A descriptive and comparative study of oral health in 8-year-old Swedish children

C-G. CROSSNER & A-K. HOLM

Department of Pedodontics, University of Umeå, Umeå, Sweden

Crossner, C-G. & Holm, A-K. A descriptive and comparative study of oral health in 8-year-old Swedish children. *Acta Odont. Scand.* 33, 135—142, 1975.

The aim of the study was to assess the oral health of a group of children, and to compare the findings with the results from an investigation performed 4 years earlier in children of the same age and living in the same area. The material consisted of 149 randomly selected 8-year-old children. The study included examination of caries and the state of the gingival conditions, enamel hypoplasia and opacities, supragingival calculus and extrinsic stains. Determinations were also made of the rate of secretion, pH and buffer effect of stimulated saliva. Socio-economic data and anamnestic dental data were noted. The investigation showed a decrease in caries frequency in the primary teeth, but not in the permanent teeth, during the four-year-period. As in the former investigation, regression analyses showed a negative correlation between the level of education of the parents and caries indices, and that the variation of the gingival indices could be explained by socio-economic factors. In addition, a negative correlation was found between the caries index for primary teeth and the rate of secretion of the saliva and the presence of supragingival calculus.

Key-words: Dental caries; gingivitis; oral health; saliva

Anna-Karin Holm, Department of Pedodontics, University of Umeå, Norrlandsgatan 18 B, S-902 48 Umeå, Sweden

Recent epidemiologic studies in children in Sweden have shown significant correlations between socio-economic factors and dietary habits, on one hand, and caries and gingivitis, on the other (*Samuelson, Grahnén & Arvidsson*, 1971 b; *Köhler & Holst*, 1973; *Martinsson*, 1973; *Holm et al.*, 1975). According to these correlations, socioeconomic factors, particularly the level of education of the parents and the social class to which they belong, influence the dietary habits of the children, which in turn have a direct effect on their dental status. The dietary factor that has proved to be of greatest interest from a dental point of view is the consumption of high-sugar snacks between meals, particularly sweets, soft drinks, buns and cakes.

It may be assumed that the expanding service for the care of the health and dental health of children, with emphasis on prophylaxis, will produce continuous improvements. This makes periodic investigations of the general and dental health of the children desirable to enable assessment of the effect of the prophylactic and therapeutic treatment given.

In 1967 a group of 8-year-old children in Umeå were examined regarding dietary habits and oral health (*Samuelson, Grahnén*

Received for publication, January 14, 1975

& *Lindström*, 1971 a). The purpose of the present investigation was

to assess the dental health of a group of 8-year-old children examined in 1971, and

to compare certain variables with those in the 1967 investigation.

With the aid of multiple regression analysis, the effect of certain dental and socio-economic variables on caries and the state of gingiva was explored.

MATERIAL AND METHODS

The material consisted of 149 randomly selected 8-year-old children (79 boys and 70 girls) living in the town of Umeå. The mean age of the children was 8 years 4 months and the median age 8 years 3 months. In the 1967 investigation the material consisted of 99 boys and 100 girls in Umeå with a mean age and a median age of 8 years 4 months. In both investigations the children had received annual treatment of the permanent dentition, but only emergency treatment of the primary teeth. In addition, as the fluoride content of the drinking water in Umeå is less than 0.1 mg/l all the children had rinsed their mouth with NaF-solution (0.2%) once a week under supervision at school.

In order to make comparisons between the 1967 and 1971 investigations possible, the same criteria and examination methods were used with the exception that radiographs were taken in all the children in 1971 but only in 5% in 1967. Moreover, the examinations were carried out during the same time of the year, and gingival findings by the two examiners were calibrated before the gingival indices were recorded.

Dental examination

The dental examination consisted of assessment of:

1 Decayed, missing and filled teeth and surfaces
2 Gingival status (*Löe & Silness*, 1963)
3 Enamel hypoplasia and opacities
4 Supragingival calculus
5 Extrinsic stains
6 Rate of secretion, pH and buffer effect of stimulated saliva.

The first five items were estimated in the way described by *Samuelson et al.* (1971 a).

In the examination of the saliva, saliva stimulated by chewing was used. The rate of secretion and pH were determined with methods described by *Andersson et al.* (1974) and the buffer effect by the method of *Ericsson* (1959).

In the radiographic examination orthopantomograms were obtained of each child as well as two posterior bitewings.

Anamnestic, dental and socio-economic data were obtained at personal interviews with the children's mothers. These interviews were made by specially trained interviewers who were the same as those in the 1967 investigation. The methods have been described by *Holm & Arvidsson* (1974) and by *Samuelson et al.* (1971 a, 1975).

Variables used in the multiple regression analysis

Regressands:

Decayed, missing and filled teeth and surfaces (DMFT and DMFS)
Gerdin's index*)
Gingival Index

Table I. *Number of erupted permanent teeth, decayed, missing and filled permanent teeth and surfaces (DMFT- and DMFS-values) and Gerdin's index*

	No. of children	No. of erupted permanent teeth		DMFT		DMFS		DS		FS		Gerdin's index	
		$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
1971 Boys	79	11.19	1.51	3.67	1.14	5.30	2.34	2.04	1.76	3.27	2.21	0.43	0.22
Girls	70	11.67	1.88	3.76	1.18	5.27	2.09	2.10	1.48	3.17	2.04	0.45	0.21
Total	149	11.42	1.72	3.71	1.16	5.29	2.23	2.07	1.64	3.22	2.14	0.44	0.22
1967 Boys	99	10.58	2.15	3.32	1.38	4.17	2.27	0.76	1.23	3.41	2.19	0.52	0.21
Girls	100	11.85	2.07	3.60	1.17	4.49	2.00	0.90	1.23	3.59	1.81	0.50	0.21
Total	199	11.22	2.11	3.46	1.29	4.33	2.14	0.83	1.23	3.50	2.00	0.51	0.21

Regressors:

Dental variables
- rate of secretion (ml/min), pH and buffer effect (resulting pH) of saliva
- supragingival calculus (yes or no)
- consumption of fluoride tablets (number of years)
- toothbrushing frequency (number of times per day)
- toothbrushing started (<2 years, 2—4 years, >4 years)
- help with toothbrushing (yes or no)
- finger- or dummy-sucking (number of years)

Socio-economic variables
- father's level of education
- mother's level of education
- number of children
- income per capita

Statistical methods

Student's t-test, chi-square test and linear and multiple regression analyses were used (*Snedecor & Cochran*, 1971). The regression analyses have been described in detail by *Samuelson et al.* (1971 b). The levels of significance used were **($p<0.01$), ***($p<0.001$).

*) The caries index for the primary dentition was calculated according to *Gerdin* (1966) and in this study called Gerdin's index. For further information, see also *Samuelson et al.* (1971 b).

RESULTS

Caries

Means and standard deviations of DMFT, DMFS, DS, FS and Gerdin's index are given in Table I. No significant difference between sexes was found. Gerdin's index ranged from 0.00 to 0.88 and that of DMFS from 0 to 12.

Of the decayed and filled surfaces of the permanent teeth, 62 % were occlusal surfaces, 27 % buccal and lingual surfaces, and 11% approximal surfaces. Of the approximal lesions, 68% could be diagnosed only radiographically. Only one child had no decayed or filled primary or permanent teeth. Of all the first permanent molars, 12% were free from caries or fillings. While no permanent tooth had been extracted, the extractions of primary teeth because of caries amounted to 1.15 per child. The frequency

Table II. *Number of decayed surfaces diagnosed by radiography only*

	No. of children	Primary teeth		Permanent teeth	
		$\bar{x}$	S.D.	$\bar{x}$	S.D.
Boys	79	2.49	2.41	0.49	0.84
Girls	70	2.13	2.30	0.56	1.05
Total	149	2.32	2.37	0.52	0.95

of secondary caries of the permanent teeth was 8 % of all filled surfaces.

The number of surfaces with primary caries that could be diagnosed only with the aid of posterior bitewings is given in Table II.

The caries index in the 1967 investigation differed from that in the 1971 study in respect of both the primary and the permanent dentitions (Table I). DMFS and DS were higher ($p<0.001$) in the 1971 study, while Gerdin's index was lower ($p<0.01$).

Gingival status

The mean and standard deviation of the Gingival Index was 0.79 ± 0.32. No statistically significant differences were found between boys and girls. Two children had a Gingival Index of 0.00, while the highest value recorded was 1.84.

The state of the gingiva was almost the same in 1967 and 1971 (Fig. 1). The percentage distribution of the various scores 0, 1, 2, 3, is given in Fig. 2.

Extrinsic stains, enamel hypoplasia and opacities and supragingival calculus

The frequencies are clear from Table III. No statistically significant differences between the sexes were found. Children with supragingival calculus had a lower mean Gerdin's index than children without ($p<0.01$).

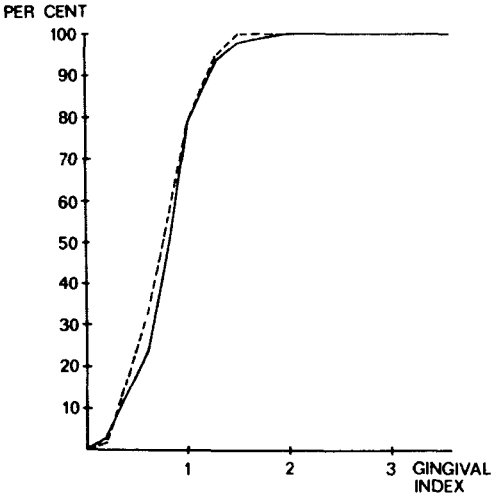

Fig. 1. Frequency polygon of the gingival index in 1967 (- - - -) and 1971 (————).

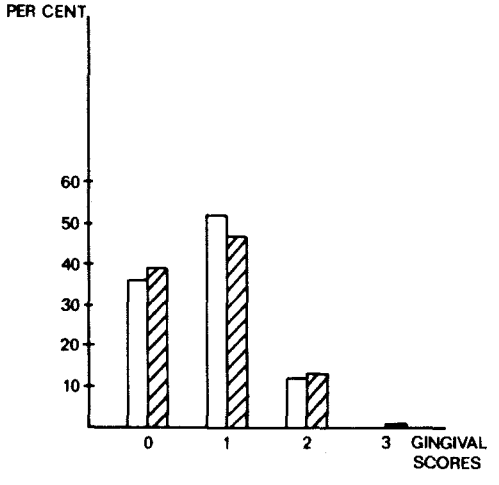

Fig. 2. Percentage distribution of the different gingival scores 0, 1, 2, 3. Open bars: 1967, hatched bars: 1971.

Table III. *Percentage of children with extrinsic stains, enamel hypoplasia and opacities, supragingival calculus*

	No. of children	Extrinsic stains			Enamel hypoplasia	Enamel opacities	Supragingival calculus
		Green	Black-brown	Yellow			
Boys	79	4	4	4	6	10	19
Girls	70	0	6	6	8	11	24
Total	149	2	5	5	7	11	22

Table IV. *Salivary flow rate in ml/min, pH and buffer effect (resulting pH) of stimulated saliva*

	No. of children	Flow rate		pH		Buffer effect	
		$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Boys	79	1.17	0.53	7.45	0.19	5.19	1.37
Girls	70	0.87	0.50	7.45	0.22	4.88	1.24
Total	149	1.03	0.54	7.45	0.20	5.04	1.33

For further details of median, maximum and minimum values and percentiles see *Andersson et al.* (1974)

Saliva

Mean values for the rate of secretion, pH and buffer effect of the saliva are given in Table IV. The values found for both the rate of secretion and the buffer effect were higher in the boys than in the girls, but only the former difference was statistically significant ($p<0.001$). Linear regression analysis showed that both the rate of secretion and the buffer effect were negatively correlated with Gerdin's index ($p<0.001$ and $p<0.01$, respectively).

Table V. *The percentage distribution of toothbrushing frequency in 1971*

	No. of children	>2 times/ day	2 times/ day	1 time/ day	Never or seldom
Boys	79	5	61	29	5
Girls	70	14	67	19	0
Total	149	9	64	24	3

Anamnestic data

Table V gives the frequency of toothbrushing. Three per cent of the children, all boys, did not begin to brush their teeth before they were 4 years old. Nine per cent always received help from their parents. No statistically significant correlation was found between the frequency of toothbrushing and the level of education of the parents. The frequency of toothbrushing did not differ statistically from that in the 1967 investigation. Of the children, 8% had consumed NaF-tablets (0.25 mg F) for at least 2 years. Seventy-seven per cent had never used such tablets. Fluoridated tooth paste was used by 93% of the children, which means that of those children who regularly brushed their teeth, only 3% used non-fluoridated dentifrice. Seventy-five per cent of the children still had or had had some form of sucking habit. The frequency of dummy-sucking and finger-sucking is given in Fig. 3. Seven per cent of the children still sucked their fingers, while 1% still used a dummy. Of the dummy-suckers, in all 56%, 4% had dipped the dummy in sugar.

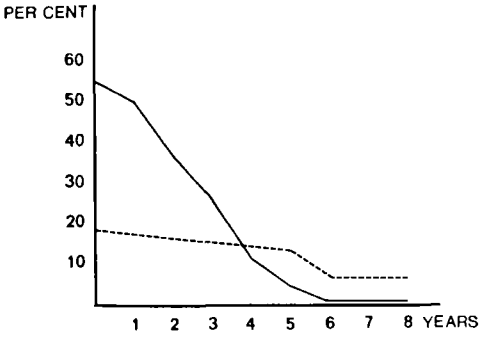

Fig. 3. Incidence of dummy- and finger-sucking at different ages (——— dummy, - - - finger).

Regression analyses

The results of the multiple regression analyses are given in Table VI. As in the 1967 investigation, a negative correlation was found between the level of education of the parents and caries indices, and the Gingival Index could be explained by

Table VI. *The relationship between dental and socioeconomic variables. R^2 in % shows the amount of the variation of the regressands explained by the regressors. A preceding minus sign of significance (*) denotes a negative correlation*

Regressands	Salivary flow rate	Supragingival calculus	Father's education	Mother's education	No. of children	R^2 in %
DMFS			−***			14.5
Gerdin's index	−***	−**		−***		30.2
Gingival index					**	9.9

socio-economic factors. In addition a negative correlation was found between Gerdin's index and the rate of secretion of saliva and the presence of supragingival calculus.

DISCUSSION

The mean value of DMFS was higher than in the 1967 investigation. The difference was due to the increase in the number of decayed surfaces (DS) (Table I). This may be explained by the fact that in the 1967 investigation bitewings were obtained of only 5% of the children, compared with 100% in the 1971 study. If the caries demonstrable only by radiography were excluded, the difference would no longer be significant. In addition, the mean number of erupted permanent teeth was larger in 1971 (Table I). But the mean value found for Gerdin's index was significantly lower in 1971, and if caries demonstrable only by radiography were excluded, the difference will be still more striking ($p<0.001$).

Thus, no noteworthy change had occurred in caries of the permanent dentition. Neither was any such change expected, because in this age group caries is usually confined to the fissure system of the first permanent molars, where caries varies *but little with* socioeconomic factors (*Mansbridge*, 1960) or prophylactic measures otherwise tending to prevent caries (*Koch*, 1967).

The improvement in the caries situation in the primary dentition, on the other hand, was striking in that the 1971 children had a mean of approximately four decayed or filled surfaces fewer than the 1967 children. This decrease in the frequency of caries can probably to a large extent be explained by changes in dietary habits in Umeå between 1967 and 1971 (*Samuelson et al.*, 1975) because brushing of the teeth and the use of fluoride prophylaxis appear not to have changed during this period.

The value of radiography in the diagnosis of caries is obvious from the fact that 68% of the approximal lesions in the permanent teeth could be confirmed only with the aid of radiography and that almost three carious lesions in each child could be diagnosed only radiographically (Table II).

The status of the gingiva in 1971 was almost the same as that in 1967 (Figs. 1 and 2). Neither was any change expected because toothbrushing habits had not changed during this period. According to the regression analysis (Table VI), a social variable, »number of children» was most closely correlated with the state of the gingiva. This may perhaps be explained by the assumption that the larger the sibships the less help each sibling receives

with toothbrushing, for example. The correlation is probably not due to chance because the same type of correlation was found with a similar variable in the 1967 investigation, namely »persons per room». No correlation was found between the level of education of the parents and the toothbrushing habits of the children. It is true that caution must be exercised in the evaluation of the frequency of toothbrushing reported by the parents, but probably no significant correlation is to be expected. While the socio-economic variable is closely related to the development of caries in children, which was shown both in this investigation and in others (*Samuelson et al.*, 1971 b; *Martinsson*, 1973), a relation between oral hygiene and the development of caries has been difficult to demonstrate in these ages (*Sutcliffe*, 1973).

The frequency of extrinsic stains was about 12 %, which is lower than that reported in earlier investigations of children, for whom a figure of at least 25% (*Gülzow*, 1963; *Sutcliffe*, 1967) has been given. This is probably because of the attention paid by the school dental service to prophylactic measures.

The total frequency of enamel hypoplasia and of opacities (18 %) as well as supragingival calculus (22%) appears to be higher than that in earlier investigations. Recent studies have, however, shown equally high figures. Thus, *Gerdin* (1969) reported enamel hypoplasia and opacities in 22% of another series of Swedish school children in a non-fluoridated district. The frequency of supragingival calculus in a larger series of 9—11-year-old children »attending schools in lower socio-economic neighbourhoods of San Fransisco, U.S.A.» was found to be more than 50% (*Suomi et al.*, 1971). This increasing frequency despite increasing dental prophylaxis may at first sight appear strange, but it can probably be explained by improved diagnostic methods.

A more careful registration can probably also explain why the clinically frequently noticed correlation between the presence of calculus and a low caries frequency in adults here is confirmed already in children. This, together with the negative correlation of the rate of secretion and buffer effect in saliva with the frequency of caries in these children, clearly shows the important role played by saliva in the aetiology of caries. In addition, the multiple regression analysis showed a higher R^2-value than in the 1967 investigation, partly because of these salivary variables.

Dummy-sucking (56%) was initially three times as common as finger-sucking (19%). On the other hand, children who used a dummy stopped sucking earlier, and after four years of age finger-sucking was the most common habit. In about 10% it persisted up to school age. Similar figures have been reported in other Swedish investigations (*Klackenberg*, 1971; *Larsson*, 1973).

As in 4-year-old children (*Holm et al.*, 1975), a clear improvement in caries frequency was found in 8-year-old children during the four year period 1967—1971, an improvement which can probably be ascribed to dietary changes during that period (*Samuelson et al.*, 1975).

REFERENCES

Andersson, R., Arvidsson, E., Crossner, C.-G., Holm, A.-K., Månsson, B. & Grahnén, H. 1974. The flow rate, pH and buffer effect of mixed saliva in children. J. Int. Assoc. Dent. Child. 5, 5—12

Ericsson, Y. 1959. Clinical investigations of the salivary buffering action. Acta Odont. Scand. 17, 131—165

Gerdin, P.-O. 1966. Caries-indices for the mixed dentition. Thesis. Almqvist & Wiksell, Stockholm

Gerdin, P.-O. 1969. Kliniskt-makroskopiskt iakttagbara rubbningar av de permanenta tändernas emaljmineralisation. Clinico-macroscopically observable disturbances of the enamel mineralization of the permanent teeth. I. Odont. T. 77, 5—38

Gülzow, H. J. 1963. Schwarze und grüne Zahnbeläge. Untersuchungen über ihre Häufigkeit und über ihre Beziehungen zur Kariesfrequenz. Dtsch. Zahnärztl. Z. 18, 1370—1376

Holm, A.-K. & Arvidsson, S. 1974. Oral health in preschool Swedish children. 1. Three-year-old children. Odont. Rev. 25, 81—97

Holm, A.-K., Blomquist, H. K:son, Crossner, C.-G., Grahnén, H. & Samuelson, G. 1975. A comparative study of oral health as related to general health, food habits and socioeconomic conditions of 4-year-old Swedish children. Community Dent. Oral Epidemiol. 3, 34—39

Klackenberg, G. 1971. A prospective longitudinal study of children. Data on psychic health and development up to 8 years of age. Acta Paediat. Scand. 60, Suppl. 224

Koch, G. 1967. Effect of sodium fluoride in dentifrice and mouthwash on incidence of dental caries in schoolchildren. Odont. Revy 18. Suppl. 12

Köhler, L. & Holst, K. 1973. Dental health of four-year-old children. Acta Paediat. Scand. 62, 279—288

Larsson, E. 1971. Dummy- and finger-sucking habits with special attention to their significance for facial growth and occlusion. 1. Incidence study. Sven. Tandlaek.-Tidskr. 64, 667—672

Löe, H. & Silness, J. 1963. Periodontal disease in pregnancy. I Prevalence and severity. Acta Odont. Scand. 21, 533—551

Mansbridge, J. N. 1960. The influence of social and economic conditions on the prevalence of dental caries. Arch. Oral Biol. 1, 241—253

Martinsson, T. 1973. Socio-odontologic investigation of schoolchildren with high and low caries frequency. Odont. Revy 24, Suppl 24

Samuelson, G., Blomquist, H. K:son, Crossner, C.-G., Holm, A. K. & Grahnén, H. 1975. An epidemiological study of child health and nutrition in a northern Swedish county VII. A comparative study of general and dental health, food habits and socio-economic conditions in 4-year-old children. Acta Paediat. Scand. 64, 241—247

Samuelson, G., Grahnén, H. & Arvidsson, E. 1971 b. An epidemiologic study of child health and nutrition in a northern Swedish county. VI. Relationship between general and oral health, food habits and socio-economic conditions. Am. J. Clin. Nutr. 24, 1361—1373

Samuelson, G., Grahnén, H. & Lindström, G. 1971 a. An epidemiologic study of child health and nutrition in a northern Swedish county. V. Oral health studies. Odont. Revy 22, 189—220

Snedecor, G. W. & Cochran, W. G. 1971. *Statistical methods.* Sixth edition. The Iowa State University Press, Ames, Iowa, U.S.A.

Suomi, J. D., Smith, L. W., McClendon, B. J., Spolsky, V. W. & Horowitz, H. A. 1971. Oral calculus in children. J. Periodont. 42, 341—345

Sutcliffe, P. 1967. Extrinsic tooth stains in children. Dent. Pract. 17, 175—179

Sutcliffe, P. 1973. A longitudinal clinical study of oral cleanliness and dental caries in schoolchildren. Arch. Oral. Biol. 18, 765—770