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DENTAL CONDITION OF FIVE-YEAR-OLD CHILDREN IN INSTITUTIONS AND PRIVATE SCHOOLS COMPARED WITH L.C.C. SCHOOLS

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From time to time in the literature the dental condition of various races, social classes, types of school, and so on is compared. If the differences observed are so big that they are self-evident—as, for instance, the difference in caries incidence between children in Great Britain and children of certain native races living in their natural habitat—the criteria used in assessing these differences are for many purposes perhaps not of great importance. Should the discrepancies be less outstanding, however, it is essential that the same standards and the same age groups should be used in the examination of each race, class, or school if true comparisons are to be made. This is especially necessary if the effect of specific procedures or dietary factors is being put to the test.

It is, we believe, unfortunate that the majority of workers, when investigating the dental condition of groups of people, concentrate only on caries incidence and sometimes its extent, ignoring the structure of the teeth, or, if they consider it at all, recognizing only one type of defect—that to which we and our colleagues refer as gross or G-hypoplasia. Thus valuable data are lost.

It is often stated that children brought up in institutions have less caries than their contemporaries living in their own homes. As we had had long experience in examining and charting the deciduous teeth of children attending public elementary schools, using the same standards throughout (Mellanby and Coumoulos, 1944, 1946; Coumoulos, 1946), and had accumulated much information on the subject, we determined in 1945 to see for ourselves how the dental condition of institutional children compared with that of some other sections of the community of the same age groups. During the same period we also made a study of children living at home and attending private schools, and in this paper we shall compare in some detail the findings in the 5-year-old children of these two groups with each other and with data obtained from children of similar age residing usually in their own homes and attending L.C.C. schools in the same year. Details of this last group have already been published (Mellanby and Coumoulos, 1946).

In the present study we use the term "institutions" to cover communal homes for children deprived of a normal home life for one reason or another, such as destitution, illegitimacy, or the death of one or both parents. Some of the institutions visited in the course of the investigation were run by municipal or education authorities, others by religious or charitable organizations. The selection was made as representative as possible, and for this we have to thank Dr. H. E. Magee, of the Ministry of Health.

The majority of the children in the institutions were from poor or unsatisfactory homes. The private schools ranged from the small "select" type to larger ones attached to senior schools, and, so far as could be judged from information supplied, most of the children attending them came from well-to-do families. Many of the children attending the L.C.C. schools were of poor parentage, although some were of a higher social grade. The method of examination and the criteria used in the assessment of dental structure, caries, and other conditions have been described previously (Mellanby and Coumoulos, 1946, and earlier publications by M. M. and colleagues).

Results

A comparison of the findings in the three surveys under review is given in Tables I to VIII. Table I indicates that

TABLE I.—Percentages of Teeth Present at Time of Inspection

Type of Tooth	Institutions	Private Schools	L.C.C. Schools
Upper:			
Centrals	94.0	93.5	92.6
Laterals	97.8	99.2	98.3
Canines	99.8	100.0	99.6
1st molars	99.5	98.2	95.0
2nd molars	99.8	99.5	97.5
Lower:			
Centrals	85.7	76.0	79.4
Laterals	98.5	97.4	98.0
Canines	100.0	99.9	99.9
1st molars	98.6	95.4	92.4
2nd molars	99.2	98.4	91.7
All types	97.3	95.8	94.4

comparatively few teeth were missing, either shed or extracted, from any of the groups of children. Our chief concern was with the structure of the *deciduous teeth* and their caries incidence and extent rather than with the state of the teeth per child; but before considering these points in detail mention may be made of the percentages of children found to be free or almost free from caries (see Mellanby and Coumoulos, 1946). Table II shows that the

TABLE II.—Percentages of Children Caries-free or Almost Caries-free

Place of Investigation	No. of Children Examined	Caries-free	Almost Caries-free	Total
Institutions	325	57.2	8.9	66.1
Private schools	371	50.4	4.3	54.7
L.C.C. schools	691	24.2	3.9	28.1

institutions had a larger percentage (66.1) in this category than the private schools (54.7), which in turn showed a great advance on the L.C.C. schools (28.1).

In dealing with the individual types of teeth and with the teeth as a whole, the surface structure will be mentioned first, as we consider this to be very important in relation to their resistance to caries.

Surface Structure of the Teeth

As is seen from Table III, the children attending private schools had many more teeth graded as Hy₀—that is to say, of good structure (54%)—than either those attending the L.C.C. schools (38%) or those living in institutions (32.3%). In other words, structure was by far the best in the private schools and was worst in the institutions. As would be expected, when each individual type of tooth was considered, the children at private schools

the institutional children, 10.3% of the first and 10.5% of the second molars being affected, whereas the figures for private and L.C.C. schools ranged from 1.1 to 2.6% for the same types of teeth.

The average hypoplasia figure (AHF), which relates only to M-hypoplasia (see Mellanby and Coumoulos, 1946) and gives a rough computation of the extent of this imperfection, was lowest for all types of teeth together in the private schools, but was approximately the same for the other two groups—that is, 0.6 in the private schools compared with 0.92 in the institutions and 0.91 in the L.C.C. schools. Again, the AHF for each type of tooth was lower for the private schools group than for either of the others, which varied slightly from tooth to tooth. In all

TABLE III.—Comparison of Tooth Structure in Institutions, Private Schools, and L.C.C. Schools

Type of Tooth	Place of Investigation	Total No. of Teeth Examined for Structure	Hy ₀	M-Hy ₁	M-Hy ₂	M-Hy ₃	G-Hy	Hy Unclassified	AHF*
Upper:									
Centrals	Institutions	609	32.2	39.2	20.5	1.6	6.2	0.2	0.91
	Private schools	689	51.8	30.9	14.2	0.6	2.5	0.0	0.63
	L.C.C. schools	1,262	25.0	36.2	26.1	6.0	6.6	0.2	1.14
Laterals	Institutions	635	32.9	53.5	8.3	0.5	4.6	0.2	0.75
	Private schools	722	64.4	26.3	6.5	0.6	1.8	0.4	0.42
	L.C.C. schools	1,341	38.6	39.4	14.3	2.2	5.4	0.1	0.79
Canines	Institutions	647	30.0	57.2	9.1	0.5	1.4	1.9	0.79
	Private schools	735	63.8	31.2	3.3	0.3	1.0	0.5	0.39
	L.C.C. schools	1,369	40.8	45.7	10.1	1.1	1.1	1.2	0.71
1st molars	Institutions	639	7.7	36.9	46.6	2.7	6.1	0.0	1.47
	Private schools	725	24.8	47.2	23.2	2.9	1.9	0.0	1.04
	L.C.C. schools	1,282	8.7	39.2	42.9	6.4	2.8	0.0	1.48
2nd molars	Institutions	644	6.2	32.6	51.7	5.4	4.0	0.0	1.59
	Private schools	736	19.8	51.4	24.9	2.8	1.1	0.0	1.11
	L.C.C. schools	1,342	5.2	39.5	45.7	8.6	1.0	0.0	1.58
Lower:									
Centrals	Institutions	552	78.1	20.5	0.4	0.0	1.1	0.0	0.21
	Private schools	559	92.5	7.1	0.2	0.0	0.2	0.0	0.08
	L.C.C. schools	1,097	85.1	14.0	0.4	0.0	0.5	0.0	0.15
Laterals	Institutions	636	66.8	31.3	0.8	0.0	1.1	0.0	0.33
	Private schools	718	87.9	11.1	0.4	0.0	0.4	0.1	0.12
	L.C.C. schools	1,348	79.5	19.2	0.8	0.0	0.3	0.1	0.21
Canines	Institutions	647	50.1	40.2	2.2	0.0	2.3	5.3	0.48
	Private schools	736	81.8	13.7	1.6	0.0	0.7	2.2	0.18
	L.C.C. schools	1,370	69.7	23.5	2.3	0.1	0.7	3.8	0.30
1st molars	Institutions	631	16.6	40.4	30.7	1.9	10.3	0.0	1.20
	Private schools	698	37.0	41.5	16.1	2.1	1.1	0.1	0.85
	L.C.C. schools	1,235	22.3	39.6	32.5	3.1	2.6	0.0	1.17
2nd molars	Institutions	637	8.8	40.0	36.4	4.2	10.5	0.0	1.40
	Private schools	718	24.2	44.6	26.7	2.8	1.7	0.0	1.03
	L.C.C. schools	1,241	7.5	37.5	45.4	8.1	1.5	0.0	1.55
Totals	Institutions	6,277	32.3	39.5	20.9	1.7	4.8	0.8	0.92
	Private schools	7,036	54.0	31.0	12.1	1.2	1.3	0.4	0.60
	L.C.C. schools	12,887	38.0	33.6	22.0	3.5	2.3	0.6	0.91

* AHF (average hypoplasia figure) = $\frac{\text{Total hypoplasia figure}}{\text{Total no. of teeth examined for structure (excluding those with G-hypoplasia or unclassified hypoplasia)}}$

were consistently at the head of the scale, and those attending L.C.C. schools were in most cases better than those residing in institutions.

The proportion of teeth showing some degree of M-hypoplasia was least in the private schools group (44.3%) and much higher in the institutions (62.1%) and L.C.C. schools (59.1%). Comparatively few in any group showed severe M-hypoplasia (M-Hy₃): taking all types together, the private schools had 1.2%, the institutions 1.7%, and the L.C.C. schools 3.5%.

Gross hypoplasia (G-Hy) was negligible compared with M-hypoplasia. The institutions had 4.8% showing this condition compared with 62.1% with M-hypoplasia, the L.C.C. schools 2.3% compared with 59.1%, and the private schools only 1.3% compared with 44.2%. These figures for gross hypoplasia correspond roughly to the figures usually given in the textbooks for all generally recognized hypoplasias (Pitts, 1921; Ainsworth and Young, 1925). Taking individual types of teeth, the highest percentages with gross hypoplasia were found in the lower molars of

groups the lower incisors had the smallest AHF and second molars the greatest—a fact which has been observed in all investigations where the same standards have been used in the assessment of structural defects in deciduous teeth.

Incidence and Extent of Caries

When we turn to the subject of caries quite a different picture is presented. As is shown in Table IV, the percentage of carious teeth of all types together was somewhat lower in the institutions than in the private schools, in spite of the fact that the structure of the teeth was so much worse, and much lower than in the L.C.C. schools, the respective figures being 10.5%, 14.2%, and 26.5%. In general, the same relation was evident between the three groups when each type of tooth was considered separately. As is usually found, in all three groups the lower incisors were rarely carious, only 2.1% or less in any group coming into this category, and the highest incidence occurred in the second molars, the lower teeth of this type being worse

than the upper. In the institutions 26.3%, in the private schools 34.9%, and in the L.C.C. schools 58.8% of the lower second molars were carious.

Just as comparatively few teeth in any group were severely affected by M-hypoplasia, so few showed severe caries, only 8.3% or less of the teeth in any group being in this category (C_3). The lowest incidence of this grade was found among the institutional children—that is to say, in those with teeth of the worst structure—and the greatest incidence among those attending the L.C.C. schools. (It should be noted that this category, as in previous investigations, includes the relatively few missing canines and molars, which are assumed at the age of 5 years to have been extracted for caries—see figures in brackets in Table IV.)

in each group of children and for each type of tooth in the present survey the percentage of carious teeth increased with the severity of the M-hypoplasia, but there were some very marked differences between the groups, especially in relation to the worst grades of structure (M-Hy₂ and M-Hy₃). It is seen in Table V, for instance, that 56.8% of the molars graded as M-Hy₂ in the private schools and 66.5% in the L.C.C. schools were carious, whereas the corresponding figure for the institutions was only 29.8%. Similarly, for the molars graded as M-Hy₃ the percentages of carious teeth were 89.6 for the private schools, 92.3 for the L.C.C. schools, and only 58.2 for the institutions. The same trend is apparent when other grades of structure and other types of teeth are considered.

TABLE IV.—Caries Incidence and Extent in Institutions, Private Schools, and L.C.C. Schools

Type of Tooth	Place of Investigation	Total No. of Teeth	C ₀	C ₁	C ₂	C ₃	Total Carious Teeth	ACF†
Upper:								
Centrals	Institutions	611	89.7	2.3	6.2	1.8	10.3	0.20
	Private schools	694	88.8	3.0	6.5	1.7	11.2	0.21
	L.C.C. schools	1,280	70.5	5.0	17.2	7.3	29.5	0.61
Laterals	Institutions	636	95.0	1.3	3.5	0.3	5.0	0.09
	Private schools	736	94.2	2.4	2.7	0.7	5.8	0.10
	L.C.C. schools	1,358	85.1	3.2	8.6	3.1	14.9	0.30
Canines	Institutions	650	97.1	0.3	2.3	0.3 (0.15)*	2.9	0.06
	Private schools	742	95.8	1.6	1.9	0.7 (0.0)*	4.2	0.07
	L.C.C. schools	1,381	92.5	1.7	4.2	1.6 (0.4)*	7.5	0.15
1st molars	Institutions	650	86.3	5.7	5.5	2.5 (0.5)*	13.7	0.24
	Private schools	742	79.8	4.7	9.7	5.8 (1.8)*	20.2	0.42
	L.C.C. schools	1,382	61.1	8.3	17.4	13.2 (5.0)*	38.9	0.83
2nd molars	Institutions	650	74.6	13.2	10.2	2.0 (0.2)*	25.4	0.40
	Private schools	742	72.4	9.3	14.2	4.1 (0.5)*	27.6	0.50
	L.C.C. schools	1,382	48.6	17.7	23.6	10.1 (2.5)*	51.4	0.95
Lower:								
Centrals	Institutions	557	98.9	0.4	0.7	0.0	1.1	0.02
	Private schools	564	98.9	0.5	0.5	0.0	1.1	0.02
	L.C.C. schools	1,098	98.3	0.9	0.8	0.0	1.7	0.03
Laterals	Institutions	640	99.2	0.5	0.3	0.0	0.8	0.01
	Private schools	723	99.4	0.1	0.4	0.0	0.6	0.01
	L.C.C. schools	1,354	97.9	0.6	1.3	0.2	2.1	0.04
Canines	Institutions	650	98.9	0.3	0.6	0.2 (0.0)*	1.1	0.02
	Private schools	742	97.3	0.3	2.2	0.2 (0.1)*	2.7	0.05
	L.C.C. schools	1,382	94.1	0.7	4.3	0.9 (0.1)*	5.9	0.12
1st molars	Institutions	650	83.5	4.2	7.2	5.1 (1.4)*	16.5	0.34
	Private schools	742	69.9	4.5	14.6	11.1 (4.6)*	30.1	0.67
	L.C.C. schools	1,382	51.4	7.2	21.1	20.3 (7.6)*	48.6	1.10
2nd molars	Institutions	650	73.7	10.2	9.2	7.0 (0.8)*	26.3	0.49
	Private schools	742	65.1	11.5	14.3	9.1 (1.6)*	34.9	0.68
	L.C.C. schools	1,382	41.2	15.1	19.5	24.1 (8.3)*	58.8	1.27
All types	Institutions	6,344	89.5	3.9	4.6	1.9 (0.3)*	10.5	0.19
	Private schools	7,169	85.8	3.9	6.9	3.5 (0.9)*	14.2	0.28
	L.C.C. schools	13,381	73.5	6.2	12.0	8.3 (2.5)*	26.5	0.55

* Unbracketed figures include missing canines and molars, which are assumed to have been extracted for caries. Figures in brackets show these teeth as percentages of the total number.

† ACF (average caries figure) = $\frac{\text{Total caries figure}}{\text{Total no. of teeth (including extractions)}}$

The average caries figure (ACF), which indicates the extent of caries, was lowest for all types of teeth together in the institutional group (0.19) and highest in the L.C.C. schools group (0.55), with the figure for private schools (0.28) in an intermediate position but nearer to the institutional than the L.C.C. schools figure.

Thus it is seen that, whereas the structure of the teeth was definitely the best in the children attending private schools and worst in those living in institutions, there was less caries in the teeth of the institutional children than in the private schools group. The L.C.C. group had most caries, much more than either of the other two, in spite of the fact that the structure of their teeth was better than that of the institutional children, although not nearly as good as that of the private school group.

Relationship between Structure of Teeth and their Susceptibility to Caries

As would be expected from previous investigations (Mellanby, 1923, 1934; Mellanby and Coumoulos, 1946),

The similarities and discrepancies between the findings for the three groups of children are perhaps more clearly seen if they are set out as shown below. (The figures given here are for all types of teeth together and not, as in Table V, for individual types.)

No caries was found in:

Inst.	Private Schools	L.C.C. Schools
99.7% ..	98.7% ..	98.1% ..
95.2% ..	84.4% ..	83.2% ..
72.2% ..	48.6% ..	40.9% ..
45.8% ..	13.8% ..	15.3% ..

of teeth of good structure (Hy₀)
of teeth slightly defective in structure (M-Hy₁)
of teeth defective in structure (M-Hy₂)
of teeth very defective in structure (M-Hy₃)

Severe caries was found in:

0.0% ..	0.0% ..	0.1% ..
0.3% ..	1.8% ..	1.2% ..
3.7% ..	9.3% ..	12.0% ..
8.4% ..	40.2% ..	41.0% ..

of teeth of good structure
of teeth slightly defective in structure
of teeth defective in structure
of teeth very defective in structure

From these figures the gradual decrease in percentage of teeth free from caries and increase in percentage with extensive disease as the structure deteriorates is apparent in each group; but there is a great difference between the institutional group and the other two in the proportion of non-carious and severely carious teeth associated with the more severe grades of structural defect (M-Hy₂ and M-Hy₃). The possible significance of these findings will be discussed later.

in the L.C.C. schools. The extraction rate was highest (9.6%) in the L.C.C. schools, next highest in the private schools (6.3%), and lowest (2.9%) in the institutions.

Staining of Surface Enamel or of Films on the Enamel

A record was made of the incidence of superficial staining of the teeth, so often seen in children, and it was found in all three groups (see Table VIII) that in those children with some or all of their teeth showing black or dark-brown

TABLE V.—Incidence of Caries in Teeth with Varying Grades of Structure

Grade of Structure	Place of Investigation	Incisors		Canines		Molars	
		Total No. Examined	% Carious	Total No. Examined	% Carious	Total No. Examined	% Carious
Hy ₀	Institutions	1,261	0.5	518	0.0	250	0.4
	Private schools	1,970	0.8	1,071	0.8	758	3.0
	L.C.C. schools	2,837	1.2	1,514	1.1	550	7.0
M-Hy ₁	Institutions	891	2.7	630	2.1	956	8.6
	Private schools	523	8.8	330	6.4	1,330	20.6
	L.C.C. schools	1,399	11.2	947	8.0	1,987	25.0
M-Hy ₂	Institutions	185	21.6	73	13.7	1,057	29.8
	Private schools	149	30.2	36	38.9	669	56.8
	L.C.C. schools	536	39.2	169	29.6	2,127	66.5
M-Hy ₃	Institutions	13	38.5	3	0.0	91	58.2
	Private schools	8	75.0	2	0.0	77	89.6
	L.C.C. schools	105	81.0	16	68.9	335	92.3
G-Hy	Institutions	80	38.8	24	0.0	197	19.8
	Private schools	34	38.2	12	0.0	42	38.1
	L.C.C. schools	165	62.4	24	20.8	101	52.5

NOTE.—(a) This table does not include the few teeth shown under the heading "Hy unclassified" in Table III. (b) In some grades of structure the numbers of teeth are relatively small and the percentage differences between the groups may thus be exaggerated.

The proportion of carious teeth among those classified as grossly hypoplastic (G-Hy) varies considerably, but is not generally nearly as high as that for the M-Hy₃ group (see Table V).

stains there was less caries than in those with no stain or with green stain. Most caries occurred in children who had some green stain. The relation between these stains and the incidence of caries has been discussed by a few

Arrest of the Carious Process and Treatment of Teeth

In charting the incidence of arrest, only teeth in which the carious area had become definitely hard, though not necessarily smooth and polished, were recorded as showing this phenomenon. Partial arrest was ignored. Under these conditions the percentages of carious teeth showing arrest of the disease were about the same in the institutions and L.C.C. schools, but lower in the private schools, as is seen in Table VI. On the other hand, there was, as Table VII

TABLE VIII.—Amount of Caries in Relation to Superficial Staining of Teeth

Children with:	Percentage of Carious Teeth			ACF		
	Inst.	Private Schools	L.C.C. Schools	Inst.	Private Schools	L.C.C. Schools
No stain	11.5	12.9	23.1	0.21	0.25	0.48
Black and dark-brown stains	5.7	2.9	15.4	0.11	0.05	0.30
Green stain	20.2	22.5	33.0	0.39	0.48	0.69

TABLE VI.—Teeth Showing Arrest (Spontaneous "Healing") of the Carious Process

Place of Investigation	No. of Carious Teeth Present	% of Carious Teeth Present Showing Arrest	% Showing Arrest	
			If Filled Teeth are Omitted	If Filled Teeth and those Treated with Silver Nitrate are Omitted
Institutions	645	20.6	21.7	21.9
Private schools	955	15.4	19.2	19.7
L.C.C. schools	3,203	21.5	22.1	22.8

TABLE VII.—Carious Teeth Extracted, Treated by Silver Nitrate, or Filled

Place of Investigation	Total No. of Carious Teeth (Including Extractions)	Treatment			Total Percentage of Carious Teeth Treated
		% Extraction	% Silver Nitrate*	% Filled*	
Institutions	664	2.9	1.1	4.7	8.6
Private schools	1,019	6.3	1.8	18.5	26.6
L.C.C. schools	3,545	9.6	2.8	2.4	14.8

* The figures in these columns would have been slightly higher if the extracted teeth had been excluded from the total numbers in the second column.

shows, far more treatment, especially that taking the form of fillings, among the children attending private schools than among the other two groups, 18.5% of carious teeth being filled, as against 4.7% in the institutions and 2.4%

other workers, including Pedersen (1946), who also observed that children with black stains were on the average less affected with dental caries than children without such stains on their teeth, and that those with green or yellow stains seemed to be more susceptible to the disease.

Discussion

An account has been given of the dental condition of the deciduous teeth of three groups of 5-year-old children examined in 1945, one group residing in institutions and the other two living at home and attending private schools and L.C.C. schools.

The first fact observed in this survey was that in the institutions 66.1% and in the private schools 54.7% of the children were free or almost free from caries, whereas in the L.C.C. schools the proportion in this category was of quite another order—namely, 28.1%. It was clear, therefore, either that there was some much more powerful protective factor against caries at work in the children in institutional and private schools than in those at the L.C.C. schools—and if this was so it appeared to be even more potent in the first than in the second of these groups—or that in the children attending L.C.C. schools there was some more powerful caries-producing factor in action.

Before discussing the possible reasons for these differences between the groups further details must be considered. When the teeth themselves, as opposed to the dentition as a whole, are taken into account, and when structure is pitted against caries, some interesting facts come to light. For instance, in the institutions 32.3% of the teeth were of good structure (Hy₀), in the private schools 54%, and in the L.C.C. schools 38%. The relationship between the groups was quite different when the incidence of caries was considered, since in the institutions 10.5% of the teeth were carious, in the private schools 14.2%, and in the L.C.C. schools 26.5%. Thus, whereas by far the best dental structure was found in the private schools and the worst in the institutions, the latter had the lowest incidence of caries. In the L.C.C. schools the structure of the teeth was rather better than in the institutions, but the caries incidence was very much higher than that of either of the other two groups.

Moreover, though in each group of children the better the structure the less the caries, yet for any given grade of structural defect there were fewer teeth with caries among the institutional children than among those in the other groups. For instance, in examining the molars it was found that:

In grade M-Hy₁

8.6%	were carious in the institutions
20.6%	" " " " private schools
25.0%	" " " " L.C.C. schools

In grade M-Hy₂

29.8%	were carious in the institutions
56.8%	" " " " private schools
66.5%	" " " " L.C.C. schools

In grade M-Hy₃

58.2%	were carious in the institutions
89.6%	" " " " private schools
92.3%	" " " " L.C.C. schools

Similar differences between the groups could be quoted for other types of teeth.

The incidence of arrest of the carious process was rather lower in the private schools than in either of the other groups, where the results were about the same.

In view of the hypothesis, based on previous investigations by one of us and confirmed by colleagues, that the better the structure of the teeth the more likely they are to resist attack by caries, these results were clearly in the nature of a challenge, since it was found, in short, that (a) in each of the three groups the ordinary rule held—namely, there was a direct relation between structure and incidence of caries—but (b) comparing the three groups of children one with another the opposite conditions appeared to exist, for the children in the institutions, with the worst structure, had the least caries.

In comparing first the institutional and the private school children, there are two outstanding facts to be explained in the somewhat anomalous results of the survey: (1) Why was the structure of the teeth of the private school children better than that of the institutional children? and (2) Why in the teeth of the institutional children, which were worse formed, was there less caries than in the better-formed teeth of the private school children? It is necessary in this case to work on the basis of what is known, and, as previously mentioned, the two points that have been established are: (a) that diets of high calcifying qualities in the pre-eruptive stage—that is, in pregnancy and lactation of the mother and in the early life of the child—produce better-formed teeth than diets poorer in this respect; and (b) that these same diets when given after eruption suppress, to some extent at least, the development of dental caries and tend to arrest the disease if present. Thus we have some of

the same factors at work in the pre-eruptive and the post-eruptive stages, but in the pre-eruptive period the effect of the diet is to control the structure of the teeth and in the post-eruptive to influence the development and course of dental caries. The problem, however, is not as simple as it looks because, clearly, the better-formed teeth resulting from the high calcifying diet of the pre-eruptive period will in themselves be more resistant to dental caries than badly formed teeth when both are exposed to the same post-eruptive diet. The teeth under examination in this work are the deciduous set, and since their calcification begins at about the twentieth week of foetal life and eruption is more or less complete when the child is about 2 years old, it is during this period that the type of feeding must control the actual structure of the teeth. Since, however, the lower incisors begin to be erupted at the age of 6 months, the period from six months onwards must also be regarded as a post-eruptive age for an increasing number of deciduous teeth. After about two years the environmental effects would be wholly post-eruptive, while before six months the effect can be regarded as wholly pre-eruptive.

To explain the better-formed teeth of the private school children as compared with those of the institutional children, it is necessary to show that the diet of the former in pre-natal and early life was better from the point of view of calcifying properties than that of the institutional children during the same period of development. While actual proof cannot be given, we do not doubt that this is in fact the case, though the levelling up of the nation's dietaries that has taken place during recent years, and particularly during the war, has probably made this difference less than it used to be. Indeed, if this were to-day only a question of the well-to-do mother *versus* the poor mother, increased facilities for getting protective foods, either free or at a cheap rate, are now so great that big differences might not be expected. The children, however, who become the responsibility of an institution are recruited largely from unsatisfactory homes where the mothers are often less well informed and more neglectful of their children, either from force of circumstances or because the children are unwanted. It is to be expected, therefore, that so long as they continue to live under such conditions the children will be less well fed from the point of view under discussion than their contemporaries in better circumstances who will ultimately attend private schools.

As a class the well-to-do mothers are more intent on following medical advice during pregnancy and lactation than the mothers of the institutional children, and this advice nowadays usually includes an injunction to drink plenty of milk and to add cod-liver oil and other sources of vitamin D to the diet. Again, the children of the former, when weaned, are more likely to be fed in early life according to the same principles. From all points of view, therefore, it might be expected that the teeth of the private school children would be of better structure than those of the institutional children. When, however, we turn to the post-eruptive stage matters are not the same. As the children of the well-to-do mother grow older there is a tendency for them to become more pampered and for dietary preferences to be considered. If, for instance, such an item as milk or eggs is disliked it may be omitted, and the diet generally becomes of lower nutritional and calcifying quality. Sometimes, too, the daily dose of cod-liver oil or other preparation may be missed solely because parents or nurses do not like it or because they are careless in giving it to the children. In other words, the post-eruptive is often not so good as the pre-eruptive dietetic condition of children of this class. When, however, we consider the institutional children the matter is different.

On entry to an institution relatively neglected children come under conditions where feeding arrangements are regular and the diet is generally of a high quality from a nutritional standpoint—and incidentally from the point of view of calcification, as visits to institutions will confirm. This is due largely to the steadily increasing interest in the welfare of these children during recent years, but partly to wartime stringency. It is known that priority supplies, including milk, eggs, and cod-liver oil for institutional children, are regularly obtained. Moreover, it is almost certain that they are consumed, since individual likes and dislikes, which tend to disrupt the feeding arrangements of children of well-to-do mothers, cannot be considered in a large community.

Such a state of affairs as that outlined above would in our opinion account largely for the otherwise anomalous findings in the institutions and private schools.

So far as could be judged from evidence kindly supplied by teachers in the various schools and by health visitors, the children attending L.C.C. schools would, on the average, be in a position in regard to diet intermediate between those at the private schools and those in institutions during the period of tooth development, although nearer the latter than the former; but in the post-eruptive years they would probably tend, because of the financial status of their parents and for other reasons, to be in a somewhat worse position than the private school children, though from the standpoint of this survey they would be subject to similar disabilities in regard to dietary likes and dislikes. If this were so, it would explain the fact that the structure of the deciduous teeth of these children was not nearly as good as that of the private school group, though somewhat better than that of the institutional children, and that their caries incidence was greater than that of either of the other two groups.

In this discussion only those environmental conditions—and especially the calcifying qualities of the diet—which have been established by experiment as influencing dental structure and incidence of caries have been considered. They seem to explain the facts as described. At the same time there are certainly other factors at work influencing the incidence of caries, about which we have no certain knowledge. It is said that fluorine is an important anti-caries factor, and, in England, Maldon is cited as a typical example. Here the fluorine content of the water is high and there is stated to be little dental caries compared with that in other parts of the country. In 1945 one of us (Counmoulos, 1946) found only 11.2% of deciduous teeth carious in 5-year-old children attending public elementary schools in that district—about the same proportion as was found in the present survey in the institutional children, few if any of whom were born or reared in Maldon. Again, the percentage of carious teeth in the private school group was not very much higher than that of the Maldon group. In the Maldon teeth, as in the three groups reported here, there was a direct relation between caries and M-hypoplasia, suggesting that the small amount of caries was again largely the result of the good structure rather than the influence of the fluorine in the water, although it seems that fluorine probably plays some part in the sequence of events.

Other possible factors affecting the initiation or prevention of caries, such as the effect of carbohydrates, the question of dental treatment, and the influence of tooth-brushes, have been considered in earlier publications (Mellanby and Counmoulos, 1944, 1946) dealing with the incidence of dental caries among school-children and will not be discussed here, as such discussion would at present lead only to negative conclusions. Still, the condition of the teeth of the institutional children as regards caries is,

in view of their defective structure, remarkable, and if there are secrets yet to be discovered which can fully explain these results, as there almost certainly are, every effort should be made to reveal them.

Summary

A description is given and a comparison is made of the dental condition in 1945 of three groups of 5-year-old children, one residing in institutions and the others living at home and attending private schools and L.C.C. schools.

The proportion of children free or almost free from caries was greatest in the institutions, somewhat less in the private schools, and very much less in the L.C.C. schools.

Examination of the individual teeth revealed that, whereas the dental structure was by far the best in the children attending private schools and worst in those living in institutions, caries incidence and extent were lower in the latter than in the former. In the L.C.C. school group the structure of the teeth was slightly better than in the institutional group but far worse than in the private school group, and the incidence and the extent of caries were the highest of all.

Although there was a direct relation between the structure of the teeth and the incidence and extent of caries among children of each group—that is to say, the better the structure the less the caries—this did not hold between children of the different groups: thus in the institutional group teeth of a given grade of structural defect had much less caries than teeth of the same structure in either of the other two groups.

The incidence of arrest of the carious process was approximately the same in the institutions and L.C.C. schools and rather lower in the private schools.

In each group of children black or dark-brown superficial staining of the teeth appeared to be associated with a lower incidence, and green staining with a higher incidence, than the absence of stain.

Possible reasons for the striking contrasts between the groups of children in regard to their dental structure and caries incidence and extent are discussed, and it is suggested that the calcifying properties of the respective diets at different periods, both pre-eruptive and post-eruptive, are an important key to the situation.

Surveys of this kind are possible only with the good will and co-operation of many people. We should therefore like to acknowledge our great indebtedness to the following, among others: (1) the proprietors, head teachers, and assistants of the private schools, who were always very kind and helpful in every way; and (2) the superintendents, matrons, and teachers in the institutions, who were ready not only to assist us directly, but, in addition, to provide much information for which we asked. Our thanks also are due to Dr. H. E. Magee, who kindly arranged our visits to the institutions, and to Mrs. M. Kelley for her help, generously given at all times.

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Mr. Hardman, Parliamentary Secretary to the Ministry of Education, announced in the House of Commons recently that the Foundation of Education Research was being asked to undertake an inquiry into the effects on children of various forms of punishment and rewards. Mr. Hardman made this statement in reply to a question by Mr. P. Freeman (Newport, Lab.), who raised the question of corporal punishment of children in State schools. Mr. Hardman stated that his Ministry had not advocated the use of corporal punishment, but public opinion had to be convinced that without it discipline could be maintained, and he personally deplored its continuance as a means of discipline. It is to be hoped that the committee of inquiry will include among its members representatives of the school medical service and of medical psychology, and that they will examine evidence from countries where corporal punishment is prohibited in schools.