

Effect of Caries Preventive Measures Directed to Expectant Mothers on Caries Experience in their Children

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The aim of this prospective study was to determine the effectiveness of caries preventive measures started during pregnancy on the caries experience of first-time mothers and their infants. Eighty-one pregnant women with low social background were selected on the basis of the presence of active carious lesions and were randomly divided into control (38) and experimental (43) groups. The initial dental status (DMFS and white spot lesions) was established through clinical examination. The prophylactic measures were repeated during pregnancy and 6 and 12 months after delivery. Both groups received primary care intervention. They were instructed in relation to the etiologic factors of dental caries and received oral hygiene kits. Oral hygiene instructions were reinforced through interactive brushing. The experimental group also received antimicrobial treatment (topical application of NaF and iodine solution immediately after prophylaxis and 3 and 5 days later) and restorative care using glass ionomer cement. By the time the children were 2 years of age, 33.3% of the infants in the control group and 14.7% in the experimental group had caries activity. A significant difference in caries prevalence was observed between children with and without visible dental plaque. The mean number of tooth surfaces with carious lesions (including areas of demineralization) was higher among the children in the control group compared to the experimental group (6.3 x 3.2), however, with no statistical significance. Maternal caries increase was a significant factor influencing the caries experience of the children. These data support the evidence of an association between caries prevalence in young children and clinical (dental plaque) and maternal factors.

Key Words: caries prevention, dental caries, mothers, pregnant women, transmission.

INTRODUCTION

For more than three decades, it has been recognized that dental caries is an infectious and transmissible disease that is strongly modified by diet (1). Early childhood may be the most important time for future dental health. During this period, the primary teeth erupt, bacteria colonize on the teeth and dental health behavior begins to form (2). In many infants, a combination of recent immature enamel in an environment of cariogenic flora with frequent ingestion of fermentable carbohydrates would render teeth particularly suscep-

tible to caries (1).

A group of bacteria collectively known as the *mutans streptococci* (MS) has been implicated as the principal bacterial component responsible for dental caries in humans. The major source from which infants acquire MS is their mothers (3). Children whose teeth are colonized earlier by MS show higher caries experience than those colonized later or not at all (1,4,5).

Successful infant colonization of maternally transmitted MS cells is, to a large extent, dependent on the magnitude of the inoculum. Mothers with dense levels of MS infection are usually in need of extensive

and costly dental treatment (6). Nevertheless, in underprivileged communities, little attention is placed on exploring the main source of infection (1). The majority of pregnant women get no instructions during pregnancy regarding oral health, even though this is a phase of increased acceptance of instructions that should be used as an opportunity to introduce preventive programs (7).

Low-income mothers have difficulty finding dental care for themselves and their children. Pregnant patients frequently experience some form of dental trouble and only a minimal percentage of them are receiving dental treatment. Prenatal education becomes the key to the dental care of the infant because mothers should serve as models for their children (8) and interventions with children are much more likely to be successful in an environment where the mother is already a successful patient (1).

In the United States of America and in several European countries, various methods to reduce maternal salivary MS counts have delayed the acquisition of this microorganism by infants (4,5,7,9-12). Therefore, the aim of this prospective study was to determine the effectiveness of caries preventive measures starting during pregnancy on the caries experience of low-income Brazilian first-time mothers and their infants, because the impact of each factor may differ in each population due to cultural, social and economic differences.

MATERIAL AND METHODS

Study design: This prospective study had a total duration of 30 months, beginning during pregnancy with the establishment of preventive measures, which were maintained until the infants were 24 months old.

Study subjects: After the study design was approved by the Ethics Committee of the Bauru Dental School and by the Municipal Health Department, 100 pregnant women were pre-selected in nine Basic Health Units from the suburbs of Bauru, according to the following criteria: all of them should be in the second or third semester of their first pregnancy, without any medical recommendations that could make dental treatment inadvisable, and presenting three or more active carious lesions (cavities) in smooth dental surfaces (proximal, buccal or lingual).

The goals and planning of the Program were explained in detail to the patients who met the inclusion criteria. The patient signed an informed consent form.

Consent was obtained from the child's caretaker for patients who were less than 18 years old. Socioeconomic characterization of the patients was accomplished through the criteria established by the Associação Brasileira de Anunciantes (ABA) (13).

Baseline data assessment: Baseline data on the oral health conditions of the patients were obtained using dental indexes. The dental examinations were carried out as follows: 1) Salivary flow-rate (SF) and salivary buffer capacity (SBC). These were performed by means of collection of stimulated saliva, according to the instructions provided by the manufacturer of the Flux-dent system (All-Dent, Dois Corregos, São Paulo, Brazil). 2) Evaluation of the periodontal condition using the Community Periodontal Index of Treatment Needs (CPITN). 3) Clinical evaluation of dental plaque accumulation by the Patient's Hygiene Performance Index (PHP). 4) Evaluation of dental status. The clinical examination was carried out with a dental probe and dental mirror in a dental office, without any radiographic examination, through recording of the Decayed, Missing and Filled Surfaces (DMFS) Index. Additionally, the initial carious lesions were counted (including demineralization areas or white spot lesions - WSL). Professional prophylaxis was performed before clinical evaluation of the dental status. The examinations were carried out by two previously calibrated examiners.

Treatment protocol: Approximately 430 patients were examined until the 100 pregnant women meeting the inclusion criteria could be selected. The initial number of patients was based on the consulted references and represented about 5% of the pregnant patients/year attending public health centers in the city of Bauru. These subjects were randomly divided into two groups, experimental and control, and were asked to return in order to effectively initiate the Program. Eighty-one patients returned, 43 from the experimental group and 38 from the control group. These patients were submitted to the study model, as follows.

Preventive measures directed to expectant mothers: Both groups received an educational/preventive approach: the patients received an oral hygiene kit containing one toothbrush, 125 m of dental floss and two 90-g tubes of dentifrice for each semester, besides printed educational material (handout). The patients were made aware of the caries activity status of their own mouths and were instructed in relation to the

etiologic factors of dental caries and preventive measures. The role played by diet on the carious process and the risk of microorganism transmission from mother to infant were emphasized. Oral hygiene instructions were reinforced through an "interactive brushing" individually accomplished by the dentist after plaque disclosure. A "dietary questionnaire" was also provided in order to highlight sucrose intake by the patient.

In the control group, cavities in posterior teeth were filled with the zinc oxide-eugenol cement IRM (Dentsply Ltd., Petropolis, RJ, Brazil), whereas the anterior teeth were restored with the composite Fill Magic (Vigodent, Rio de Janeiro, RJ, Brazil). The first intention was to restore all cavities with zinc oxide-eugenol cement, which is the intermediate restorative material used by public health services in Bauru. However, because of immediate failure of this material in a number of class III, IV and V preparations and its unpleasant appearance that led to rejection by the patients, the composite was used.

In the experimental group, primary care intervention and topical application of antimicrobial agents were performed. The primary care intervention comprised elimination of infection sites through tooth extraction, endodontic dressings, root scaling and sealing of cavities with glass ionomer cement Fuji IX (GC Dental Co., Japan). The topical application of NaF and iodine solution was carried out in 3 sessions: the first immediately after prophylaxis, and the second and third applications after 3 and 5 days, respectively, without prophylaxis, after dental care of the patient, as suggested by Caufield and Gibbons (14). The composition of this solution was 1.0 g KI, 1.2 g NaF, 53.0 ml glycerin, H₂O to complete 100 ml, solution adjusted to pH 4.5 using 85% H₃PO₄ according to the recommendations of Dasanayake et al. (10).

The removal of carious tissue was carried out in quadrants with manual (excavators) and mechanical (low-speed) instruments. The removal of carious tissue was complete whenever possible. All operative procedures were performed by a single dentist (R.L.Z.) in a mobile dental office, during pregnancy and 15 to 60 days after delivery.

Reevaluations - 6 months after delivery: In both groups, the educational/preventive approach was completed with special emphasis on the infant's oral health; the mothers were instructed to clean the anterior teeth

and alveolar ridges with a gauze (or diaper) moistened with filtered water. A practical demonstration was provided by the dentist on the baby. The infants were also submitted to clinical examination, and the maternal PHP, CPITN and salivary indexes were reevaluated. The antimicrobial solution and topical fluoride were reapplied in the experimental group mothers.

Reevaluation - 12 months after delivery: An infant toothbrush was provided, and oral hygiene with the toothbrush and a minimal amount of toothpaste was initiated in all infants. The infants were examined clinically, in an attempt to record the presence of visible dental plaque on the buccal surface of the maxillary incisors, as suggested by Alaluusua and Malmivirta (2), as well as the presence of dental surfaces with incipient caries lesions, or cavities (decayed surfaces - DS).

Treatment directed to the mothers was also continued, with the evaluation of caries increment (cavities and demineralization areas) and the clinical behavior of the restorative materials employed for primary care intervention in both groups. The mothers in the experimental group were submitted to prophylaxis, fluoride therapy and decontamination with iodine solution, as previously described. In this group, all new cavities were excavated and sealed and defective restorations were repaired. For the control group, only emergency procedures were carried out.

Reevaluation - 24 months after delivery: At this stage, the children were between 24 and 28 months old. Clinical examination (not blind) was carried out in the infants for the presence of visible plaque and initial and established carious lesions (DS). Approach to mothers: evaluation of the maternal caries increment (DMFS and count of initial lesions), evaluation of the clinical behavior of the restorative materials, reevaluation of the PHP, CPITN, SF and SBC indexes, repair and replacement of unsatisfactory restorations in both groups.

The experimental and control groups were compared in relation to initial dental status at baseline (*t* test). The mothers' caries increment between control and experimental groups and between mothers of caries-active and caries-free children were compared using the *t* test. The data of the complementary parameters (PHP, CPITN, SBC) during the study was evaluated using the Mann-Whitney and Friedman's tests. The prevalence of caries-active children between the groups was evaluated (chi-squared test) as well as the manner in which the children were affected by the disease

(Student's *t* test). $P < 0.05$ was considered significant.

RESULTS

Part of the sample was lost to follow-up and only 64 patients completed the study, with 34 in the experimental group and 30 in the control group. Only these patients were included in the statistical analysis. Analysis of the variables was initially performed through comparison of the experimental and control groups, in an attempt to highlight the baseline conditions, as well as the behavior of the analyzed parameters in relation to the different approaches employed.

The caries experience of the patients is shown in Table 1. The mean number of decayed surfaces (DS) among the expectant mothers was 14, becoming even more expressive if the initial lesions are taken into account, reaching a mean value of 19.9 surfaces affected by caries. The conversion of the DMFS index in DMFT index (number of decayed, missing and filled teeth) yielded a mean value close to 14. The mean number of decayed teeth was 9.

Experimental and control groups presented a similar behavior regarding caries increment (Table 2). Nevertheless, the data were always higher for the con-

trol group, in which the presence of 85 new cavities was observed (46 in smooth surfaces) compared to 73 new lesions diagnosed in the experimental group (32 in smooth surfaces), despite the fact that the latter comprised a larger number of patients.

At the 24-month evaluation, the prevalence of caries-active children was higher in the control group than in the experimental group (33.3% vs 14.7%, respectively), although not statistically significant ($p < 0.08$, Table 3).

All variables were also evaluated comparing the group of mothers of caries-free infants ($n = 49$) with the group of mothers with caries-active infants ($n = 15$), regardless of the group to which they belonged, in order to identify a possible correlation between caries activity of mother-child couples. The maternal caries activity, evaluated by means of the advent of new lesions in the maternal dentition during the preventive approach, demonstrated a strong association with the caries experience of the infants (Table 4). The group of mothers whose children presented caries activity demonstrated an increment in both initial and established lesions, which was significantly higher than the group of mothers of caries-free infants (9.4 and 4.5, respectively). The difference observed between the groups was mainly due to the incre-

Table 1. DMFS index and number of surfaces with cavities (DS) and white spot lesions of the experimental and control groups.

	DMFS	Surfaces with cavities	White spot lesions
Experimental	36.2 ± 23.2	14.3 ± 9.2	4.9 ± 4.4
Control	27.0 ± 12.3	13.6 ± 4.7	7.0 ± 5.1
Mean	31.9	14.0	5.9

Data are reported as mean ± SD. Baseline values, $n = 64$.

Table 2. Comparison between caries increment (cavities and white spot lesions) of the experimental and control groups (mothers) at 24 months.

	Experimental	Control	<i>t</i>	<i>p</i>
Cavities	2.2 ± 2.5	2.8 ± 2.1	-1.190	n.s.
White spot lesions	3.0 ± 3.3	3.4 ± 4.3	-0.422	n.s.
Total	5.2 ± 4.5	6.2 ± 5.7	-0.848	n.s.

Data are reported as mean ± SD. n.s. = not statistically significant ($p > 0.05$, *t*-test).

Table 3. Prevalence of caries-active infants in the experimental and control groups at 24 months.

	Experimental	Control	Total	χ^2	<i>p</i>
Caries-free infant	29 (85.3%)	20 (66.7%)	49		
Caries-active infant	5 (14.7%)	10 (33.3%)	15	3.082	0.08
Total	34	30	64		

Statistically significant if $p < 0.05$ (chi-squared test).

Table 4. Comparison between maternal caries increment (cavity and white spot lesions) of the group of mothers of caries-free infants and the group of mothers of caries-active infants.

	Mothers of caries-free infants (N = 49)	Mothers of caries-active infants (N = 15)	<i>t</i>	<i>p</i>
Cavities	2.1 ± 2.2	3.7 ± 2.4	-2.379	0.020*
White spot lesions	2.4 ± 3.1	5.7 ± 4.6	-3.119	0.002*
Total	4.5 ± 4.0	9.4 ± 6.5	-3.457	0.0009*

Data are reported as mean ± SD. *Significant if $p < 0.05$ (*t*-test).

ment that took place during the first year of this study.

The oral health quality in the group of mothers of caries-active infants was statistically worse than that of the group of mothers of caries-free infants. This could be demonstrated through the PHP index (Mann-Whitney test). Among the infants, the plaque accumulation further presented a significant correlation with caries activity (Table 5).

DISCUSSION

The dental needs of expectant mothers are often considered to be a minor problem by the prenatal staff. This fact is related to the socioeconomic status, being even more concerning among low-income populations with a low level of instruction (1,15). The analyzed group comprised young women (mean age 19.1 ± 3.7 years), mostly teenagers (75% between 14 and 20 years), of low socioeconomic background (66% low socioeconomic status) with a poor level of instruction (70% had not completed elementary school).

Soderling et al. (5) reported a mean DMFT of 18 among expectant mothers in Finland, but the authors did not mention the decayed component or the incipient lesions. In the study conducted by Wright et al. (16), the patients presented a mean DMFS of 34, corresponding to a DMFT of 16 (this study included radiographic examination), with a mean of 16.4 surfaces requiring restorative treatment. These values are similar to those observed in the present study: DMFS 32; DMFT 14; mean number of decayed teeth 9; mean number of decayed surfaces 14.

Brambilla et al. (9) reported a mean DMFT of 12.5, the mean number of decayed teeth was much lower than that found in the current study: 1.4 vs 9. Günay et al. (7) observed a DMFT of 14.5 with a

corresponding DMFS of 46.4, yet only 8 out of the 54 analyzed patients presented active carious lesions.

Thus, it can be noted that the caries activity in the present sample was similar or even higher than that observed in other studies carried out in expectant mothers with high counts of MS.

Regarding the complementary indexes (PHP, CPITN and SBC), both groups presented homogeneous baseline values, which remained unchanged, without any statistical difference in any evaluation (Mann-Whitney test).

When the study was begun, 95.4% of the pregnant women required some type of periodontal treatment. Strictly preventive procedures met the treatment needs of 21.9% of the patients, whereas 64.1% also needed root scaling and 9.4% were in need of a more complex treatment. These data are comparable to previous reports of Brazilian patients (17,18).

The variables PHP and CPITN presented a remarkable reduction at the 6-month evaluation, which was probably due to procedures such as prophylaxis, root scaling and oral hygiene instructions, but these returned to baseline values at the 24-month evaluation (Friedman's test). The salivary buffer capacity was different in each evaluation, presenting increasing values in both groups.

In the present study, the approach between groups was different in terms of the use of antimicrobial agents (fluoride and iodine with previous prophylaxis) and the material used for primary care intervention. The clinical behavior of the glass ionomer cement was significantly better than that of the IRM zinc oxide-eugenol cement (in posterior restorations) and comparable to the outcomes of the Fill Magic composite (in anterior fillings). After 24 months, 90.6% of the glass ionomer cement fillings and 93.6% of the composite fillings were regarded as clinically satisfactory, whereas at the 12-month evaluation approximately 74% of the class I restorations and 85% of the class II restorations carried out with the IRM cement were unsatisfactory.

The oral condition of the control group regarding primary care intervention was much less favorable compared to the experimental group (formation of niches for bacterial colonization reducing the efficacy of the oral health procedures and motivation of the patients). In the experimental group, the small number of failures of the restorative material allowed repair of the fillings and excavation and sealing of new cavities. The pri-

Table 5. Correlation between the presence of visible dental plaque in the maxillary incisors (24 months) and caries activity in infants.

Infant	Absence of visible plaque	Presence of visible plaque	Total	p
Caries-free	25 (51.0%)	24 (49.0%)	49	0.008*
Caries-active	2 (13.3%)	13 (86.7%)	15	
Total	27	37	64	

*Significant if $p < 0.05$ (Fisher's test).

mary care intervention with glass ionomer cement used in the experimental group agreed with that suggested by Wright et al. (16). It is a high-intensity, fast restorative treatment employing a material that does not predispose to bacterial recolonization.

The antimicrobial protocol of this study was similar to that of Dasanayake et al. (10) and they concluded that this protocol did not influence the acquisition of MS by children. The caries prevalence of children in the experimental group was higher than that of the control group at 2 years (17% and 4%, respectively). They argue that the moment of application of the solution was early and should have been repeated during the eruption of the first molars. In the present study, the NaF/iodine solution was reapplied as suggested by Dasanayake et al. (10) and might have played a coadjutant role on the minor caries experience of the infants in the experimental group.

Regarding the caries increment in the maternal dentition, an interesting fact was observed. The third molars erupting during the study (75% of the patients aging less than 21 years) comprised 23.4% of the new cavities and 29.2% of the initial lesions diagnosed. This is a considerably high percentage that might be explained by the fact that they represent a virgin habitat prone to colonization by the predominant microbial species in the oral environment, similar to the colonization of the infants' deciduous dentition.

The prevalence of caries-active infants in the experimental group was close to that observed by Dasanayake et al. (10) in their experimental group (17%) and to the values reported for 3-year-old children in the experimental group of Köhler et al. (4) (16%). However, it disagrees with the absence of caries-active children at 2 years of age in the studies conducted by Tenovuo et al. (12) and Günay et al. (7).

Despite of the large variation on caries prevalence during early childhood between different countries or regions, the literature is homogeneous regarding the identification of polarization groups that are remarkably affected by the disease, which require early identification and establishment of an intensive preventive program (1,19).

The experimental approach proved to be useful in reducing or delaying the manifestation of caries among the infants. At the 12-month evaluation, only two infants in the control group presented demineralization areas. The manner by which the children were

affected by the disease was also more severe in the control group, yet with no statistical difference, probably due to the small number of caries-active children. In the control group, from the 10 caries-active infants, 5 presented more than 6 decayed dental surfaces. This was not observed in any child in the experimental group. From the total of 65 dental surfaces with incipient lesions, 52 were diagnosed in infants from the control group. Similarly, from the 14 dental surfaces with cavities, 11 were observed among the infants in the control group.

In this study, as well as in the studies conducted by Alaluusua and Malmivirta (2) and Mattos-Graner et al. (8), a significant association was identified between the presence of plaque on the buccal surfaces of the deciduous maxillary incisors and the caries experience (incidence). At both 12 and 24 months, a high prevalence of children with plaque accumulation could already be observed in the group becoming caries-active afterwards. We believe that this variable plays a paramount role for the identification of children at risk at early ages (1 year), especially regarding the population as a whole, which is under the care of the clinician.

It was observed that neglected oral hygiene of both mother and child (demonstrated by a higher maternal PHP and a higher plaque accumulation on the infants' incisors) was associated to a larger incidence of lesions among the mothers and to the manifestation of the disease among the infants. Further, there was a positive correlation between the carious activity of the mother-child couples.

The breastfeeding pattern and frequency of sucrose intake were similar between the caries-active and caries-free infants. At 6 months, 79.7% had already had contact with sucrose, and at 12 months daily sucrose intake was present in 100% of the sample. The introduction of a cariogenic diet at 6 months of age was observed in 86.7% of the caries-active infants and 77.6% of the caries-free infants.

In the present study, 21% of the sample was lost to follow-up during the 2-year period. Köhler et al. (11), who initiated their study with 81 patients, lost 7% of the sample to follow-up at 23 months. Brambilla et al. (9) began their study with 65 patients, similar to the number of patients remaining in the present study. Dasanayake et al. (10) concluded their study with 48 patients, approximately 77% of the initial value. Günay et al. (7) started their research with 86 expectant moth-

ers; the 6-month evaluation comprised only 60, and after 3 years there was a loss of 38% of the sample. Therefore, it can be concluded that both the initial number of patients and the loss to follow-up observed in the current study were in agreement with similar clinical studies.

The role played by the immunological system, as well as the influence of a number of external variables, could not be controlled in this study. Nevertheless, the significant findings of this study frequently agreed with the corresponding literature and should be viewed as relevant issues to be addressed for the early identification of groups with high caries risk during early childhood and also for the establishment of intensive preventive measures.

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RESUMO

O objetivo deste estudo longitudinal foi avaliar a efetividade de um programa de saúde bucal, iniciado durante a gestação, sobre a experiência de cárie de primigestas e seus filhos. Oitenta e uma gestantes, pertencentes a classes sociais pouco favorecidas, foram selecionadas com base no diagnóstico clínico de lesões de cárie ativas e foram divididas aleatoriamente em grupo controle ou experimental. A condição dentária inicial foi estabelecida através do índice CPOS e do diagnóstico das lesões de mancha branca. As medidas preventivas foram aplicadas durante a gestação e 6 e 12 meses após o parto. Ambos os grupos receberam abordagem educativa. O grupo experimental recebeu adicionalmente tratamento com anti-microbianos e adequação bucal utilizando cimento de ionômero de vidro. A prevalência de crianças cárie-ativas com a idade de dois anos foi de 33,3% no grupo controle e 14,7% no grupo experimental. Foi observada diferença significativa na prevalência de cárie entre crianças com e sem placa dentária visível. O número médio de superfícies com lesões de cárie (incluindo as desmineralizações) foi maior para as crianças do grupo controle quando comparadas às do grupo experimental (6,3 x 3,2), porém sem atingir significância estatística. O incremento de cárie na dentição da mãe apresentou correlação significativa com a incidência de cárie na dentição das crianças. Estes dados suportam a evidência de associação entre a incidência de cárie na primeira infância e a presença de placa, assim como a influência significativa de fatores maternos.

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