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Efficacy of an oral health promotion intervention in the prevention of early childhood caries

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Abstract – *Objective:* Despite a marked improvement in oral health of Australian children over the last 30 years, severe early childhood caries (S-ECC) affects up to 17% of 2- to 3-year-old children with some requiring hospitalization and invasive treatment. This provided a compelling rationale to develop and test an oral health promotion programme which aimed to reduce this unnecessary suffering. The purpose of this study was to test the efficacy of an oral health promotion programme for the parents of infants, starting during the pregnancy, using a randomized controlled trial. *Methods:* A programme was developed around the provision of anticipatory guidance to nulliparous women (women expecting their first child) in Adelaide. Mothers in the test group received oral health promotion information during pregnancy, and later when the child reached 6 and 12 months of age. After the second round of information the test group mothers were randomized again. The information was reinforced in one of the test subgroups through a telephone consultation. There was no contact with mothers in the control group after enrolment. At the age of 20 ± 2.5 months all test and control group children were examined by a dentist. The case definition of an incidence of S-ECC was one or more upper incisor teeth being carious at the level of a cavitated or noncavitated lesion. The differences in S-ECC incidence between the test and control groups, and the test subgroups were analysed. *Results:* Of 649 women enroled in the programme (test group 327, control group 322), 441 had their child examined at follow-up. The incidence of S-ECC in the test group was 1.7% and in the control group 9.6% ($P < 0.001$). *Conclusion:* An oral health promotion programme based on repeated rounds of anticipatory guidance initiated during the mother's pregnancy was successful in reducing the incidence of S-ECC in these very young children.

Key words: anticipatory guidance; caries prevention; infants; pregnant women

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The crucial importance of early childhood for a child's further development is recognized by all professions involved in developmental care. To foster general well-being and quality in a child's life, a wide set of health and nonhealth outcomes must be achieved. There is consensus in the literature that the child's quality of life is characterized by four core domains: physical symptoms (pain and fatigue), functional status (ability to perform age – appropriate daily activities), psychological functioning (affective states, adjustment indices and self-esteem) and social functioning (the number, type and quality of social contacts and relationships) (1).

While not all disorders which reduce the quality of a child's life can be actively influenced, an effort should be made to address those amenable to prevention. One of those disorders is early childhood caries (ECC), the consequences of which are associated with all four core domains of a child's

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quality of life. ECC is associated with physical symptoms such as discomfort, pain, infection, abscesses, gastrointestinal disorders, malnutrition, including retarded growth because of pain and reluctance to eat. Thus, the consequences of ECC can reach well beyond the dental area and negatively influence general health and development of the child (2). Chewing difficulties, malocclusion, restriction of communication because of poor speech and loss of space for succeeding teeth cause functional difficulties (3). Psychological problems arising from aesthetic dissatisfaction may compromise a young child's smile, leading to low self-esteem. Learning difficulties could follow as a consequence of the physical and psychological impact leading to intellectual limitation and handicap. Dental pain and necessary treatment can have adverse effects on the developing psyche of a young child and cause fear and aversion toward future dental treatments (4). In addition, for children experiencing ECC the risk for developing future dental caries is increased (5).

Early childhood caries is characterized by the involvement of maxillary incisors and, if the carious process continues, other primary teeth, e.g. molars and canines, while the mandibular incisors are generally not involved. According to the definition suggested by the US National Institute of Health (6). ECC indicates the presence of one or more decayed (noncavitated or cavitated lesions), missing (because of caries) or filled tooth surfaces in any primary tooth in a child 71 months of age or younger. In children younger than 3 years of age any sign of smooth surface caries (noncavitated or cavitated) should be considered as severe ECC (S-ECC).

To prevent the development of the S-ECC, the American Academy of Paediatric Dentistry recommends that infants (and parents) be scheduled for an initial oral evaluation visit within 6 months of the eruption of the first primary tooth, but not later than 12 months of age. In addition, the infant oral health care visit should be seen as the foundation upon which a lifetime of preventive education and dental care can be built to ensure optimal oral health (7).

Despite these recommendations, a preventive dental visit at such an early age is rare. Many children with dental caries come from low-income and deprived families, whose access to dental care is limited by socioeconomic circumstances. Data from one study of preschool children in South Australia showed that only 2.2% of children had had a dental visit by 2 years of age, and 10.7% of children by 3 years of age [A.J. Spencer (unpublished data)]. Children who make such early dental visits are likely to fall into two groups: those who visit with an older sibling or parent for their check-up, and those who visit because of parental concern about existing dental problems, either teething or the development of S-ECC. As a result, only a small minority who visit can be regarded as doing so for prevention or early detection of ECC. To prevent unnecessary discomfort to the child and to reduce the need for invasive treatment, new oral health promoting interventions involving the broader population must be developed.

Anticipatory guidance, defined as a proactive, developmentally-based counselling technique that focuses on the needs of a child at particular stage of life, could provide a foundation for preventive oral health education and dental care and thus enhance the opportunity for a childhood free from preventable oral disease (7). The benefits of anticipatory guidance to the oral health of children were recognized by Nowak and Casamassimo (8), who put forward the idea to implement early intervention through anticipatory guidance from paediatricians and family physicians in well-child care clinics with the opportunity to see the child perhaps 10 times before 3 years of age, and through education of dental professionals who are not used to the developmental approach in prevention.

The purpose of this study was to test the efficacy of an oral health promotion programme targeting nulliparous women to reduce S-ECC at 18 months of age. The intervention took the form of information provided to help mothers set up proper oral health habits early, rather than trying to change established unhealthy habits later. Traditionally anticipatory guidance which occurs in a one-on-one setting with the information tailored specifically to a particular child. In this study the information provided was based on generally accepted clinical and epidemiological data and targeted through printed material to many mothers and children at different stages across the child's early life.

Materials and methods

Ethical issues

The Human Research Ethics Committee from the University of Adelaide and ethics committees of five metropolitan teaching hospitals approved the study.

Design

A randomized controlled trial was selected as the research design for the intervention study.

Justification of sample size

The number of participants was determined by the population incidence of S-ECC, among 18-month olds, which was estimated to be 2.6% for cavitated lesions and 16.7% for noncavitated lesions or cavitated lesions (9). To detect a 50% difference between the test and control groups with a two-tailed significance test, a 5% critical level and power of 80%, a sample of 250 children was required in each of the test and control groups at the planned 18-month follow-up examination.

Subjects

The recruitment of subjects into the study occurred in 2002. The nulliparous women, most in the 5th to 7th months of pregnancy, were recruited into the study in waiting rooms by one of the authors, during their regular antenatal visits at the participating teaching (public) hospitals. In the South Australian health system women can have most of their antenatal care with their general practitioner (28% in 2002) or a private obstetrician (34%) (10), attending hospital only on a few occasions, including to give birth. This limited opportunities for enrolment of such women during antenatal hospital visits and meant that subjects were biased toward women who chose to have their antenatal care predominantly at teaching hospitals.

Exclusion criteria for enrolment were high-risk and multiple pregnancies. Improperly completed questionnaires and the mother's inability to comprehend written English were the other exclusion criteria as the intervention materials were based on written English. Zelen's design with double consent and a random number table (11–13) was used to allocate women into test or control groups before their participation was sought.

In the Zelen design randomization precedes consent. The potential participants were randomly allocated to test and control groups, then approached and informed about the aims of the study and their group allocation. They had the opportunity to accept or refuse the group to which they were randomly allocated. Lack of blinding (14) and potential loss of statistical power (if many participants refuse the allocated group) are the main disadvantages of the design. The main advantage is that the intervention could begin immediately after the consent form was signed (15). With a 9.9% perinatal and neonatal mortality rate (per 1000 births) in year 2002 and 2.4% of all live births notified with congenital abnormalities in South Australia (10), some negative pregnancy outcomes were expected. For this reason medical records were checked for pregnancy outcomes before mothers were contacted again. This check resulted in some further exclusions (Fig. 1; Table 1).

Intervention

Throughout the study women in the test group received three rounds of printed information applied in the form of anticipatory guidance. Test group mothers received the first round of information at enrolment into the study. The second and the third rounds of information were mailed to the mothers home address when their child reached 6 and 12 months of age.

The topics covered in each round offered mothers information and support relevant to their own and the child's oral development across the subsequent 6 or more months period. In addition, the first round of information included information for expectant mothers related to oral health changes during pregnancy. The emphasis was on oral hygiene during pregnancy and proper nutrition. Other topics covered in this part were the importance of primary teeth, the use of pacifiers and sleeping patterns of the child. The second and third rounds of information were concerned with the eruption of teeth, oral hygiene and nutrition. The oral health promotion material was supplemented with the existing nutritional recommendations based on Child and Youth Health's 'Feeding Babies and Young Children' and the National Health and Medical Research Council's 'Dietary Guidance for Children and Adolescents' (16). This endorsed material supported the guidance provided for the healthy development of teeth. With each round of information test group mothers received a small incentive supporting the programme, e.g. mouthrinse for mothers during pregnancy, finger toothbrush for children or toothbrush for mothers. Mothers were not paid for participation in the study.

Using a random numbers table, half of the mothers in the test group (group A) were selected

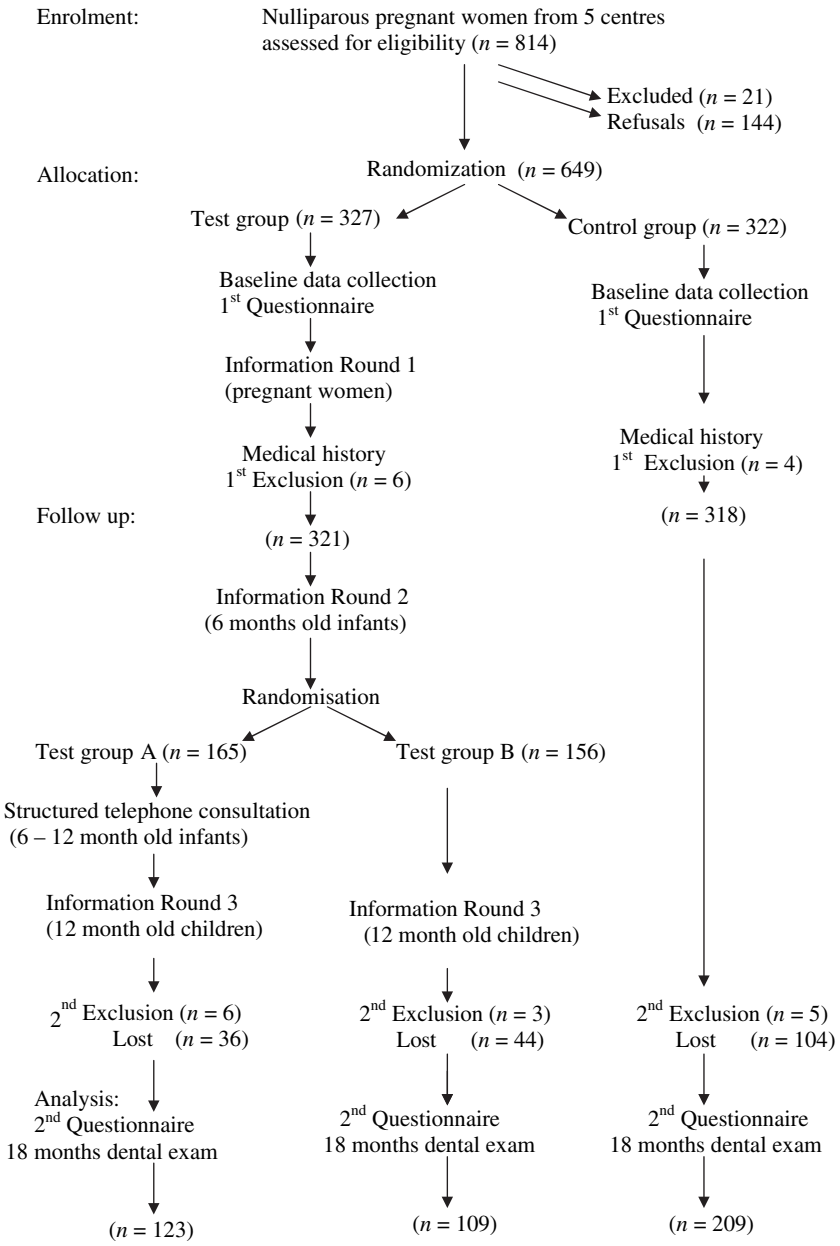

Fig. 1. Flow diagram of participants through key stages of a RCT.

to test the impact of a structured telephone consultation as an additional mode of contact. The structured telephone consultation was conducted as a scripted interview. At the time of consultation the infants were between 6 and 12 months of age. Up to six attempts, on different days and time slots were made to reach the selected participants by phone. After arrangement of a suitable time for the consultation, 18 questions acted as prompts to examine the developing pattern of oral hygiene and eating habits of the child. The 18 questions were based on the anticipatory guidance which the mother received earlier in the study. Further consultation occurred to a varying extent with each mother addressing specific issues that arose. No phone calls were made to mothers in the test group B.

In summary the intervention for test group women consisted of:	
Information round 1	Anticipatory guidance about oral health in pregnancy
Information round 2	Anticipatory guidance about oral health for infants
For a random subgroup structured telephone consultation	Scripted interview on oral health for infants and consultation on issues arising in the interview
Information round 3	Anticipatory guidance about oral health of 12-month old children

Table 1. Exclusions and losses of participants during the randomized clinical trial

Reasons	Test (n = 327)			Control (n = 322)	Total (n = 649)
Exclusion 1	6			4 (n = 318)	10 (n = 639)
	Test A (n = 165)	Test B (n = 156)	Test A + B (n = 321)		
Exclusion 2	6	3	9	5	14
All exclusions[a]			15	9	24
Losses					
Nonattendance	14	15	29	37	66
Loss	12	21	33	53	86
Moved	10	8	18	14	32
Loss to follow up	36	44	80	104	184
Follow up at 18 months	123	109	232	209	441
Retention (%)	77.4	71.2	74.4	66.8	70.6

[a]Exclusion 1 + Exclusion 2.

Data collection

In total four questionnaires (maternal oral health survey, refusal to participate, child's oral health survey, evaluation of oral health intervention) were used during the study. The two main questionnaires (maternal and child's oral health survey) were tested through a pilot study. Medical records, the structured telephone consultation (see above) and the dental examinations were other sources of data.

Details of questionnaires

The baseline questionnaire 'maternal oral health survey' focused on the health habits of pregnant women, their perception of their general and oral health as well as their psychological well-being. It used a combination of standard questionnaire scales e.g. Corah's anxiety scale and standard questions e.g. Washington home care index (17), questions validated in other settings and questions developed specifically for the purpose of this study. The questionnaire contained 90 items in total. To investigate the reasons why some pregnant women refused involvement in the study an 18 item 'refusal to participate' questionnaire was developed. The questionnaire contained only simple yes/no responses, so as to not discourage a response. Space was also allowed for women refusing to participate to express their views. The 'child's oral health survey' questionnaire administered for the planned 18 month follow-up focused on feeding practices, oral hygiene, sleeping patterns, non-nutritional eating habits, teething and general health of the child. To evaluate the intervention, the mothers in the test group completed an 'evaluation of oral health intervention' questionnaire, consisting of 21 items, concerned with the content, usefulness, credibility, readability and impact of the written material.

Medical records

The medical records relating to the infant's and mother's health were examined soon after birth. Information relevant to the infant's health included: date of birth, gestation at birth, birth weight, sex, race, congenital abnormalities, Apgar score and resuscitation at birth. Information relevant to the mother's health included; gestation at first visit, booking blood pressure, hospitalization during pregnancy, onset of labour, postnatal hospital stay in days and some laboratory test results.

Dental examinations

The dental clinics at four metropolitan teaching hospitals across Adelaide were secured for the dental examinations. Mothers had the opportunity to choose the most convenient location. Procedures appropriate for young children were used during the examination. Children were examined in the 'knee-to-knee' position on their mothers lap. A new toothbrush was used to clean the labial surfaces of the upper incisors. Before the examination the teeth were dried with cotton pads. Standard infection control procedures were used during the examinations. A fibre-optic light was used as a source of light. No sharp instruments were used during examinations. All children were examined by one of the authors (KP), who completed series of familiarization exercises at the Dental Clinic of Women's and Children's Hospital prior to the examinations as part of the study.

To assist with blinding the examiner from knowing the characteristics of the child (test/control group), the examinations were organized through a dental receptionist who received the examination

schedules. The status of labial surfaces of the teeth was recorded on the field dental record developed for this purpose. Noncavitated and cavitated lesions were recorded for all teeth. The study focused on the earliest manifestation of S-ECC.

To calculate cumulative incidence of S-ECC, the definition of S-ECC suggested by the US National Institute of Health (6) was used. A case of S-ECC was defined when one or more upper incisor teeth labial surfaces were carious, either noncavitated or cavitated. Diagnosis was based on visual criteria only (18). The lesion was diagnosed as noncavitated if an area of demineralization was without loss of surface continuity detected visually. The lesion was diagnosed as cavitated, if a loss of continuity of the enamel was detected (19).

Results

Enrolment

From a total of 814 pregnant women approached in the waiting rooms of antenatal clinics, 649 women responded positively to the invitation to participate in the study, a 79.7% response rate. Only 2.6% of approached women were not suitable for the study because they had one or more of the specified exclusion criteria. Eighteen per cent of the approached women refused to participate in the study (Fig. 1). The reasons for refusing participation were given by 37 of the 144 nonparticipants. Most reported that they were too busy (78.4%) or perceived participation in the study as inconvenient (67.6%). The only significant sociodemographical difference (chi-square $P < 0.05$) between participants and nonparticipants was linked to employment, with a higher percentage of nonparticipants being employed full-time.

Randomization and group comparability

Most mothers stayed in the group to which they have been allocated. Only five women (0.8%) from all women recruited to the trial changed the group to which they were randomly allocated once they received information about the aims of the trial. All moved from the control group to the test group. In total 327 women were allocated to the test group and 322 women into the control group. The comparability of groups was examined for the mother's sociodemographical characteristics (e.g. age at enrolment, country of birth, main language spoken at home, marital status, education, income), their self-assessment of their general and oral health, oral hygiene practices, smoking habits and use of alcohol during pregnancy, planned or unplanned pregnancy, importance of healthy baby teeth and other characteristics. The only significant differences between the groups at baseline were in the use of dental floss (31.6% in the test group used versus 22.6% women in the control group; chi-square $P < 0.01$) and in the use of alcoholic drinks during the pregnancy (12.4% in the test group compared with 7.4% in the control group; chi-square $P < 0.05$).

Retention of participants

In the period between enrolment into the study and the follow-up dental examination the number of participants declined. First, there were two rounds of exclusions imposed by the researchers. The first exclusion was based on information from medical records after the child's birth. Women who had a miscarriage, intrauterine death or an infant with developmental defects (cleft/lip palate) were excluded from the study. The second exclusion process occurred when inviting participants to present their child for a dental examination. The reasons for exclusion at this point were death of the child (cot death, accidental death), or inability of mothers to care for the child (e.g. mother missing, arrested, sick, living in a safety house). In total, 24 subjects (15 in the test and nine in the control group) were lost to the study through exclusions. Further losses to the study were categorized as 'nonattendance' (mother contacted, but unable or unwilling to bring the child for dental examination), 'moved' (mother moved to distant location), 'loss' (unable to locate). Figure 1 summarizes the flow of the participants through the key stages of the study.

Up to six attempts, at different days and time slots, were made to reach the participant by phone to arrange the dental examination appointment. As problems contacting mothers were expected, the initial questionnaire asked for wide range of contact information (home, work, mobile phone numbers, addresses and phone numbers of further contact persons). If these means were not successful, medical records served as another source of contact information. When a participant did not attend for the dental examination, a new appointment was arranged. The overall retention thorough to the examination was 70.6%, higher in the test group (74.4%) than in the control group (66.8%; Table 1).

Before analysing the dental examination data the comparability of test and control groups was again analysed using the same sociodemographical characteristics of the mothers assessed at baseline. There were no statistically significant differences between examined children and children lost to the study in the test group. However, in the control group losses to follow-up were higher among younger and less educated mothers (chi-square $P < 0.01$). No statistically significant differences in any sociodemographical characteristics were found between the A and B test groups.

The comparability of examined children with respect to their allocation to the test and control group was also evaluated according to the age of the children at examination (months), time of the eruption of the first tooth and time elapsed between the eruption of the first tooth and examination. The mean age of the children at examination was 20.2 months (20.1 months in the test group and 20.4 months for children in the control group), instead of the planned 18 months. This reflected a delay experienced in successfully appointing some mothers and children for dental examinations. The five most frequent months for eruption of the first tooth averaged between the 4th and 8th month of age, accounting for 68.9% of eruptions. Eruption of the first tooth averaged at 7.1 months of age (7.0 months in the test group and 7.1 months in the control group). Using one-way ANOVA, there was no significant difference between test and control groups.

Distribution and extent of carious lesions on the labial surface of affected teeth. When the distribution of lesions on incisors was examined in the test group, the most frequently affected tooth was the 51 (1.7%), while the other incisors (52, 61, 62) were affected by S-ECC equally, which represented 0.4% for each tooth. In the control group the most affected tooth was the 61, with lesions occurring in 7.6% of all 61 teeth present in the mouth, followed by teeth 51, 62 and 52, representing 5.3%, 5.3% and 3.9% each of these teeth present in the mouth. The most frequently affected teeth by carious lesions on labial surfaces in both groups were central incisors, with 71% of all lesions in the test groups and 58.7% of all lesions in the control group.

When the teeth were assessed according to the depth of lesions, characterized as noncavitated or cavitated, from seven affected teeth in the test group only one tooth displayed cavitation, while in the control group from 46 affected teeth 11 teeth displayed cavitation. Across both groups the teeth most frequently affected with a cavitated lesion were the 61 and 51 (each with four teeth with cavitation), while teeth 52 and 62 were affected equally (each with two teeth with cavitation).

Among the test group the extent of carious lesions on the labial surface of the teeth affected was <1/3 of the labial surface for two teeth, >1/3 but <2/3 of the labial surface for three teeth and >2/3 of the labial surface of two teeth. In the control group 29 teeth were affected by carious lesions that extended only on <1/3 of the labial surface. The affected area was greater, between 1/3 and <2/3 of labial surface for seven teeth and was >2/3 of labial surface for 10 teeth.

Cumulative incidence of S-ECC

Table 2 presents the incidence of S-ECC in the test and control groups, including test A and test B groups. The incidence of S-ECC in the test group was 1.7% and in the control group 9.6%. This difference was statistically significant (Fisher's exact test $P < 0.05$). If a case definition based on cavitation only was applied, the number of cases shrank to approximately one-quarter. While the incidence was greater in the control group (1.9%) than in the test group (0.4%), it was not significant. The telephone consultation with mothers in the test group A did not influence the incidence of the S-ECC in the test group.

Variables traditionally considered as important factors in the development of S-ECC were entered into bivariate and multivariate logistic regressions (Table 3) to control for confounding or heterogeneity. Test/control group, age of the child at examination, and one/both parents family structure were significant variables in bivariate and multivariate logistic regression analyses to explain

Table 2. Cumulative incidence of severe early childhood caries (S-ECC) on maxillary incisors in the test, tests A and B and control groups

	Number of children				
	No (S-ECC)		S-ECC		Total
Group	*n*	%	*n*	%	*n*
Test A + B	228	98.3	4	1.7	232
A	121	98.4	2	1.6	123
B	107	98.2	2	1.8	109
Control	189	90.4	20	9.6	209
Total	417	94.6	24	5.4	441

Fisher's exact test: $P < 0.01$ (test and control groups); $P = 0.903$ (tests A and test B groups); $P < 0.01$(test A and control group); $P < 0.01$ (test B and control group).

Table 3. Bivariate and multivariate logistic regression analyses of severe early childhood caries (S-ECC) with un-adjusted and adjusted odds ratios

	Un-adjusted odds ratio (95.0% CI)			Adjusted odds ratio (95.0% CI)		
Variable		Lower	Upper		Lower	Upper
Control group*** (ref. test group)	6.1	2.0	18.1	6.8	2.1	21.9
Mother's age	1.0	1.0	1.1	1.0	0.9	1.1
Examination – age (months)**	1.2	1.1	1.4	1.3	1.1	1.5
One parent family* (ref. both parent family)	2.5	1.1	5.9	3.3	1.2	8.8
Mother's employment	1.6	0.7	3.7	0.5	0.2	1.3
Australia born (ref. overseas born)	1.2	0.4	3.5	0.8	0.3	2.8
Education: [primary, some secondary (ref.)]						
Completed secondary, some university, college	1.4	0.5	4.0	1.2	0.4	4.1
Completed university, college	2.0	0.7	5.9	2.5	0.6	9.7

Significance: *$P < 0.05$; **$P < 0.01$; *** $P < 0.001$. Adjusted Negelkerke $R^2 = 0.197$.

S-ECC among examined children. With the test group as reference (0), the adjusted odds ratio for developing S-ECC in the control group was 6.8 (95% CI 2.1–21.9). Each unit increase in the age of the child (months) at examination increased the odds for developing S-ECC 1.3 (95%CI 1.1–1.5) times. With both parent families as the reference group (0), one-parent families had higher odds, 3.3 (95% CI 1.2–8.8), for developing S-ECC.

Evaluation of the written information

All 232 mothers in the test group who received written information during the study evaluated the programme before the dental examination of their child. The overall evaluation of the programme ranged from 'very good' (38.5%), 'good' (55.2%) to 'neutral' (6.3%), (scaled responses in five category format from 'very good' to 'poor') with no differences between the test A and B groups.

Discussion

This study has shown that providing first-time mothers with information on oral health care for their infants decreased the rate of S-ECC, with significant differences between the incidence of S-ECC in the test and control groups. It would seem that the presentation, use of language, readability, credibility and usefulness of the information fulfilled the requirements of an oral health intervention and determined the helpfulness of printed material. Additional telephone consultation with mothers in part of the test A group did not affect the outcome of the study.

The timing and regularity of the delivery of the information may have been an important element, as it provided first-time mothers with information and assistance in dealing with what must be a challenging situation for them. Their motivation to participate in the study could be attributed to their desire to give their child the best possible care and to spare the child from complications caused by S-ECC. Emotional attachment to their child certainly played an important role in their decision making. The initial contact with the researcher during enrolment in the study, when importance of primary teeth for the health of a child was discussed, may have engendered trust and enhanced the mothers' enthusiasm towards prevention of S-ECC as well as their participation in the study.

Numerous sources refer to mothers as the 'key figure' in the child's dental health as they are usually the principal carers and gatekeepers between the family and outside world (20). From a developmental perspective, the maternal influence remains important throughout childhood, even if societal influence increases as the child ages (21). Failure to adequately educate and support mothers at an early stage can lead to subsequent dental problems in children (22). It is also believed that good oral habits introduced to the child during the primary stage of socialization are likely to stay with it into later life (23).

Nevertheless, there are only a few reports of prevention-oriented programmes targeting first-time mothers who have no previous experience with rearing of a child. In their studies to reduce the salivary *Streptococcus mutans* count Köhler et al. (24–26) repeatedly targeted first time mothers and

their first-born children to assess the effect of interventions with positive results. It has recently been reported that first-time mothers are more receptive to health promotion interventions than mothers in general (27).

While we were aware that information about the prevention of S-ECC is only a part of raising an orally healthy child, the nonintrusive method of providing the information gave us an efficient method of accessing and retaining the involvement of test group mothers. Indeed, retention of participants in the study was relatively high at 71%, considering first-time mothers have a high mobility, often changing residence to accommodate their new family circumstances. Retention in the study was higher in the test than in the control group. This may in part be caused by the increased contact with the test group compared with the control group. However, there was also a difference in the social strata of women remaining in the study between the test and control groups. The retention rate in the test group was higher among women with the lowest levels of education, while the reverse was the case in the control group. This may well be a reflection of the mothers' varying motivation to participate in the study. Mothers with the lowest formal education level may see participation in the test group as an opportunity to extend their knowledge about the prevention of ECC and thus improve their parenting skills. Mothers with the highest education may feel less need for this support. In contrast, mothers with lower educational attainment in the control group may not identify with the value of the research and be unwilling to continue to participate. The same pattern was seen when retention was correlated to family income.

The method of delivering much of the information to mothers' home address via the mail presented several advantages: it gave each mother the opportunity to examine the information in private and at a time suitable to her. Other family members had the opportunity to inspect the information, if the mother shared the information with them, which could be an important unifying factor in the child's dental care. If the mother kept the information, she could retrieve it if the need arose.

Several other programmes of ECC prevention have been reported in the literature. They have concentrated on the suppression of growth and transmission of bacteria (M. Strepotococci, Lactobacilli) from mother to child and/or on behavioural changes through health promotion and motivational interviewing, including use of fluoride (26, 28–37).

The results of this study are not directly comparable with others in literature. An intervention which shares some similarities is that of motivation interviewing (MI), which has been pursued for the prevention of ECC among the parents of young children at high risk of developing caries. Weinstein et al. (36, 37) have reported on the 1- and 2-year results of MI with telephone calls and reinforcement of behavioural change. Mothers were recruited when the children were 6–18 months old and followed for 2 years. At an average age of just over 3.5 years children were examined and the dfs was calculated. The MI approach was associated with significant less caries. However, some of that outcome may have been as a result of greater compliance with recommended fluoride varnish treatment.

Other studies have also reported success in terms of a decreased prevalence of ECC (26, 28–37), however, they all required additional staff to conduct the interventions and in many cases regular preventive dental visits of mothers/children. In the present study, personal contact with participants was limited to the enrolment and dental examination of the children as an outcome assessment. Only test group A had a further telephone contact and this consultation did not improve the study outcomes (Table 2). In fact, many considered the phone call more disruptive than helpful, even when they were asked to indicate the most suitable time slot to conduct the consultation. The most costly and time-consuming part of the intervention therefore appeared to be ineffective.

During the planning of the study little attention was paid to the possibility of contamination through other sources of information. The potential for crossover of information from the mothers in the test group to those in the control group was minimal, because of the geographical distances among the residences of mothers. Residences were distributed over 151 postcodes across Adelaide and its suburbs. In addition, any contamination from other information sources does not mitigate our results, as it would not have differentially favoured either the test or control group.

Representativeness of the sample has been assessed against all nulliparous women (n = 3413) who gave birth to a singleton in the hospitals where recruitment occurred in 2002. The 649 mothers enroled in the study represent nearly one in five of all nulliparous women who gave birth to a

singleton in that year in the hospitals involved. There were minimal differences in the mean and variance between the age of all nulliparous women giving birth in the teaching hospitals (25.8 ± 5.8) and mothers enroled in the study (25.4 ± 5.4) with mothers in the trial being only slightly younger.

The antenatal clinics of public hospitals seem to be an appropriate site for the enrolment of expectant mothers into oral health promotion programmes as younger and financially less secure women, whose access to dental care is limited by these circumstances, preferentially use the services of these hospitals. Involving them in the programme during their pregnancy, and providing them with information about their own oral changes during pregnancy and relevant dental care can establish the stimulus and motivation for the maintenance of both their own and their child's oral health. Further, their knowledge about their role in the study as well as their understanding that their participation in the study could create knew knowledge (as was emphasized during enrolment) increased their interest in the study. The direct contact with the researcher during the enrolment gave a face to the researchers and the affiliation with a university, may have increased the trust of participants towards study.

There are several limitations of the present study that caution its ready application in oral health promotion. First, examinations were conducted when the children were only 20-month old. At this age the disease process is at early stage and noncavitated lesions were included in case definition. It is not known how many children or lesions at the noncavitated stage will progress to cavitation and breakdown of crowns of affected teeth. Secondly, no test–retest reliability information was collected. While we accepted that retest created an unwelcome burden for mothers, it left open the possibility of lack of reliability in the dental observations. Thirdly, all mothers were recruited and the intervention administered by the same author as who conducted the dental examinations. Any recall of group assignment of individual mothers could have biased the dental observations. These concerns call for replication of the study with increased emphasis on blinding and reliability.

Despite the success of the intervention at 20 months of age, it is uncertain whether the effect will remain in the longer term, if no further contact is maintained with participating mothers. Based on the underlying principles and rationale of this study, anticipatory guidance could be provided to a wider age range and more children. The timing of the intervention was an important aspect, as guidance provided around the time when it is needed increases interest and adherence. The nulliparous women targeted by the study may have been more 'susceptible' to the information because of their inexperience in child rearing.

In emphasizing the oral health-promoting information, the value of social support received through their participation in the programme and through the interest of the researchers should not be overlooked. Social bonds and supportive interactions have been widely recognized as important factors for psychological well-being and general health, and may be seen as an effective buffer or mediator of life stress (38). The stress alleviating effect of social support was found especially among low-income pregnant women who received lay visitors (39). Therefore, part of the outcome of this research may reflect the interest and support shown by the researchers.

There is limited literature addressing the association between social support and oral health and it is limited to its impact on older people (40) and adolescents (41), where social support is seen as an important factor influencing dental treatment. However, there is no existing literature addressing the association between social support and oral health in pregnancy. While different forms of social support are recognized (e.g. physical, emotional), in the case of this study it was mainly informational social support that was provided to the participants in the form of assistance relating to the maintenance of the child's oral health. During the examination many mothers expressed the need to continue with this form of support. They acknowledged that they were not previously aware of many practices described in the information material, and that the information received helped them to make informed decisions.

The retention of mothers in the test group with lower education and lower income demonstrated that despite their social disadvantage they are willing to participate in activities that could improve the oral health of their children, if such an opportunity arises. The success of long-term oral health promoting programmes thus depends on the ability to establish relationships with mothers and their engagement in a health promoting process. Mothers must be aware that they and their children will benefit from participation in the programme. Ideally the programme should include other family members, especially grandmothers,

who could offer valuable social support to a young family. Information regarding lifestyle related to caries prevention held by grandparents could often be outdated. Differences in opinions among family members about what is good for a child may create tension among family members, which could be prevented by the inclusion of a wider set of family members. If this intervention is expanded, the main beneficiaries will be people from rural and remote areas, where not only geographical distances but especially shortage of health professionals limit their access to routine dental care, and especially preventive dental care.

Conclusions

Early childhood is considered to be the most important stage in the life of an individual, with profound impact on future development. An oral health promotion programme provided in the form of anticipatory guidance in three rounds (during pregnancy, 6 and 12 months of age) significantly reduced the incidence of S-ECC.

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