THE CARIOSTATIC EFFECT OF CALCIUM SUCROSE PHOSPHATE IN A GROUP OF CHILDREN AGED 5-17 YEARS

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Introduction

A preliminary report on the planning and establishment of a clinical trial of the efficacy of calcium sucrose phosphate, in the form of a food additive, as a cariostatic agent was published in 1967(1). The results after one year indicated reductions in the dental caries increment for all children in the ages 5-17 years.

A further report published in 1968(2) covering the results observed after two years showed "an overall reduction of 25 per cent in caries increment in the mouths of children eating the treated food and this reduction is mainly demonstrated in the proximal surfaces of posterior teeth which show more than 50 per cent less caries".

The present paper reports the results observed after three years at the conclusion of the trial.

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Initially 1506 children were examined and participated in this clinical trial. Normal exodus of children from the Homes was anticipated and it was hoped that approximately 800 of the original subjects would remain in the trial for at least two years. Based on the data presented in Barnard's survey[3] these numbers would yield significant results if the difference is of the order of twenty per cent of the Control Group score.

The loss of subjects in the first two years was approximately as anticipated and their replacements participated in the project and observations of their dental caries experience have been recorded.

The circumstances which determined the initial selection of institutions, namely numbers of boys and girls in appropriate age groups, accessibility to the source of supply and control of treated foods and agreement to participate in the project, restricted the location and numbers of children. Factors beyond the control of the institutions and of ourselves have brought about greater losses in the numbers of subjects over the three years.

Table 1 shows the distribution of the children between Control and Treatment Groups over the period 1965-1968. It will be seen that the rate of loss was somewhat greater than expected and only 527 children of the original groups remained for the final examination at the end of three years.

The mean ages at the time of the first examination (1965) of these children were:-

Control	(361)	12.0 years
Treatment	(166)	10.8 years

Of the 361 subjects in the Control Group 195 were members of the one boys' boarding school participating in the trial. The reason for this disparity in average ages of the Control and Treatment Groups developing since the earlier examinations is largely the lower turnover rate of students at that school. This difference in ages means that direct unweighted comparisons between the two groups could be misleading.

A summary of results from all subjects present at two or more examinations is given in Table 2 followed by more detailed results for subjects present at all four examinations, in Tables 3-9. Data on which these are based are given in Appendices A, B and C, which also include data for subjects present for less than four examinations.

Since four institutions (2 Control, 2 Treatment) were situated in an area where fluoridation of the community drinking water had commenced in 1961, statistical significance tests have been carried out on and between the groups living in fluoridated and non fluoridated areas. The data are shown in Tables 7, 8 and 9.

The conditions of the trial and examinations (both dental and medical) and the dietetic supervision have remained as described in the previous reports[1][2][4]. Medical evidence shows that the physical status of both groups remains similar and this will be reported in detail elsewhere.

Results

All subjects

Table 2 presents a summary of the mean DMF teeth per child for all subjects who were present at two or more examinations. The annual increment in mean DMF teeth for each age group present at all examinations (1965-1968) should allow measurement of any overall difference between Control and Treatment Groups. However, since depletion of subjects has greatly reduced numbers in some age groups, Table 3 shows these data restricted to the ages 9-13 years (1965) where the number in both groups is at least 19. (Complete data for all age groups are shown in Appendix A.)

The mean increment of DMF teeth for the Control Group is 7.53 and for the Treatment Group 6.38, a difference of 15.3 per cent; and of DMF surfaces for the Control Group is 20.65 and for the Treatment Group 16.96, a difference of 17.9 per cent.

Table 4* shows the increments in all surfaces for boys and girls present at all examinations (1965-1968) in the age groups 5-10 years and 11-17 years.

The difference is greatest in the boys aged 5-10 years (22.78 per cent) followed by the girls aged 11-17 years (18.55 per cent).

If the results for the proximal surfaces in the bicuspid and molar teeth in the age groups for all children 9-13 years and for the boys and girls in the age groups 5-10 and 11-17 years are examined (Tables 5 and 6*), it will be seen that for children

*This age grouping in Table 4, 6 was used in the previous report[2]. Also in these tables subjects at institutions in fluoridated areas were omitted in order to present homogeneous groups for statistical significance testing.

aged 9-13 years there is a reduction in the dental caries increment of 29.5 per cent for the period 1965-1968 (Table 5). For all the children there is a range in reduction from 3.95-36.06 per cent (Table 6). It should be noted that for the boys aged 11-17 years (the group in which the largest numbers remained) the reduction 25.18 is significant at the 1.0 per cent level.

Subjects from fluoridated area

Four institutions (2 Control, 2 Treatment) were located in an area where fluoridated water supplies existed since November, 1961. These institutions were treated in the trial exactly as the other institutions, but because of the fluoride factor the results of the dental examination have not been included where significance tests were carried out in the previous sections of this report. A summary of the results in terms of age and DMF teeth is given in Table 7. It will be noted that the subjects of the Treatment Group had a lower increment of caries (4.21 DMF teeth) than those of the Control Group (5.85 DMF teeth), a difference of 28 per cent.

The mean DMF surfaces (all and proximal) of the remaining 45 children in the fluoridated area are compared with those of the non-fluoride groups in Tables 8 and 9. The increment of DMF surfaces for children aged 5-17 years in the fluoride area ranges from 10.27-18.45 in the Control and from 8.08-17.00 in the Treatment Group. In the non-fluoride area the corresponding ranges are 13.65-22.29 for the Control Group and 12.35-19.36 for the Treatment Group.

Discussion

The problem of loss of subjects from the trial has been referred to above. Nevertheless, sufficient remained to enable observations to be made which show a general benefit in terms of a lower dental caries incidence for the Treatment Group. This can be demonstrated by statistical significance tests in a number of cases.

All subjects

The New South Wales survey of Barnard (1956)[3] showed that although the annual increments in DMF teeth were almost equal in the years 6-15 there is a temporary increase in the rate around the age of 11 or 12 years. Such considerations make direct comparisons of these DMF rates invalid, except perhaps in cases where the distributions of ages are similar in the two groups.

In subjects who were present at all examinations it will be seen (Table 2) that some of the reduction in caries increment gained in 1967 has apparently been lost since the difference in the mean DMF teeth per subject between the 1967 and 1968 examinations is greater in the Treatment than in the Control Group. This largely arises from the differences in age of the two groups which, because of losses of subjects, have become greater as the trial continued.

At the final examination in 1968 the average age of subjects in the Control Group was 15 years, whilst for those in the Treatment Group it was 13.8 years. In the Control Group 126 children were 17 years of age or over at the 1968 examination

compared with only 10 children in the Treatment Group. Since it can be expected that children over 16 years of age have a lower annual increment of DMF teeth than younger children, the age difference referred to above favours the Control Group. Figures for all subjects are in fact weighted means of the different age rates, the weights being the numbers in the group of each age.

When allowance for age imbalance is made, the data in Table 2 for subjects present at all examinations suggest that the reduction in caries increment significantly demonstrated[(2)] in the data from the 1965-1967 examinations was maintained in the 1965-1968 examination.

A more detailed presentation of the position is given in Table 1 (Appendix A) where not only are the DMF teeth rates given, but the rates for unerupted and erupted caries-free teeth are also presented. In Table 2 (Appendix A) similar analyses for DMF surfaces are given.

A comparison of increments in DMF teeth and surfaces (Table 3) shows a reduction of approximately 30 per cent for each of the first two years in DMF teeth followed by an increase of 27 per cent in the third year. DMF surfaces show a similar reduction followed by approximately equal increments in the third year.

As a tooth needs only one DMF surface to be classified as DMF, the above data suggest that further surfaces have been attacked in the Control Group without appreciably increasing the DMF teeth rate.

This indicates, as does the data from Table 2, that the curve relating DMF surfaces to age for the Treatment Group may have shifted positively by a distance of two years on the age scale.

The data in Table 5 again supports the results reported[2] for the two year period, namely that there is a reduction in caries increment on the proximal surfaces, although this has fallen to 29.5 per cent by the end of the third year.

The average effects for the age range (9-13 years) produced reductions for the Treatment Group of :-

DMF teeth	15.3 (Table 3)
DMF surfaces	17.9 (Table 3)
DMF proximal surfaces	29.5 (Table 5).

Examination of data for DMF surfaces grouped on an age and sex basis for subjects present at institutions in the non fluoridated areas (Tables 4 and 6) will show reductions in increments both for all surfaces and for proximal surfaces in the Treatment Group.

For the 11-17 years age group containing the largest numbers of boys (Table 6) statistical significance was found at the 1 per cent level. (Similar significance was found in the 1965-1967 data (Table 4)[2]. In other cases where high reductions were obtained, for example 36.06 per cent for girls aged 11-17 years, the limited numbers in the group and the inherent variability in the data prevent the same degree of significance, as was found after two years, from being obtained.

For subjects present at the last two and three examinations only, DMF rates for both teeth and surfaces are shown in Table 2, in Table 4 (Appendix B) and Tables 5, 6 7 and 8 (Appendix C). Statistical significance is at the 5 per cent level for boys and girls aged 11-17 years but the numbers of subjects are small.

The reduction gained by the Treatment Group for these two years is less than that reported for the first two years. This may be due to the extra variability caused by the subjects entering the trial at any time between the 1966 and 1967 examinations, whereas all original subjects entered the trial at the same time.

Subjects from fluoridated area

Because of the reduced numbers, statistical significance should not be placed on the figures from the fluoridated area. However, they are consistent with an overall benefit for fluoride and an additional benefit for the calcium sucrose phosphate additive which is of the same order as it was in the non-fluoride institutions. This follows the pattern of the significant results found in the two years data[2].

Sixteen subjects joined these Homes in 1966 and of these only one joined a Control Group Home and therefore reliable comparison could not be made between new Control and Treatment subjects. In subjects who were present from 1966-1968 in the Treatment Groups the average increments for all DMF surfaces and DMF proximal surfaces were 8.28 and 3.56 respectively and corresponding values in non-fluoride groups were 13.06 and 5.57.

this does not in itself add anything to the purpose of the trial, except that it is consistent with the accepted results from fluoride trials and is evidence of the general reliability of the trial data.

Conclusions

1. One of the major difficulties of conducting a clinical trial of this nature lies in the loss of subjects originally examined.

2. The clinical trial of calcium sucrose phosphate used as a food additive for a period of three years in 527 children (Control 361, Treatment 166) aged 5-17 years demonstrated a lower incidence of dental caries for those children receiving the additive.

3. The results reported previously for the first two years of the trial have been confirmed after three years and this has been demonstrated by statistical significance in a number of cases.

4. There is also a consistent pattern of reduced incidence of dental caries in the Treatment Group in comparisons in which, due to the relatively small numbers involved, significance testing produces non-significant results.

5. In the age groups 9-13 years there are reductions for the Treatment Group of :-

DMF teeth	15.3 per cent
DMF surfaces	17.9 per cent
DMF proximal surfaces	29.5 per cent

6. Strong evidence supports the earlier findings that most benefit is gained on proximal surfaces which accounted for approximately 40 per cent of all lesions found.

7. The medical investigations showed no differences in the physical status and general health between the children of the Control and Treatment Groups.

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References

(1) Harris, R., Schamschula, R.G., Gregory, G., Roots, Miriam and Beveridge, J. - Observations on the cariostatic effect of calcium sucrose phosphate in a group of children aged 5-17 years. Preliminary report. Aust. dent. J. 12: 2, 105-113 (Apr.) 1967.

(2) Harris, R., Schamschula, R.G., Beveridge, J. and Gregory, G. - The cariostatic effect of calcium sucrose phosphate in a group of children aged 5-17 years. Aust. dent. J. 13: 1, 32-39 (Feb.) 1968.

(3) Barnard, P.D. - Dental survey of State School children in New South Wales. Jan. 1954-June 1955. N.H.M.R.C. Sp. Rpt. Series No. 8, Canberra, 1956.

(4) Harris, R., Roots, Miriam, Gregory, G. and Beveridge, J. - Calcium sucrose phosphate as a cariostatic agent in children aged 5-17 years. III. Dietary factors. Aust. dent. J. (accepted for publication).

TABLE 1

Numbers of children included in observations for the three year programme who were present at all examinations 1965-1968.

Date of Examination	Control	Treatment	Total
1965	885	621	1506
1966	632	408	1040
1967	479	242	721
1968	361	166	527

Between the 1965 and 1966 examinations 245 additional subjects (Control 123, Treatment 122) entered the trial and were present at the 1967 examination; of these 161 (Control 83, Treatment 78) were also present at the 1968 examination. Between the 1966 and the 1967 examinations 274 additional subjects (Control 136, Treatment 138) entered the trial and were present at the 1968 examination.

TABLE 2

Mean DMF teeth per child at each annual examination.

(All subjects 1965-1968)

Date of first examination	Date of subsequent examination(s)		N	Average age in 1965	DMF teeth 1965	Difference 1966-1965	DMF teeth 1966	Difference 1967-1966	DMF teeth 1967	Difference 1968-1967	DMF teeth 1968
1965	1966, 1967, 1968	C	361	12.0	8.67	2.45	11.12	2.23	13.35	1.61	14.96
		T	166	10.8	5.75	1.64	7.39	1.95	9.34	2.35	11.69
1965	1966, 1967	C	479	11.9	8.53	2.45	10.98	2.12	13.10	- -	- -
		T	242	11.4	6.85	1.71	8.56	1.89	10.45	- -	- -
1965	1966	C	632	11.7	8.19	2.45	10.64	- -	- -	- -	- -
		T	408	11.9	7.75	1.93	9.68	- -	- -	- -	- -
1966	1967, 1968	C	83	8.6	- -	- -	5.82	1.94	7.76	1.77	9.53
		T	78	10.4	- -	- -	6.18	2.01	8.19	2.19	10.38
1966	1967	C	123	9.1	- -	- -	6.59	2.05	8.64	- -	- -
		T	122	10.5	- -	- -	7.25	1.78	9.03	- -	- -
1967	1968	C	136	8.1	- -	- -	- -	- -	6.19	1.90	8.09
		T	138	9.3	- -	- -	- -	- -	7.87	1.90	9.77

C = Control Subjects T = Treatment Subjects N = Number of Subjects

TABLE 3

The increment of dental caries expressed as mean DMF teeth and DMF surfaces in the Control (189) and Treatment (132) Groups of children aged 9 - 13 years for the years 1965 - 1968.

Age at first examination	Group	N	Increments in DMF teeth and DMF surfaces per child							
			1965 - 1966		1966 - 1967		1967 - 1968		1965 - 1968	
			Teeth	Surfaces	Teeth	Surfaces	Teeth	Surfaces	Teeth	Surfaces
9 years	C	22	1.54	4.87	2.23	3.73	2.23	7.00	6.00	15.60
	T	19	1.05	2.26	1.05	2.27	2.00	4.05	4.10	8.58
10 years	C	24	1.12	2.87	2.88	5.63	3.17	7.42	7.17	15.92
	T	20	0.85	3.25	2.35	5.90	3.85	8.80	7.05	17.95
11 years	C	29	4.07	7.34	3.59	9.73	1.72	9.45	9.38	26.52
	T	31	1.87	4.68	3.16	6.39	3.19	8.42	8.23	19.49
12 years	C	29	3.04	8.07	3.10	8.41	1.48	5.66	7.62	22.14
	T	37	2.73	5.60	2.57	6.94	2.62	9.33	7.92	21.87
13 years	C	85	3.06	7.79	2.65	8.40	1.73	6.89	7.44	23.08
	T	25	2.09	6.30	1.00	4.74	1.48	5.83	4.57	16.87
9 - 13 years	C	189	2.57	6.19	2.89	7.18	2.07	7.28	7.53	20.65
	T	132	1.72	4.42	2.03	5.25	2.63	7.29	6.38	16.96
Difference (per cent)	DMF Teeth DMF Surfaces		33.1	28.6	29.8	26.9	-27.3	-0.1	15.3	17.9

$$\text{Difference} = \frac{100\ (\text{Average Control} - \text{Average Treatment})}{\text{Average Control}}$$

C = Control Subjects T = Treatment Subjects N = Number of Subjects

TABLE 4

The increment of dental caries expressed as DMF surfaces in the Control (335) and Treatment (147) Groups of children for the years 1965 - 1968. (Non-fluoridated areas)

Increments in DMF surfaces for boys and girls

Sex	Age (1965) Yrs.		N	1965 - 1966	1966 - 1967	1967 - 1968	1965 - 1968	Difference (per cent)
Boys	5 - 10	C	56	4.07	3.94	5.29	13.30	22.78
		T	24	2.91	3.13	4.29	10.33	
Boys	11 - 17	C	239	7.20	7.97	7.29	22.46	10.55
		T	76	5.66	6.10	8.33	20.09	
Girls	5 - 10	C	21	3.76	5.00	5.81	14.57	3.43
		T	28	2.71	4.50	6.86	14.07	
Girls	11 - 17	C	19	6.58	7.11	6.47	20.16	18.55
		T	19	5.63	4.63	6.16	16.42	

$$\text{Difference} = \frac{100\ (\text{Average Control} - \text{Average Treatment})}{\text{Average Control}}.$$

C = Control T = Treatment N = Number of Subjects

TABLE 5

The increment of dental caries on the proximal surfaces of the bicuspid and molar teeth of 321 children aged 9 - 13 years for the period 1965 - 1968

Age (1965) Yrs		N	Differences in mean DMF proximal surfaces per subject			
			1965 - 1966	1966 - 1967	1967 - 1968	1965 - 1968
9	C	22	1.32	1.27	2.45	5.05
	T	19	0.26	0.16	1.47	1.89
10	C	24	0.75	1.67	3.17	5.58
	T	20	0.70	1.80	3.45	5.95
11	C	21	3.17	3.28	3.90	10.34
	T	31	1.35	1.16	4.39	6.90
12	C	29	3.03	3.24	3.21	9.48
	T	37	1.05	2.16	4.46	7.68
13	C	85	2.64	3.89	3.33	9.86
	T	25	1.22	1.04	3.70	5.96
9 - 13	C	189	2.18	2.67	3.21	8.06
	T	132	0.92	1.26	3.49	5.68
Difference (per cent)			57.8	52.8	-8.7	29.5

$$\text{Difference} = \frac{100\ (\text{Average Control} - \text{Average Treatment})}{\text{Average Control}}.$$

C = Control Subjects T = Treatment Subjects N = Number of Subjects

TABLE 6

The increment of dental caries on the proximal surfaces of the bicuspid and molar teeth of the 482 children aged 5-17 years for the period 1965-1968. (Non-fluoridated areas)

Increments in DMF surfaces for boys and girls

Sex	Age (1965) Yrs		N	1965 - 1966	1966 - 1967	1967 - 1968	1965 - 1968	Difference (per cent)
Boys	5 -10	C	56	0.90	1.23	1.73	3.86	32.12 N.S.
		T	24	0.12	0.92	1.58	2.62	
Boys	11 - 17	C	239	2.90	3.22	3.53	9.65	25.18**
		T	76	1.26	1.50	4.46	7.22	
Girls	5 - 10	C	21	0.53	1.23	2.29	4.05	3.95 N.S.
		T	28	0.78	0.97	2.14	3.89	
Girls	11 - 17	C	19	2.00	3.53	2.79	8.32	36.06 N.S.
		T	19	1.21	1.06	3.05	5.32	

$$\text{Difference} = \frac{100\ (\text{Average Control} - \text{Average Treatment})}{\text{Average Control}}.$$

** = Significant at 1% level N.S. = Not significant C = Control Subjects

T = Treatment Subjects N = Number of Subjects

TABLE 7

Mean DMF teeth per child of 45 children of both Control and Treatment Groups living in a fluoridated area (1965 - 1968).

	Number of Children	Average Age (Years)	DMF TEETH PER CHILD				
			1965	1966	1967	1968	Difference 1965 - 1968
Control	26	9.8	3.50	5.23	7.42	9.35	5.85
Treatment	19	10.1	4.42	5.58	6.84	8.63	4.21

TABLE 8

The mean DMF surfaces increment of all children (527) aged 5 - 17 years living in both fluoride and non-fluoride areas, 1965 - 1968.

	Age (Years)	MEAN DMF SURFACES INCREMENT			
		Fluoride		Non-fluoride	
		No.	DMFs.	No.	DMFs.
Control	5 - 10	15	10.27	77	13.65
	11 - 17	11	18.45	258	22.29
Treatment	5 - 10	13	8.08	52	12.35
	11 - 17	6	17.00	95	19.36
Total		45		482	

TABLE 9

The mean DMF increment for the proximal surfaces of the bicuspid and molar teeth of all children (527) aged 5 - 17 years living in both fluoride and non-fluoride areas, 1965 - 1968.

	Age (Years)	MEAN DMF SURFACES INCREMENT			
		Fluoride		Non-fluoride	
		No.	DMFs.	No.	DMFs.
Control	5 - 10	15	2.27	77	3.91
	11 - 17	11	7.18	258	9.55
Treatment	5 - 10	13	1.85	52	3.31
	11 - 17	6	4.33	95	6.84
Total		45		482	

APPENDIX A

TABLE 1. Mean number of unerupted, caried-free and DMF teeth at each examination for all subjects present at all examinations

Age (years) at first examination (1965)		CONTROL N	CONTROL 1965	CONTROL 1966	CONTROL 1967	CONTROL 1968	TREATMENT N	TREATMENT 1965	TREATMENT 1966	TREATMENT 1967	TREATMENT 1968
5	U	2	27.50	24.00	19.50	17.00	0				
	C		0.50	1.00	5.00	5.00					
	D		0.00	3.00	3.50	6.00					
6	U	10	25.80	20.80	17.70	15.60	6	26.67	21.50	17.17	15.33
	C		2.10	4.30	6.20	8.30		1.33	6.17	8.67	9.00
	D		0.10	2.90	4.10	4.10		0.00	0.33	2.17	3.6
7	U	11	21.36	17.54	14.91	12.09	9	19.00	16.56	13.44	9.11
	C		5.46	7.82	8.73	10.82		6.44	8.33	10.78	13.33
	D		1.18	2.64	4.36	5.09		2.56	3.11	3.78	5.5
8	U	23	17.30	14.91	12.65	9.39	11	17.73	15.73	13.27	10.18
	C		8.17	9.22	10.17	11.56		7.27	8.00	9.18	11.46
	D		2.52	3.87	5.17	7.04		3.00	4.27	5.54	6.3
9	U	22	15.14	12.68	7.91	3.14	19	15.05	12.42	7.79	3.74
	C		9.14	10.04	12.59	15.14		10.74	12.32	15.90	17.95
	D		3.73	5.27	7.50	9.73		2.21	3.26	4.32	6.3
10	U	24	12.92	8.58	4.00	1.42	20	12.40	8.35	4.00	1.25
	C		11.50	14.71	16.42	15.83		11.35	14.55	16.55	15.45
	D		3.58	4.71	7.58	10.75		4.25	5.10	7.45	11.3
11	U	29	6.52	3.21	0.45	0.17	31	9.26	4.87	2.29	0.81
	C		15.90	15.14	14.31	12.86		13.90	16.42	15.84	14.13
	D		5.59	9.66	13.24	14.97		4.84	6.71	9.87	13.(
12	U	29	3.00	1.41	0.24	0.10	37	4.73	2.24	0.60	0.19
	C		16.97	15.52	13.59	12.24		16.43	16.19	15.27	13.05
	D		8.03	11.07	14.17	15.66		6.84	9.57	12.14	14.7
13	U	85	2.36	1.49	0.56	0.25	23	2.52	1.09	0.13	0.00
	C		16.25	14.06	12.34	10.93		16.17	15.52	15.48	14.13
	D		9.39	12.45	15.09	16.82		9.30	11.39	12.39	13.(
14	U	89	0.60	0.42	0.14	0.08	6	0.00	0.00	0.00	0.00
	C		14.33	12.00	10.52	9.09		13.17	12.17	11.17	10.33
	D		13.08	15.58	17.35	18.83		14.83	15.83	16.83	17.
15	U	36	0.03	0.03	0.00	0.00	3	0.00	0.00	0.00	0.00
	C		13.67	12.31	10.89	10.14		8.67	8.00	7.67	7.00
	D		14.31	15.67	17.11	17.86		19.33	20.00	20.33	21.
16	U	1	0.00	0.00	0.00	0.00	1	0.00	0.00	0.00	0.00
	C		10.00	7.00	8.00	8.00		20.00	21.00	19.00	14.00
	D		18.00	21.00	20.00	20.00		8.00	7.00	9.00	14.

Key U - Unerupted C - Erupted and caries-free D - DMF

APPENDIX A

TABLE 2. Mean number of surfaces classified as U, C, or D at each examination for all subjects present at all examinations

Age (years) at first examination (1965)		CONTROL N	CONTROL 1965	CONTROL 1966	CONTROL 1967	CONTROL 1968	TREATMENT N	TREATMENT 1965	TREATMENT 1966	TREATMENT 1967	TREATMENT 1968
	U		145.50	127.00	103.50	91.00					
5	C	2	2.50	17.00	38.50	45.50	0				
	D		0.00	4.00	6.00	11.50					
	U		136.10	110.10	94.50	84.00		141.17	113.50	91.83	82.67
6	C	10	11.80	33.60	46.70	54.50	6	6.83	34.17	53.33	59.8
	D		0.10	4.30	6.80	9.50		0.00	0.33	2.83	
	U		113.36	93.54	80.18	65.54		101.00	88.56	72.11	49.56
7	C	11	32.64	49.54	58.46	71.09	9	42.11	52.44	66.56	83.4
	D		2.00	4.91	9.36	11.36		4.89	7.00	9.33	1
	U		92.52	80.35	68.39	50.96		94.64	84.54	72.00	55.64
8	C	23	50.78	59.30	68.04	81.04	11	47.27	53.91	63.09	77.2
	D		4.70	8.35	11.56	16.00		6.09	9.54	12.91	1
	U		81.46	68.45	42.96	17.23		81.05	67.16	42.53	20.63
9	C	22	59.00	67.14	88.91	107.64	19	63.10	74.74	97.10	114.9
	D		7.54	12.41	16.14	23.14		3.84	6.10	8.37	1
	U		69.75	46.67	22.50	8.00		66.90	45.20	21.90	6.80
10	C	24	71.00	91.21	109.75	116.83	20	73.60	92.05	109.45	115.7
	D		7.25	10.12	15.75	23.17		7.50	10.75	16.65	2
	U		35.76	17.83	2.48	0.90		50.32	26.74	12.64	4.64
11	C	29	99.55	110.14	115.76	107.90	31	86.36	105.26	112.97	112.5
	D		12.69	20.03	29.76	39.21		11.32	16.00	22.39	3
	U		16.38	7.76	1.28	0.52		25.86	12.43	3.40	1.11
12	C	29	111.69	112.24	110.31	105.41	37	106.78	114.62	116.70	109.6
	D		19.93	28.00	36.41	42.07		15.35	20.95	27.89	3
	U		13.01	8.27	3.13	1.44		13.91	6.04	0.96	0.00
13	C	85	112.31	109.26	106.00	100.80	23	113.61	115.17	115.52	110.6
	D		22.68	30.47	38.87	45.76		20.48	26.78	31.52	3
	U		3.36	2.33	0.75	0.45		0.00	0.00	0.00	0.00
14	C	89	113.49	107.19	101.44	94.16	6	110.50	102.67	100.83	95.8
	D		31.15	38.48	45.81	53.39		37.50	45.33	47.17	5
	U		0.14	0.14	0.00	0.00		0.00	0.00	0.00	0.00
15	C	36	111.75	106.08	100.78	95.94	3	98.33	90.67	89.33	85.0
	D		36.11	41.78	47.22	52.06		49.67	57.33	58.67	6
	U		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
16	C	1	116.00	101.00	98.00	90.00	1	134.00	135.00	131.00	122.0
	D		32.00	47.00	50.00	58.00		14.00	13.00	17.00	2

Key U - Unerupted C - Erupted and caries-free D - DMF

APPENDIX B

TABLE 3. New DMF teeth rates for subjects present at all four examinations, excluding subjects from four institutions in fluoridated area.

1965 PROPORTION DMF TEETH AT 1968 EXAMINATION

Age Group		Unerupted at examination in:			Erupted and caries free at examination in:		
		1965	1966	1967	1965	1966	1967
5	C	0.700	0.625	0.333	-	-	0.667
	T	-	-	-	-	-	-
6	C	0.233	0.023	0.000	0.714	0.238	0.017
	T	0.279	0.054	0.091	0.375	0.514	0.154
		NS	NS	NS	NS	*	**
7	C	0.239	0.167	0.172	0.396	0.234	0.071
	T	0.124	0.119	0.051	0.276	0.187	0.144
		*	NS	NS	NS	NS	NS
8	C	0.276	0.258	0.217	0.321	0.219	0.131
	T	0.160	0.120	0.115	0.307	0.197	0.059
		*	NS	NS	NS	NS	NS
9	C	0.345	0.303	0.212	0.256	0.212	0.131
	T	0.212	0.226	0.140	0.233	0.117	0.119
		*	NS	NS	NS	*	NS
10	C	0.750	0.384	0.368	0.216	0.225	0.138
	T	0.451	0.427	0.396	0.227	0.246	0.197
		**	NS	NS	NS	NS	NS
11	C	0.582	0.611	0.500	0.390	0.234	0.137
	T	0.450	0.448	0.333	0.326	0.288	0.194
		*	*	NS	NS	NS	*
12	C	0.712	0.676	0.000	0.364	0.271	0.152
	T	0.599	0.573	0.462	0.335	0.270	0.180
		NS	NS	NS	NS	NS	NS
13	C	0.633	0.642	0.407	0.380	0.267	0.146
	T	0.509	0.560	0.333	0.207	0.137	0.105
		NS	NS	NS	**	**	NS
14	C	0.848	0.800	0.800	0.375	0.260	0.154
	T	-	-	-	0.215	0.151	0.090
					**	*	NS
15	C	0.000	0.000	-	0.262	0.187	0.087
	T	-	-	-	0.269	0.125	0.087
					NS	NS	NS
16	C	-	-	-	0.200	0.000	0.000
	T	-	-	-	0.300	0.333	0.263
					NS	NS	NS

APPENDIX B

TABLE 4. New DMF teeth rates for subjects present at the last three examinations, but not present at the first examination, excluding subjects from four institutions in fluoridated area.

1966 PROPORTION DMF TEETH AT 1968 EXAMINATION

Age Group		Unerupted at examination in: 1966	Unerupted at examination in: 1967	Erupted and caries free at examination in: 1966	Erupted and caries free at examination in: 1967
5	C	0.407	0.444	0.000	0.125
	T	0.167	0.167	-	-
		NS	NS		
6	C	0.197	0.100	0.136	0.197
	T	-	-	-	-
7	C	0.217	0.048	0.317	0.200
	T	0.062	0.000	0.286	0.043
		NS	NS	NS	NS
8	C	0.152	0.000	0.163	0.100
	T	-	-	-	-
9	C	0.179	0.120	0.109	0.089
	T	0.486	0.286	0.300	0.182
		**	NS	**	NS
10	C	0.317	0.433	0.165	0.118
	T	0.157	0.083	0.207	0.133
		*	**	NS	NS
11	C	0.431	0.375	0.287	0.152
	T	0.352	0.254	0.121	0.125
		NS	NS	**	NS
12	C	0.583	1.000	0.377	0.179
	T	0.328	0.357	0.186	0.115
		NS	NS	**	NS
13	C	0.550	0.600	0.309	0.101
	T	0.556	0.438	0.228	0.176
		NS	NS	NS	NS
14	C	1.000	-	0.397	0.263
	T	0.667	1.000	0.291	0.211
		NS		NS	NS
15	C	-	-	0.292	0.150
	T	-	-	-	-

APPENDIX C

TABLE 5. Mean DMF surface increments for subjects present at examinations in 1966, 1967, 1968, not present at the 1965 examination. (Non fluoridated areas)

Sex	Age (1966) Yrs.		N	1966 - 1967	1967 - 1968	1966 - 1968	Difference (per cent)
Boys	5 - 10	C T	34 12	2.77 2.91	2.91 3.42	5.68 6.33	-11.44 N.S.
Boys	11 - 17	C T	17 41	10.35 5.07	9.06 8.44	19.41 13.51	30.40*
Girls	5 - 10	C T	19 4	3.10 11.25	3.11 6.25	6.21 17.50	-182.12 N.S.
Girls	11 - 17	C T	12 6	9.92 5.67	7.75 4.33	17.67 10.00	43.41

$$\text{Difference} = \frac{100\ (\text{Average Control} - \text{Average Treatment})}{\text{Average Control}}.$$

* = Significant at 5% Level N.S. = Not significant

APPENDIX C

TABLE 6. Mean DMF surface increments for subjects present at examinations in 1966, 1967, 1968, not present at examination in 1965 (mesial and distal surfaces of bicuspid and molar teeth). (Non fluoridated areas)

Sex	Age (1966) Yrs.		N	1966 - 1967	1967 - 1968	1966 - 1968	Difference (per cent)
Boys	5 - 10	C	34	0.79	1.00	1.79	-44.13 N.S.
		T	12	1.16	1.42	2.58	
Boys	11 - 17	C	17	3.71	3.47	7.18	16.16 N.S.
		T	41	1.41	4.61	6.02	
Girls	5 - 10	C	19	0.58	1.05	1.63	-114.72 N.S.
		T	4	2.50	1.00	3.50	
Girls	11 - 17	C	12	3.75	3.33	7.08	64.69*
		T	6	1.17	1.33	2.50	

$$\text{Difference} = \frac{100\ (\text{Average Control} - \text{Average Treatment})}{\text{Average Control}}.$$

* = Significant at 5% level N.S. = Not significant

APPENDIX C

TABLE 7

Mean DMF surface increments for subjects present at 1967, 1968 examinations, not present at 1965, 1966 examinations

(non fluoridated areas)

SEX	AGE (1967)	N	1967-1968	Difference (per cent)
Male	5-10	C 53	3.73	24.93 N.S.
		T 20	2.80	
Male	11-17	C 36	8.64	6.71 N.S.
		T 66	8.06	
Female	5-10	C 19	3.58	40.78 N.S.
		T 17	2.12	
Female	11-17	C 11	6.73	-16.20 N.S.
		T 17	7.82	

APPENDIX C

TABLE 8

Mean DMF surface increments for subjects present at 1967, 1968 examinations, not present at 1965, 1966 examinations

(mesial and distal surfaces of bicuspid and molar teeth)

(non fluoridated areas)

SEX	AGE (1967)	N	1967-1968	Difference (per cent)
Male	5-10	C 53 T 20	0.68 1.00	-47.06 N.S.
Male	11-17	C 36 T 66	4.58 3.73	18.56 N.S.
Female	5-10	C 19 T 17	1.00 0.18	82.00 N.S.
Female	11-17	C 11 T 17	2.55 3.18	-24.71 N.S.