

# Evaluation of a public oral health educational and mouth rinse program for the prevention of caries in an area using fluoridated water

## *Avaliação do procedimento coletivo na prevenção da cárie em localidade com água fluoretada*

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### **ABSTRACT**

#### **Objective**

To evaluate the effectiveness of the collective procedures (CPs = oral health educational and preventive annual programs developed in public schools by the public health system) for preventing dental caries.

#### **Methods**

To compare the experiences of caries in adolescents aged 15 to 19 ( $n = 213$ ), in the 9th grade of public schools, whether or not they were participants in the collective procedure when children. The data was obtained in 2005 in a cross-sectional study conducted in Embu, in the metropolitan region of São Paulo, which has been conducting collective procedures since 1992 and has had its water fluoridated since 1983. Groups: A - those who had received the collective procedure in elementary school from 1st to 4th grade; B - those who had received them from 1st to 8th grade and C - those who had not received the collective procedure. Oral examinations and interviews were conducted. The experiences of caries were evaluated by DMFT, used as a dependent variable, with the definition of two outcomes:  $DMFT \geq 1$  or  $DMFT \geq 4$ . Other variables, such as socioeconomic levels, oral hygiene habits and dietary patterns were part of the bivariate analysis and multiple regression models.

#### **Results**

The DMFT of the sample was 2.49 (95% CI; 2.10-2.88). There was a difference between the means of groups B (3.1) and C (2.0) ( $p=0.027$ ). The percentage of those caries-free ( $DMFT = 0$ ) was lower in group B ( $p=0.007$ ).

#### **Conclusions**

The DMFT of the participants of the collective procedures was no lower than with those who did not participate so, in this context, collective procedures were not effective in causing a favorable impact on future generations.

**Indexing terms:** Adolescent health. Dental caries. Dental health education. Oral health.

### **RESUMO**

#### **Objetivo**

Avaliar a efetividade do procedimento coletivo em saúde bucal na prevenção da cárie dentária.

#### **Método**

Compara-se o grau da experiência de cárie em adolescentes de 15 a 19 anos ( $n=213$ ), do 1o ano do ensino médio, egressos de escolas públicas, participantes ou não dos procedimentos coletivos em saúde bucal, quando crianças. Os dados foram obtidos em 2005, em estudo transversal realizado no município de Embu, região metropolitana de São Paulo, que realiza procedimento coletivo em saúde bucal desde 1992 e cuja água é fluoretada desde 1983. A população de estudo foi dividida em três grupos: os que participaram dos procedimentos coletivos em saúde bucal da 1a à 4ª série (A), da 1a à 8ª série (B) e os que não participaram (C). Foram realizados exames bucais e entrevistas. A experiência de cárie foi avaliada pelo índice CPOD, empregado como variável dependente, definindo-se dois desfechos:  $CPOD \geq 1$ ;  $CPOD \geq 4$ . Variáveis socioeconômicas, de hábitos de higiene bucal e de padrões dietéticos compuseram modelos de análise bivariada e de regressão múltipla.

#### **Resultados**

O CPOD médio da amostra foi 2,49 (IC95%: 2,10-2,88). Houve diferença entre as médias de CPOD dos grupos B (3,1) e C (2,0) ( $p=0,027$ ). A porcentagem de livres de cárie ( $CPOD=0$ ) foi menor no grupo B ( $p=0,007$ ). Sexo feminino e alta frequência de ingestão de açúcares na adolescência estiveram associados com valores maiores de CPOD, mesmo após 8 anos de exposição aos procedimentos coletivos em saúde bucal.

#### **Conclusão**

A média CPOD dos beneficiados não foi inferior à dos não beneficiados indicando que, neste contexto, os procedimentos coletivos em saúde bucal não foram efetivos para causar impacto favorável sobre experiência de cárie.

**Termos de indexação:** Saúde do adolescente. Cárie dentária. Educação em saúde bucal. Saúde bucal.

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## INTRODUCTION

Since the collective procedure (CP) for oral health was proposed by the Ministry of Health at the end of 1991<sup>1</sup>, aimed at preventing dental caries, its effectiveness has never been evaluated.

The collective procedure comprises a set of educative and preventive actions, performed weekly in the areas of the community covered by public health care centers, particularly public elementary schools. It includes guidelines about cariogenic diet, supervised brushing (with fluoridated dentifrice), and topical application of fluoride (weekly mouth wash with a fluoridated solution or application of fluoridated gel).

In the last two decades of the 20th century and the beginning of the 21st century, the state of São Paulo has moved from a situation of high prevalence of dental caries among 12-year-olds to low, according to the classification proposed by the World Health Organization (WHO). From 1986 to 2002, there was a 62% reduction in the DMFT index<sup>2-3</sup>.

This decline has been explained by the application of methods of mass prevention, based on the fluoridation of the public water supply, by the use of fluoridated dentifrices by a large part of the population and by the increased access to collective actions for oral health into which the collective procedure was introduced<sup>4-5</sup>.

It is assumed that carrying out these procedures in the schools, along with the factors cited, would contribute to the reduction of the index of caries in children and, that this would benefit them for the rest of their lives, given the supposed preventive effectiveness of this combination of educative-preventive action.

However, when the situation with regard to this disease was evaluated in adolescents in the state of São Paulo, a significant increase was noted because, in 2002, the DMFT value rose from 2.52 among 12-year-olds to 6.43 for the group in the 15-19 age range<sup>3</sup>. These values indicate significant difficulties with the prevention of caries since, in adolescence, the degree of the disease more than doubled. This calls into question the lifelong benefit of preventive maintenance starting in childhood.

This article attempts to evaluate the preventive effectiveness of the collective procedure by analyzing the experience of dental caries among adolescents who did and did not participate in this intervention, in a municipality in the state of São Paulo.

## METHODS

The referenced population for this study comprised 4,233 adolescents from the municipality of Embu, located in the metropolitan area of São Paulo, enrolled in 2005 in the first year of high school in the 25 schools of the public school system.

In the first stage, all students were interviewed in order to determine in which schools they had received their elementary education. The municipal Secretary of Health provided a list of the schools that received the collective procedure and in which year and also indicated those which did not take advantage of the program. Lists were then created with the names of the students, based on whether or not they had studied in schools where the collective procedure was applied, and for how long.

Students who had not lived in the city since birth were excluded from the list in order to provide a control over the exposure to fluoridated water. Those who were absent on the day of the interview, or who did not remember the name of the school in which they had studied, were also excluded, in order to avoid them being included in the sampling.

Three groups were formed: Group A: students who had only participated in the collective procedure between 1st and 4th grade (1,035); Group B: students who had participated in the collective procedure between 1st and 8th grade (267); Group C: students who had not participated in the collective procedure (325).

According to the WHO<sup>6</sup>, the minimum number of individuals for an analysis of caries in groups of students is between 25 and 50, depending on prevalence and the degree of the disease. To calculate the sample, the formula proposed by Silva<sup>7</sup> was used, which considers the values of the mean and the standard deviation of the variable studied. The mean and standard deviation of caries in the state of São Paulo were used as parameters<sup>3</sup>.

$$n^* = \frac{Z^2 \times S^2}{(X \times \epsilon)^2} \times deff + TNR$$

The sample was adjusted for finite populations, per the formula:

$$n = \frac{n^*}{1+(n^*/N)}$$

Where:

n = Final size of the sample.

n\* = Size of the sample determined by the first formula.

$N$  = Size of the population of the target groups-of-interest ( $A=1,035$ ;  $B=267$ ;  $C=325$ ).

$Z$  = Significance Level of 1.96 (corresponding to 95% confidence, or  $\alpha = 0.05$ ).

$S^2$  = Variation of the sample mean, or the square of the standard deviation of the variable (4.6).

$X$  = Mean of the variable (6.43).

$\epsilon$  = Margin of Error (0.16).

deff = design effect = 1

TNR = Non-response rate (estimated percentage of loss of sample elements of 30% = 0.3)

The minimum final samples estimated for the Groups were: Group A - 91; Group B - 73 and Group C - 76 individuals. For the purposes of randomization, it was decided to select 100 individuals randomly in each group. After identifying all the children in a single record according to Group (A, B, C), the randomization proceeded according to a systematic sampling technique<sup>7</sup>.

### Collection instrument

Two identifiers were used. The first contained information to characterize, in the sample: (1) socioeconomic status; (2) oral hygiene habits; (3) cariogenic diet habits and, (4) access to dental services.

The second identifier was created from the model used in the 2003 SB Project (Survey of Oral Health Conditions in Brazil)<sup>8</sup> for the DMFT index<sup>6</sup>.

### Calibration

Five field teams, composed of dentists and dental assistants from the municipal staff, participated in the field work.

Calibration of the examiners followed the WHO recommendation<sup>6</sup> as to the definition of a gold-standard examiner, which served as the reference to gauge the calibration of all the examiners. However, during training, recommended operational procedures called a "technical agreement" were adopted, in order to improve the degree of standardization and reduce the possibility of bias in the observations.

The Kappa coefficients for the crown condition were 0.91 inter-examiners, and 0.93 intra-examiners.

### Data entry and analysis

Data were entered using the Epi Info program, version 6.04<sup>9</sup>. There were no inconsistent or incomplete identifiers, and some typing errors were corrected at the conclusion of this stage.

Referential analysis and frequency distribution of the variables and of the DMFT were carried out using Epi Info. Bivariate and multivariate analyses were performed using the SPSS program.

The variables were assigned to the following categories: gender (female/male), skin color (white/yellow or black/brown), education of the father and mother (illiterate/elementary school or high school/college), mother's occupation (if she stayed at home or not), household density (if there were less than or equal to 4, or 5 or more people in the home), access to a dentist, change of toothbrush, brushing time, exposure to other methods of fluoridation, daily consumption of a cariogenic diet during childhood and adolescence, timing of this consumption (during or between meals), experience of caries (DMFT=0 or DMFT $\geq$ 1) and experience of many caries (CPOD<4 or CPOD $\geq$ 4).

In the first stage of analysis, 3 conflicting situations were considered: Situation 1: exposure to 8 years of the collective procedures, in which the members of Group B were compared to the other groups; Situation 2: Exposure to at least 4 years of the collective procedure, in which the members of groups A and B were compared to Group C; and, Situation 3: maximum exposure versus no exposure, in which Group B was compared with Group C.

This stage proceeded to the bivariate analysis, at a significance level of 5%, in order to assess the socioeconomic and habitual variables as a function of the length of exposure to the collective procedure (8 years, 4 years or no exposure) and the outcome of dental caries, in two distinct situations: those having experienced caries (DMFT $\geq$ 1), and those having experienced multiple caries (DMFT $\geq$ 4).

In the second stage, simple linear regression analysis was performed. The socioeconomic and habitual variables which, in the bivariate analysis, showed p values less than 0.25 were included in the multivariate model. Also included were others that could contribute to an outcome of dental caries.

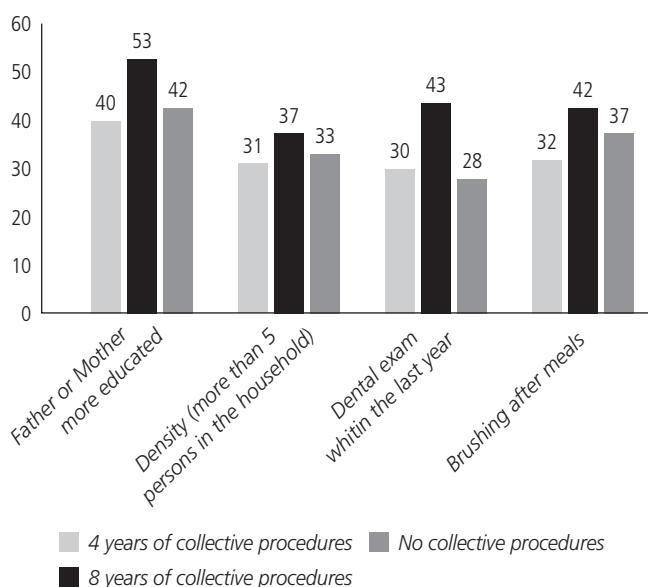
The standards for research on human beings, established by Resolution 196/96 of the National Health Council, were followed. This began with the collection of data, following approval of the project by the Ethics Research Committee of the College of Public Health of the University of São Paulo (Of. COEP 204/04).

## RESULTS

The final sample was composed of 213 youngsters, from 15 to 19 years of age, distributed into three groups (A=72, B=74 and C=67). With regard to the randomized sample (n=300), the non-response rate was 29%. However, when considering the minimum sample (nGA=91, nGB=73 and nGC=76; N=4,233), the non-response rate corresponded to 11.2%. The most frequent reasons were: absence of students on the days of the exam, leaving school during data collection and lack of parental consent.

The socio-economic, eating habits and hygiene practices variables showed no difference between all the groups of adolescents. However, it is worth highlighting the fact that the majority (58%) of those who participated for 8 years in the collective procedure had had access to dental examinations for less than one year at the time of data collection. Although this percentage had been less in the other groups (41% for both), this difference was not significant ( $p=0.074$ ) (Figure 1). Fathers or mothers with higher levels of education (protection factor for caries), and more than five individuals in the household (risk factor for caries), also presented no significant differences between the three groups ( $p=0.130$  and  $p=0.657$ , respectively).

Of all the participants, only 9 youngsters stated that they had never had access to dental exams and 4



**Figure 1.** Number of adolescents (15-19 years old), according to parents' education, number of persons in the household, access to dental exam in the last year, habit of brushing after meals, and participation in the collective procedures in oral health. Embu (SP), 2005.

of them belonged to the group that participated in the collective procedure for 8 years. Keeping in mind that 34% of the sample had no experience of caries (Table 1), it is possible that these adolescents had never had a need for dental treatment, which is the reason they never sought assistance.

A lower percentage of caries-free (20%) was observed in group B, which was just those who participated in the collective procedure for 8 years ( $p=0.007$ ).

Paradoxically, it was observed that those who participated for a longer period of time in the collective procedure had higher values for the DMFT index (Table 1). Those who did not participate in the collective procedure, or who participated for less than four years, corresponded to mean values significantly less for the DMFT index as compared to the mean value obtained for those who participated for up to eight years. Among those who did not participate, or who participated for less than four years, there was no statistical difference among the values for the DMFT index (0.027).

The experience of multiple caries ( $DMFT \geq 4$ ) was also greater ( $p=0.027$ ) among the adolescents of Group B who participated in the collective procedure for up to eight years.

The experience of caries, according to the bivariate analysis, was associated with the female gender and with cariogenic diet. Females were 5 times more likely to have experienced caries (OR 5.1; IC 95%: 1.32-19.75;  $p=0.018$ ), and consumption of a cariogenic diet between meals during adolescence revealed that it was three times more likely to be associated with this outcome (OR 3.8; IC 95%: 1.09-13.04;  $p=0.036$ ), even after 8 years of exposure to the collective procedure.

Among those who participated in the collective procedure for 4 years, females (OR 2.5; IC 95%: 1.23-5.25;  $p=0.012$ ) and the daily consumption of a cariogenic diet during childhood (OR 2.6; IC 95%: 1.22-5.62;  $p=0.014$ ) were twice as likely to have experience of caries.

As for the high prevalence of caries ( $CPOD \geq 4$ ) after 8 or 4 years of exposure to the collective procedure, there was no association with any variable in the bivariate analysis. However, the daily consumption of a cariogenic diet during childhood had a three times greater chance of being associated with multiple caries among those individuals who did not participate in the collective procedure (OR 3.3; IC 95%: 1.11-10.00;  $p=0.032$ ).

Following the multivariate analysis of the outcome of experiences of caries, there was an increase in the strength of association among the females (OR from 5.1 to 7.7) and the daily consumption of a cariogenic diet

**Table 1.** Mean DMFT (IC 95%) and components, percentage of adolescents (15 -19 years old) with DMFT=0 and DMFT≥4, according to group of exposure to the collective procedures. Embu (SP), 2005.

Condition	Exposure group											
	A (n=72) CP 1 <sup>st</sup> – 4 <sup>th</sup> grade			B (n=74) CP 1 <sup>st</sup> – 8 <sup>th</sup> grade			C (n=67) No CP			All (n=213)		
	n	Mean	%	n	Mean	%	n	Mean	%	n	Mean	%
C (*p=0.006)	37	0.51	22	40	0.54	18	55	0.82*	41	132	0.62	25
P	3	0.04	2	12	0.16	5	3	0.04	2	18	0.08	3
O (p=0.012)	127	1.76	76	176	2.38*	77	77	1.15	57	380	1.78	72
DMFT (*p=0.027)	167	2.32 (1.76-2.88)	100	228	3.08* (2.51-3.65)	100	135	2.01* (1.51-2.51)	100	530	2.49 (2.10-2.88)	100
DMFT=0 (*p=0.007)	43.1 (32.0-54.7)			20.3* (12.3-30.6)			40.3 (29.5-52.4)			34.3 (28.1-40.8)		
DMFT≥4 (*p=0.070)	26.4* (17.2-37.4)			40.5* (29.8-52.0)			28.3 (18.5-40.0)			31.9 (25.9-38.4)		

\* significant difference. CP - collective procedures.

**Table 2.** Factors associated with the experience of caries (DMFT≥1) and of multiple caries (DMFT≥4) in adolescents (15-19 years old), according to length of participation in the collective procedures. Embu (SP), 2005.

Experience of caries	Duration of collective procedures					
	4 years (Gr. A)		8 years (Gr. B)		No CP (Gr. C)	
	OR (IC 95%)	p	OR (IC 95%)	p	OR (IC 95%)	p
DMFT≥1						
Female	2.5 (1.19-5.45)	0.016*	7.7 (1.77-33.82)	0.007*	0.33 (0.11-0.99)	0.050
Cariogenic diet during adolescence	-	-	-	-	3.50 (1.02-12.05)	0.047*
Cariogenic diet between meals during adolescence	1.84 (0.86-3.94)	0.114	8.2 (1.88-35.67)	0.005*	0.53 (0.17-1.63)	0.268
DMFT≥4						
Female	1.5 (0.75-3.12)	0.240	4.9 (1.56-15.47)	0.007*	0.3 (0.88-0.96)	0.043
Cariogenic diet between meals during adolescence	1.58 (0.77-3.23)	0.206	3.48 (1.12-10.80)	0.030*	-	-

\* significant difference. CP - collective procedures.

between meals during adolescence (OR from 3.8 to 8.2), after 8 years of exposure to the collective procedure.

After 4 years of exposure to the collective procedure, the females continued to have the same chance of association with experience of caries. For those who did not participate in the collective procedure, the consumption of a cariogenic diet during adolescence was associated with the experience of caries, following multivariate analysis (Table 2).

Association with multiple caries (DMFT≥4), after 8 years of exposure to the collective procedure, was observed for females and the consumption of a cariogenic diet between meals during adolescence (OR 4.9; IC 95%: 1.56-15.47; p=0.007 and OR 3.48; IC 95%: 1.12-10.80; p=0.030, respectively). The daily consumption of a cariogenic diet during childhood, for those who did not participate in the collective procedure and had experienced multiple caries, showed no significance.

## DISCUSSION

The effectiveness of the collective procedure could be better determined if data were available, in respect of caries in adolescence in the region, prior to the introduction of these procedures. Some potential limitations of this study should be taken into account due to the lack of information hampering data analysis. Thus, the impact of this public health intervention can only be inferred from the epidemiological findings of a cross-sectional study, using official documents and the memories of the subjects to verify the exposure.

During the interviews, the young people confirmed the official information, obtained from both local health and educational institutions, about their participation or lack of participation in the collective procedure. It was not possible, however, to confirm precisely the frequency of participation.

Nevertheless, it should be noted that, while the DMFT for the 15-19 age range in the state of São Paulo was 6.43 in 2002<sup>3</sup>, this index registered 2.49 in the municipality of Embu in 2005. This is substantially lower. It is assumed that the implementation of public oral health policies, continuously performed in the municipality since the 1980s, may have contributed to this result.

Similarly, this points to the percentage of caries-free adolescents (34%), in comparison with the situation in the state of São Paulo (10%), in 2002<sup>3</sup>. Access to dental care may have had an influence on the very low percentage of caries-free individuals among the participants in the collective procedure. Instead of incorporating healthier habits for the maintenance of oral health, concepts covered in the educational activities of the collective procedure, these youngsters may have been less concerned with these precautions to the extent that dental treatment was already available to them.

It is worth considering, however, the possibility that higher DMFT values for adolescents who participated in the collective procedure for a longer period of time, resulted from over-treatment, a condition considered to be a global reality<sup>10</sup>. In the 1980s, in a study conducted by the WHO, New Zealand demonstrated the best coverage in terms of the restorative needs of students, but the highest percentage of toothless adults and the highest indices of partial and total prosthetics<sup>11</sup>. The curative needs are not solved, and they are not sufficient to eliminate the disease<sup>12</sup>.

Indeed, the component (77%) for dental fillings was greater among youngsters from the group that participated in the collective procedure for up to eight years ( $p=0.012$ ). For all the groups as a whole, this percentage was 72%. These values contrast with those obtained in 2002 for Brazil (43%), and even for the southeastern region (62%)<sup>8</sup>. They show that the adolescents in Embu who participated in the collective procedure, had access to dental treatment, in a way that was substantially different from that of adolescents from the southeastern region and the rest of Brazil. The statistical similarity ( $p=0.379$ ) of the component for fillings (57%) among adolescents who did not participate in the collective procedure (and, by deduction, did not benefit from public dental assistance in the municipality) to the percentage of the component for fillings (62%) for the southeastern region of Brazil, is consistent with this deduction.

In an ecological study performed in the state of Rio Grande do Sul, there was no link between access to dental services and the DMFT index. However, although the authors conclude that the services contributed to the

reduction in the number of untreated caries, there were also more restored or extracted teeth<sup>12</sup>.

Although the most plausible hypothesis was that the highest prevalence of caries was related to non-participation in the collective procedure, it is possible that the number of dropouts has also contributed, to some degree, to this hypothesis, but this was not corroborated in this study. In this case, the possibility may be suggested that, among children who did not participate in the collective procedure, those that remained in school through high school and were, therefore, subjects of this study, are precisely those for whom other determinants of the health-disease process acted as protective factors against caries.

Among the factors related to the prevalence of caries, only the female gender and the consumption of a cariogenic diet persisted in the multivariate analysis as being factors associated with greater chances of presenting both a smaller number and a higher number of caries, regardless of participation and the duration of participation in the collective procedure. Other risk or protection variables did not appear to be significant (Table 2).

It is worth noting that, in a study performed in Londrina (PR), in which only the activity of fluoridated mouth rinsing, one component of the collective procedure, was analyzed, there was no association between the lower prevalence of caries and participation in these activities<sup>13</sup>. The prevalence of caries was associated with the type of school and consumption of candy between meals.

Universal access up to the age of 14, associated with a program of fluoridated mouth washing, in Norwegian schools, was able to reduce the prevalence of caries. But, the DMFT index and the increase in caries from 12 to 18 years of age was associated with migration, the region of the country and the number of children attended to per dentist<sup>14</sup>.

In Belgium, the school oral health program did not result in a reduction in the prevalence of caries after 6 years of monitoring. However, educational intervention was provided only once a year<sup>15</sup>.

Quarterly interventions, as recommended in the collective procedure, but characterized by repetition of subjects and methods, led to disinterest among the children who did not recognize the dentists and the oral health assistants as sources of information and they stated that they consumed a cariogenic diet even though they knew it produced caries<sup>16</sup>.

In this sense, the role of the teacher in the educational process may be better explored, because a professional of this type can reinforce the issues related to oral health on an ongoing basis. Even though they do

not feel prepared to introduce these strategies, they were receptive to the training programs<sup>17</sup>.

Even though this study did not investigate how the educational activities of the collective procedure were developed in the municipality of Embu, they were not sufficient for the adoption of healthier oral health practices during adolescence since, regardless of the group exposed to the collective procedure, the responses in relation to the brushing of teeth and the consumption of a cariogenic diet were similar<sup>18</sup>.

## CONCLUSION

The prevalence of caries in adolescents shows no difference in terms of having participated or not in the collective procedure during childhood. The results indicate that, in the setting of the municipality of Embu, the collective procedures were not able to produce the results intended for the prevention of dental caries, as they

did not appear sufficient to overcome the effects produced by other determinants of the health-disease process nor create a favorable impact on the future generation.

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## Collaborators

SR JUNQUEIRA took part in the development, execution and final editing of the article. JLF ANTUNES took part in the design of the method, the data analysis and the editing of the article. ME ARAÚJO participated in the conception and editing of the article. PC NARVAI took part in the development, research guidance and editing of the article.

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