general/ oral health.

When controlled for confounding factors, only three of these variables showed significant association with dental caries namely, mother's education, eating sweets and perception of the importance of oral health (Table 4). Children, who frequently ate sweets, were 3.66 times more likely to have the disease. Also, children of parents, who perceived oral health less important than general health, were 3.76 times more likely to have decayed teeth. Finally, children of mothers with elementary school education or less were 1.8 times more likely to have dental caries compared to those of mothers with higher levels of education.

Table 3. Factors significantly associated with dental caries (*n* = 574)

Variable	Percentage affected	Significance	Odds Ratio	95% Confidence Interval
Income	< SR7,000: 29.2%	<i>P</i> < 0.05	1.76	1.09-2.85
	□ SR7,000: 18.9%			
Father's education	□ High school 27.8%	<i>P</i> < 0.05	4.11	1.24-13.63
	> High school 8.6%			
Mother's education	□ Elementary school 31.2%	<i>P</i> < 0.01	1.75	1.19-2.58
Solid foods	> Elementary school 20.6%	<i>P</i> < 0.001	6.52	2.58-16.45
Milk with sugar in bottle	Yes 30.3%	<i>P</i> < 0.05	2.21	1.01-4.85
	No 6.3%			
Fluids with sugar	Yes 20.9%	<i>P</i> < 0.05	2.36	1.13-4.94
	No 10.7%			
Eating sweets	Yes 22.8%	<i>P</i> < 0.001	3.90	2.39-6.40
	No 11.1%			
Drinking sweetened beverages	Yes 34.4%	<i>P</i> < 0.001	2.64	1.50-4.64
	No 11.8%			
Oral health in relation to general health	Yes 29.9%	<i>P</i> < 0.001	4.37	1.83-10.44
	No 13.9%			
Child's perceived general health	Less important 59.1%	<i>P</i> < 0.05	1.74	1.11-2.72
	Same importance 24.9%			
Parent's perceived general health	Poor-fair 35.5%	<i>P</i> < 0.05	1.59	1.01-2.50
	Good 24.1%			
Parent's perceived oral health	Poor-fair 34.0%	<i>P</i> < 0.001	2.187	1.50-3.20
	Good 24.5%			

Table 4. Factors independently associated with dental caries Logistic Regression (*n*=574)

Variable	Regression Coefficients	Significance	Odds Ratio	95% CI
Mother's education (primary school or less)	0.60	<i>P</i> < 0.01	1.80	1.19-2.72
	1.30	<i>P</i> < 0.001	3.66	2.22-6.03
	1.33	<i>P</i> < 0.01	3.76	1.49-9.50

Goodness of Fit: 555.17 - 2 Log Likelihood: 587.55
 Model Chi-square: 51.24 Model Significance: <0.0001
 Overall accuracy of classification table for caries: 74.5%
 Number of cases included in the model (sample size): 553

When children between 12 to 25 months were examined separately, the factors showing significant association with dental caries were mother's education, eating normal diet, eating sweets, drinking sweetened fluids, perception of oral health less important than general health, and parent's perceived general health and oral health.

In the Logistic Regression analysis for this age group, two factors showed independent association with dental caries. Children of mothers with lower level of education were 3.83 times more likely to have dental caries, and

children of parents with self-perceived poor oral health were 2.65 times more likely to have the disease (Table 5).

Table 5. Factors independently associated with dental caries (age group 12-25 month: *n*=298)

Variable	Regression Coefficients	Significance	Odds Ratio	95% CI
Mother's education (primary school or less)	1.32	<i>P</i> < 0.01	3.83	1.39-10.53
Parents' perceived oral health (poor)	1.30	<i>P</i> < 0.05	2.65	1.05-6.66

Goodness of Fit: 277.75 - 2 Log Likelihood: 173.7
 Model Chi-square: 20.23 Model Significance: <0.0001
 Overall accuracy of classification table for caries: 89.42%
 Number of cases included in the model (sample size): 293

For 26- to 60-month-old children, parent's education, tooth brushing, eating sweets, perceived importance of oral health, children's perceived general health, and parent's perceived oral health were significantly associated with the disease. In the Logistic Regression analysis for these older children, eating sweets, perceived poor general health in children and mother's education were the only variables that showed independent

association with caries. Children frequently consuming sweets were 2.58 times, and children with perceived poor general health were 2.17 times more likely to have caries. Finally, children of mothers with lower level of education were 1.82 times more likely to develop the disease (Table 6).

Discussion

Table 6. Factors independently associated with dental caries (age group 26-60 month: $n=276$)

Variable	Regression Coefficients	Significance	Odds Ratio	95% CI
Eating sweets	0.95	$P < 0.01$	2.58	1.36-4.90
Child's perceived general health (poor)	0.77	$P < 0.05$	2.17	1.13-4.14
Mother's education (primary school or less)		$P < 0.05$	1.82	1.10-3.04

Goodness of Fit: 267.57 - 2 Log Likelihood: 343.5
 Model Chi-square: 22.08 Model Significance: <0.001
 Overall accuracy of classification table for caries: 64.4%
 Number of cases included in the model (sample size): 267

The prevalence of dental caries among 12 to 60-month-old children in Tabuk, Saudi Arabia was consistent with that reported in other Saudi studies.^{12,14} Lower income, lower level of mother's education, eating sweets and perception of oral health less important than general health were the most common factors associated with dental caries. These findings were similar to that reported in other studies on ECC.⁵⁻⁹ However, other factors suggested in the literature such as bottle feeding,^{5,11} breast feeding,⁷ use of pacifier,^{15,16} other feeding patterns and habits^{7,17} did not show the expected association with ECC in this study. This may be explained by the late eruption observed in the population, so that by the time teeth erupted the child had already made the transition to a more solid food intake.

Very few studies examined the effect of parental attitude towards oral health on children's caries.^{9,18} In this study, parents' attitude towards oral health and belief in its importance were very important factors influencing development of dental caries in children. Children of parents, who perceived oral health less important than general health, were more likely to get dental caries. Also, children of parents with self-perceived poor oral health were more likely to get the disease.

Mother's level of education was the most important determinant of children's caries in this study, as it persistently showed a significant

association in all statistical analyses for different age groups. The World Health Organization has identified women's educational level and social status as major risk factors for child morbidity and mortality,^{19,20} and studies on children's caries, including the present study, have indicated similar association with dental caries.^{5,9} This implies that improvement in mother's education and social status is one of the most important interventions for the prevention of dental caries in children.

It is worth noting that the results of this study and other studies on the prevention of ECC^{21,22} support the current preventive programs in NWAFFH, involving education of new mothers, screening of children for caries and creating a database for ECC. The results of the study also necessitate the expansion of mother education activity to include expectant as well as young women, who have yet to bear children. Continuous monitoring of these activities is essential to evaluate effectiveness of programs designed to reduce dental caries in children. There is also a need for further studies, which examine the association between *Streptococcus mutans* counts in children, their mothers and ECC.

Conclusion

Mothers' level of education, along with parents' attitude toward oral health and eating sweets were the most important factors which influenced early childhood caries in Tabuk. These findings emphasized the importance of health promotion strategies, which target new and expectant mothers, and aim to promote a more positive attitude toward oral health.

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References

1. Low W, Tan S, Schwartz S. The effect of severe caries on the quality of life in young children. *Pediatr Dent* 1999; 21: 325-326.
2. Acs G, Lodolini G, Kaminsky S, Gisneros GJ. Effect of nursing caries on body weight in a pediatric population. *Pediatr Dent* 1992; 14: 302-305.
3. Stewart BL, Sabbah WA, Owusu-Agyakwa GB. Dental pain experience and impact on children in Tabuk,

- Saudi Arabia. *Saudi Dent J* 2002; 14: 82-88.
4. Weinstein P. Public health issues in early childhood caries. *Community Dent Oral Epidemiol* 1998; 26: 84-90.
 5. Derkson GD, Ponti P. Nursing Bottle Syndrome; prevalence and etiology in a non-fluoridated city. *J Can Dent Assn* 1982; 6: 389-393.
 6. Stecksén-Blicks C, Holm A, Mayanagi H. Dental caries in Swedish 4-year-olds children. *Swed Dent J* 1989; 13: 39-44.
 7. Weerheijm KL, Uyttendaele-Speybroeck BFM, Eurwe HC, Groen HJ. Prolonged demand breast-feeding and nursing caries. *Caries Res* 1998; 32:46-50.
 8. Seow WK, Amaratunge A, Sim R, Wan A. Prevalence of caries in urban Australian aborigines aged 1-3.5 years. *Pediatr Dent* 1999; 21: 91-96.
 9. Reisine S, Douglass J. Psychological and behavioral issues in early childhood caries. *Community Dent Oral Epidemiol* 1998; 26: 32-44.
 10. Slavkin H. Streptococcus Mutans, early childhood caries and new opportunities. *J Am Dent Assoc* 1999; 130: 1787-1792.
 11. Wyne AH, Adenubi JO, Shalan T, Khan N. Feeding and socioeconomic characteristics of nursing caries children in a Saudi population. *Pediatr Dent* 1995; 17: 451-454.
 12. Stewart BL, Al Juhani TS, Al Akeel AS, Al Brikeet HA, Al Buhairan WH, Al Bundagji NH, Al Deghaishem FA, Abdullah BR. Caries experience in grades 1 and 6 children attending elementary schools in King Abdul-Aziz Military City, Tabuk, Saudi Arabia. *Saudi Dent J* 2000; 12: 140-148.
 13. World Health Organization. Oral health surveys: Basic methods. 4th ed. Geneva: WHO, 1997.
 14. Wyne AH, Al-Ghannam NA, Al-Shammery AR, Khan NB. Caries prevalence, severity and pattern in pre-school children. *Saudi Med J* 2002; 23: 580-584.
 15. Winter GB. Problems involved with the use of comforters. *Int Dent J* 1980; 30: 28-38.
 16. Wyne AH, Spencer AJ, Szuster FSP. Prevalence and risk factors for nursing caries in Adelaide pre-school children. *J Dent Res* 1991; 70: 654 (Abstr # 33).
 17. Eronat N, Eden E. A comparative study of some influencing factors of rampant or nursing caries in pre-school children. *J Clin Pediatr Dent* 1992; 16: 275-279.
 18. Milgrom P. Response to Reisine & Douglass: Psychosocial and behavioral issues in early childhood caries. *Community Dent Oral Epidemiol* 1998; 26: 45-48.
 19. Claeson M, Bos ER, Mawji T, Pathmanathan I. Reducing child mortality in India in the new millennium. *Bulletin of the World Health Organization* 2000; 78: 1192-1199.
 20. Ware H. Effects of maternal education, women's roles and child care on child mortality. In: Mosley WH, Chen L, eds. *Child survival. Strategies for research, population and development review*. New York: Population Council Inc., 1984 pp. 191-232.
 21. Ismail AI. Prevention of early childhood caries. *Community Dent Oral Epidemiol* 1998; 26: 49-61.
 22. Weintraub JA. Prevention of early childhood caries: A public health perspective. *Community Dent Oral*