ORAL HEALTH STATUS OF THIRD GRADE CHILDREN IN NORTH YORK

Clinical and Parent-reported Measures

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Summary

We investigated the oral health status of 424, eight and nine year-old, North York children using the results of a clinical examination and a parent interview. Examination results revealed that 35% of the children were free of any evidence of dental caries, 71% had no or mild malocclusion, 68% were free of dental fluorosis, and 71% had no periodontal problems. The majority of the untreated dental decay (65%) was found in a minority of the children (10%). The results are consistent with results of the Ontario Children's Dental Health Survey and are comparable to other areas of North America, as well as other parts of the world. Subjective measures of the children's oral health, as reported by their parents, suggest that the oral health of these children was satisfactory.

When subjective and clinical measures of oral health were compared we found that children with dental decay were more likely to have experienced tooth pain over the past four weeks. We also found that parents were less likely to be satisfied with the appearance of their child's teeth if their child had moderate to severe fluorosis or any signs of malocclusion.

Introduction

Studies of oral disease in children are an important aspect of dental research, especially for a publicly funded dental program such as the North York Public Health Department's (NYPHD) school-based dental program for children. These studies help identify the children most in need of care as well as the oral diseases that should be of concern to the program directors. This knowledge can help dental program directors allocate their resources most appropriately.

Dental caries has traditionally been the childhood dental disease of most concern among dental care providers and researchers. Much research has focused on the use of preventive agents such as systemic and topical fluorides. The benefits of this preventive research is apparent in epidemiologic studies which show that the prevalence of coronal dental caries in North American children has declined substantially over the past two decades. Recent dental surveys now commonly report that many children are caries free (Kumar *et al.* 1991, Ripa *et al.* 1991, Ismail *et al.* 1992, Caplan & Weintraub 1993, O'Keefe 1995, Leake & Main 1995). However, the reduction in caries has been unevenly distributed among the children, with some individuals still experiencing relatively high levels of dental decay. O'Keefe (1995) recently reported that the prevalence of dental decay in children living in the neighbouring community of East York varied according to the district in which the child lives and the child's place of birth.

Clinical measures of oral health other than dental caries, such as periodontal health, are often included in studies of adults but are less often included in studies of children. This may be due to the fact that the prevalence of childhood dental caries in the past was high enough to warrant most of the resources, and the fact that dental caries is considered largely a childhood

disease. However, with the reduction in caries prevalence over the past two decades more attention has been directed to other areas of children's oral health. Interestingly, one of these areas, dental fluorosis, has been linked to the increased use of fluoride which is responsible for much of the decline in caries (Clark 1993).

Also more common in dental studies of adults than in dental studies of children is the use of subjective measures of oral health. Subjective measures of oral health address health from the patient's perspective and generally focus on the patient's ability to function, as well as dental aesthetics. Recent studies of children have addressed the impact of fluorosis (Clark *et al.* 1993, Riordan 1993, Clark 1995) and malocclusion (Espeland *et al.* 1992, Sheats 1995) on parent and child satisfaction with dental appearance.

The purpose of this report is to summarize the oral health of third grade schoolchildren in North York using the findings of a clinical exam and a parent questionnaire. The relationship between the objective and subjective measures of oral health was also investigated.

Methods and Materials

We asked all 779 third grade students from 15 schools that were randomly selected from a master list of all public, separate, and private schools in North York to participate. This grade was selected because we anticipated that there was a reasonable probability that these children would have experienced an amount of dental disease sufficient for study. We also wanted a cohort that would still be in the public school system two years later so we might carry out follow-up examinations.

Data collection occurred during the spring of 1993. After receiving parental consent,

children were examined by one of three private practice dentists who were recruited and trained for the study. They conducted the dental examinations in the NYPHD's school-based dental clinics using a standard dental light, dental mirrors and probes, but no dental radiographs. Examiners followed a protocol specified in the study's examination manual (Leake *et al.* 1994) and recorded information on dento-facial anomalies, malocclusions, lesions of the oral mucosa, non-fluoride enamel lesions (WHO 1987), fluorosis (TSIF, Horowitz *et al.* 1984), periodontal health (CPITN, Ainamo *et al.* 1982), calculus (Greene & Vermillion 1964), and dental caries (Radicke 1968). Assessment of malocclusion was based upon the four permanent central incisors. For mucosal and non-fluoride enamel lesions, examiners were instructed to print a description of their observations on the child's examination form. Fluorosis, periodontal health, and calculus were recorded for the six specified permanent teeth or sextants and were summarized according to the highest (worst) score recorded over these six locations. Due to the age of the participants (8 and 9 years) CPITN scoring did not include probing depth. Caries scores were initially recorded for each tooth surface and were then aggregated to provide tooth specific scores for past and present dental decay in the primary and permanent dentition of each child i.e. number of decayed (d, D), missing (e, M), and filled (f, F) teeth. A tooth was scored as decayed if there was a discontinuity of the enamel with softness at the base of the lesion.

A telephone questionnaire was then conducted with a parent or guardian of each child to obtain some subjective information on the child's oral health (Leake *et al.* 1994). Five questions were asked regarding the presence of pain in the child's teeth or gums over the last four weeks, and the parent's satisfaction with the appearance of the child's teeth, the child's ability to chew, and the child's ability to speak.

Examination and questionnaire results were entered into a computer file using EpiInfo (Dean *et al.* 1990) and were then transferred to SPSS/PC (Norusis 1990a,b) for analyses. Pearson chi-square and ANOVA were used to test for statistically significant differences in proportions and means, respectively. To determine which clinically recorded oral health measures, if any, were associated with the parents' assessments of their child's oral health (subjective measure), multiple, backward, stepwise, logistic regression analyses were carried out. One subjective oral health measure was entered into a logistic regression analysis as the dependent variable with clinical measures of oral health as the independent variables. Independent variables were removed one at a time if their probability (p-value) was equal to or greater than 0.05, beginning with the least significant variable, until only significant variables ($p<0.05$) remained in the model. Infrequent responses or clinical findings were aggregated before statistical analyses were carried out. During the logistic regression analyses, the response "don't know" was treated as a non-response because the number of occurrences was too low to infer any type of relationship.

Examination Results

Of the 779 children asked to participate in the study, we received consent from the parents of 434. Of these 434 children, we examined 424. Approximately 80% of the children were aged eight years and 20% were 9 years of age. Approximately 53% of the children examined were male, and no significant differences between the sexes were found for any of the examination results ($p \geq 0.05$, results not shown).

Dento-facial Anomalies

Only two (0.5%) of the 424 children examined were recorded as having any dento-facial anomalies, one cleft lip and one cleft palate. Due to the low frequency of this condition in the sample, no further statistical analysis of these data was carried out.

Malocclusion

Table 1 shows that the majority of children showed some degree of malocclusion, although in most cases it was slight (code 1). Less than 9% of the children had two or more of the severe malocclusion categories (codes 2-6).

Lesions of the Oral Mucosa and Enamel

Lesions of the oral mucosa were reported for 16% of the children and enamel lesions were reported for 24% of the children. Most of the lesions were not considered to require treatment by the examining dentist (Table 2). Further review of the dentists written descriptions of the lesions revealed that many of the lesions were not conditions which the WHO recommends

recording as mucosal diseases or enamel defects. Revised prevalence estimates based on WHO recording recommendations were found to be 0% for mucosal lesions and 10.6% for enamel lesions. A summarized list of the lesions identified by the examiners along with WHO recording recommendations can be found in Appendix 1.

Fluorosis

Table 3 shows that the majority of the children were found to have no (68.0%) or relatively mild (code 1) fluorosis (14.9%). Less than 5% of the children had teeth that displayed any staining or pitting due to fluorosis (codes 4-7).

Periodontal Health

Approximately 71% of the children had a healthy periodontium (Table 4). For most of the remaining children, their worst CPITN score indicated that they exhibited bleeding upon probing of one site or more. Very few children (5.2%) had any subgingival calculus or overhanging restoration margins.

Calculus

The majority of children (88.9%) received a healthy calculus score. No children were found to have supragingival calculus covering more than two thirds of the exposed tooth surface or subgingival bands of calculus (Table 5).

Caries

Mean caries scores showed that approximately 75% of the caries in the permanent and primary teeth were treated, i.e. filled (Table 6). Less than one sixth of the overall mean combined caries score (deft + DMFT) was due to decay being present (dt + DT) and 81% of the permanent tooth decay was pit and fissure decay. Caries was not normally distributed among the children, however; 42% of the children had a deft of zero and 69% had a DMFT of zero. When caries scores for the primary and permanent teeth were combined (Figure 1), we found that 35.1% of the children were free of any evidence of dental decay, i.e. deft + DMFT = 0. Less than 20% of all of the children examined accounted for greater than 50% of all the decayed, missing, and filled primary and permanent teeth. Focusing only on decayed teeth (Figure 2), we found that 71.5% of the children examined had no decayed teeth (d + D = 0). We also found that 65% of the decayed teeth belonged to approximately 10% of the population and slightly more that 5% of the children had approximately 45% of the decayed teeth.

Table 7 shows that the past and present caries experience (deft + DMFT) was significantly different among the schools (ANOVA, p=0.004). Similar results were found when we focused on the mean number of decayed primary and permanent teeth by school (d + D), but the results were not statistically significant (Table 7, ANOVA, p=0.07).

Questionnaire Results

Parent telephone questionnaires were completed for 389 of the 424 children examined. However, the actual number of responses per question was generally less than 389, as some parents did not answer all questions. According to parent responses, approximately 90% of the children did not suffer from tooth pain or painful or bleeding gums over the last four weeks (Table 8). Approximately 70% of parents reported that they were satisfied with the appearance of their child's teeth (Table 9). Almost 95% of parents were satisfied with their child's ability to speak and chew; further analyses of the responses from these two questions were not carried out.

Comparison of Clinical and Parent Reported Measures of Oral Health

Results of the logistic regression analyses are summarized in Table 10. Tooth pain was found to be significantly related to the child's number of decayed teeth. Parents of children with moderate to severe fluorosis (codes 2-7) were half as likely to be satisfied with the appearance of their child's teeth as parents of children with no or relatively mild fluorosis (codes 0, 1). Similarly, parents of children with slight to severe malocclusion (codes 1-7) were also less likely to be satisfied with the appearance of their child's teeth as parents of children with no malocclusion (code 0).

Discussion

The majority of the published research regarding children's oral health has focused on dental caries as it has historically been the major dental disease of children. Our findings also indicate that dental decay affects or has affected much of the population. Approximately 65% of the children had at least one decayed, missing, or filled primary or permanent tooth (deft + DMFT $\geq$ 1). However, the dental decay is unevenly distributed among the children, with 69% of the children having a DMFT of zero and 20% of the children accounting for almost 60% of total number of decayed, missing, and filled teeth recorded (deft + DMFT). Mean deft and DMFT scores were very similar to those reported by Ontario Children's Dental Health Survey (OMH 1994) for nine-year-olds living in North York (deft: X=2.38, SD=3.32; DMFT: X=0.66, SD=1.80), indicating that our findings are representative of all third grade children in North York.

When compared to the provincial results of the 1993-94 Ontario Children's Dental Health Survey (Leake & Main 1995), we found our mean caries scores to be slightly higher than estimates for nine-year-olds in Ontario (deft: X=2.07, SD=2.63; DMFT: X=0.54, SD=1.26). This difference is probably due to the fact that, when compared to the rest of Ontario, a greater proportion of North York residents are recent immigrants to Canada who are more susceptible to dental decay (Leake & Main 1995, Woodward & Leake 1995). O'Keefe (1995) also found immigrant children living in the neighbouring community of East York to be more susceptible to dental decay than Canadian born children.

Our caries findings also are similar to other recent studies published in the dental literature. A 1987-88 study by Kumar *et al.* (1991) in New York state reported that the 85% of children with a mean age of 7.9 years had a DMFT of zero. Another study in New York State

(Ripa *et al.* 1991) reported that 55.8% of children aged 8-11 years had a DMFT of zero. Caplan and Weintraub (1993) reported that 75% of American 8-year-old children were caries-free.

When we examined the distribution of the decayed teeth alone (d + D), we found that all the decay occurred in less than 30% of the children, and 20% of the children accounted for over 80% of the decay. This finding is similar to that recently reported by O'Keefe (1995) for 7-year-old children in East York, as well as other areas of North America (Caplan & Weintraub 1993). Thus, a minority of the child population is burdened with a majority of the dental decay. Although this proportion has fallen since 1980, it appears to have remained relatively constant over the last 5-10 years, especially in the older age groups (O'Keefe 1995). It is these high caries-risk individuals, if they can accurately be identified, who would benefit most from preventive intervention, such as pit and fissure sealants and topical fluorides.

Analysis of the caries data by school also shows that the burden of illness is not equally distributed among the North York community. This is similar to the findings of O'Keefe (1995) who reported that the caries experience of children in East York varied according to district in which the child lived.

Much of the fall in dental caries prevalence over the past two decades has been attributed to the use of systemic and topical fluorides (Waldman 1990, Caplan & Weintraub 1993). However, the increased use of fluorides may have resulted in an increase in the prevalence of dental fluorosis (Clark 1993, Riordan 1993, Weeks *et al.* 1993, Awad *et al.* 1994). Many authors now recommend that only high caries-risk individuals receive professionally applied topical fluorides (Ripa 1991, Clark 1993, Woodward & Lewis 1995), and this recommendation has been incorporated into the NYPHD's guidelines for topical fluoride application.

Findings of our study indicate that over 30% of 8-year-olds in North York have some evidence of fluorosis and that the presence of moderate to severe fluorosis (codes 2-7) is negatively associated with the parents' satisfaction with the appearance of their child's teeth. A mild amount of fluorosis appears to be acceptable to parents and, given the cariostatic effect of fluoride, should be of little concern to dental care providers. It is assumed that implementation of recent recommendations calling for more conservative use of many systemic and topical fluorides will, over time, help to reduce the higher levels of fluorosis found in some children (Clark 1993).

Other recent studies have reported similar or greater levels of fluorosis than those found during this study. The 1993-94 Ontario Children's Dental Health Survey (OMH 1994) found that about 70% of Ontario nine-year-olds and 65% of North York nine-year-olds had no evidence of dental fluorosis. Weeks *et al.* (1993) recently reported the prevalence of diffuse opacities of 4-5-year-olds in fluoridated Nantwich, UK, to be 29%, twice that of non-fluoridated Northwich. Riordan (1993) recently reported that 48% of a sample of children (mean age 7.5 years) from Perth, Australia had some evidence of dental fluorosis. Another recent study in Kelowna and Vernon, British Columbia (Clark *et al.* 1993) found evidence of fluorosis in more than 50% of the children examined, with more fluorosis found in the fluoridated community. Similar to our findings, Clark *et al.* found that most of the fluorosis was mild to moderate and that moderate to severe fluorosis (codes 2-7) was positively associated with parent's aesthetic concerns. Awad *et al.* (1994) recently reported that more than 50% of 7-9 year-old children from a non-fluoridated area who received fluoride supplements from birth had some sign of fluorosis.

Few studies have measured the periodontal health of children. In 1989-90, Payette and

Brodeur (1992) measured the periodontal health (CPITN) of 13-14 year old Quebec school children. They found, based on each child's worst score, that 58.5% suffered from bleeding gums during probing and that 22.4% of the children had calculus. Bhat (1991) studied the periodontal health of U.S. children aged 14-17 years and found, based on each child's worst score, that 58.8% suffered from bleeding on probing, 22.8% had calculus, and 2% had periodontal pockets greater than 4 mm. A recent survey of 'high risk' adolescents in North York reported, based on each individuals worst score, that 4.2% of the adolescents bled on probing, 53.2 had subgingival calculus, and 33.5% had periodontal pockets greater than 4 mm (Clarke *et al.* 1995).

Almost 30% of the children we examined had less than perfect periodontal health; most of the finding was due to bleeding gums on probing. While our results indicate that 5% of the children have more severe periodontal problems, the calculus scores suggest that most of these problems were due to overhanging restoration margins rather than subgingival calculus. Calculus results indicate that almost 90% of the children had no calculus, with most the remaining children having only supragingival calculus.

Malocclusion was found to be quite prevalent in this study, although most cases were considered slight by the examining dentist. However, even the presence of slight malocclusion was found to be negatively associated with the parents' satisfaction with the appearance of their child's teeth. An orthodontic study in Norway has reported similar findings (Espeland *et al.* 1992). This study compared need for orthodontic treatment, as determined by a clinical examination, to both the parents' satisfaction with his/her child's dental arrangement and the parents' desire for orthodontic treatment and found a significant association between the two

types of measures. However, 56% of the parents of children with a clinically determined "great need" for orthodontic treatment, expressed no dissatisfaction with their child's teeth nor desire for treatment. Another more recent orthodontic study in Florida (Sheats *et al.* 1995) reported that 63% of parents believed their child needed braces but 70% of the parents also reported that they were happy with the appearance of their child's teeth.

Although lesions of the oral mucosa and non-fluoride enamel lesions were found in 16% and 24% of the children, respectively, very few of these lesions were classified as requiring treatment. A study of enamel defects in 6-8 year-old children in West Bromwich, U.K., reported that only 1.2% of the children had enamel defects considered by the examiner to be a cosmetic problem (Elley & Charlton 1992). In 1986-87, approximately 3.5% American children aged 8 years had any mucosal lesions (Kleinman *et al.* 1994). These findings are very much lower than those found in this study. However, many of the conditions recorded by this study's examiners are not conditions which the WHO (1987) recommends recording.

When we re-examined the printed records of the mucosal and enamel conditions we found that many of the recorded conditions were conditions which the WHO (1987) recommends recording as "other conditions." We believe that these "other conditions" are not regularly reported in the literature and may account for much of the difference between our findings and those published elsewhere. The confusion surrounding these data suggests that increased examiner training and/or examination manual modifications are required in this area.

Only two children were found to have any dento-facial anomalies, one cleft palate and one cleft lip. Although this may not be considered a reliable population prevalence estimate due to sample size limitations, it is similar to estimates reported for children in the United States

(Caplan & Weintraub 1993).

According to parent responses, slightly less than 10% of the children had experienced any tooth pain or pain or bleeding of the gums during the four weeks prior to our parent interview. Not surprisingly, tooth pain was more likely in children with tooth decay.

From a functional perspective, the majority of North York children in the third grade appear to have good oral health, as very few parents reported that they were dissatisfied with their child's chewing or speaking ability. Almost one third of parents however, are unsatisfied with their appearance of their child's teeth; these children were more likely to have some degree of malocclusion and/or moderate to severe fluorosis.

Table 1. Prevalence of malocclusion.

	Code	Frequency	Percent
none	0	96	22.6
slight anomalies (e.g. rotated or tilted teeth, slight crowding or spacing)	1	207	48.8
maxillary overjet estimated to be 9mm or more	2	22	5.2
mandibular overjet, anterior crossbite equal to or greater than a full tooth depth	3	12	2.8
open bite	4	22	5.2
midline shift estimated to be more than 4mm	5	3	0.7
crowding or spacing estimated to be more than 4mm	6	25	5.9
two or more of the more severe codes ranging from 2 to 6	7	37	8.7

Table 2. Prevalence of mucosal and non-fluoride enamel lesions.

	Oral Mucosa Lesion		Enamel Lesion	
	Frequency	Percent	Frequency	Percent
absent	355	83.7	323	76.2
present, no treatment required	57	13.4	97	22.9
present, treatment required	12	2.8	4	0.9

Table 3. Prevalence of fluorosis.

	Code	Frequency	Valid Percent
none	0	283	68.0
parchment of < 1/3 of enamel surface	1	62	14.9
parchment of ≥ 1/3 but < 2/3 of enamel surface	2	42	10.1
parchment of ≥ 2/3 of enamel surface	3	13	3.1
parchment and staining of the enamel	4	5	1.2
pitting of enamel unaccompanied by staining of intact enamel	5	7	1.7
pitting of enamel and staining of intact enamel	6	3	0.7
confluent pitting of enamel	7	1	0.2
not recorded	9	8	----

Table 4. Prevalence of periodontal conditions.

	Frequency	Valid Percent
healthy	286	70.8
bleeding observed after probing	97	24.0
subgingival calculus or overhanging margin of restoration felt during probing	21	5.2
not recorded	20	----

Table 5. Prevalence of calculus.

	Frequency	Valid Percent
healthy	369	88.9
supragingival calculus covering $\leq$ 1/3 of the exposed tooth surface	40	9.6
supragingival calculus covering > 1/3 but $\leq$ 2/3 of the exposed tooth surface, or subgingival flecks of calculus	6	1.4
supragingival calculus covering > 2/3 of the exposed tooth surface, or a continuous heavy band of subgingival calculus	0	0.0
not recorded	9	----

Table 6. Caries experience in the permanent and primary teeth.

	Mean	SD	Maximum
Permanent Dentition			
D	0.14	0.45	3.0
M	0.01	0.11	2.0
F	0.44	0.96	5.0
DMFT	0.59	1.06	6.0
Primary Dentition			
d	0.38	0.93	7.0
e	0.26	0.91	10.0
f	1.87	2.42	10.0
deft	2.50	2.89	12.0
Combined Dentition			
D+d	0.51	1.11	9.0
DMFT+deft	3.09	3.38	17.0

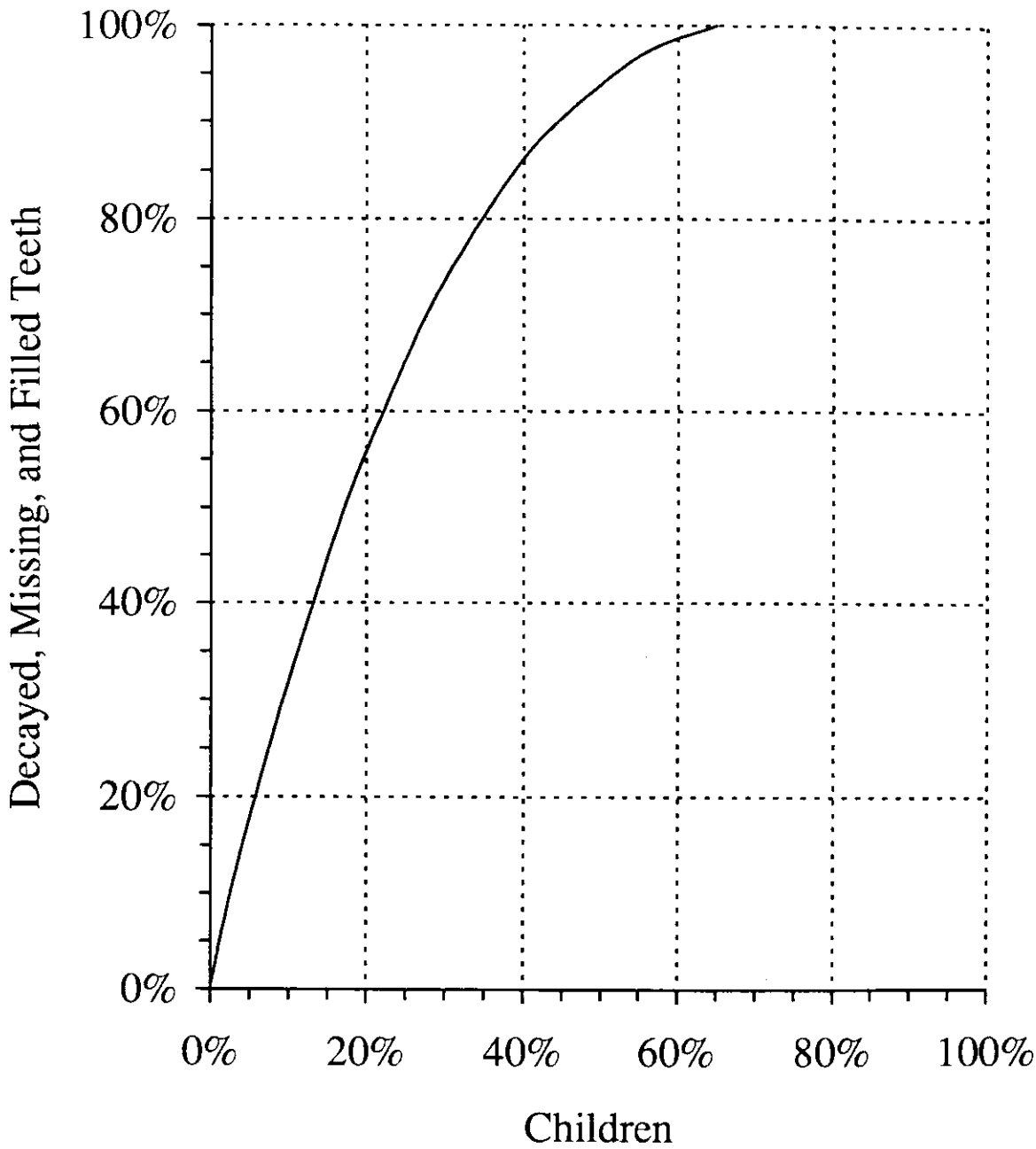

Figure 1. Distribution of decayed, missing, and filled teeth.

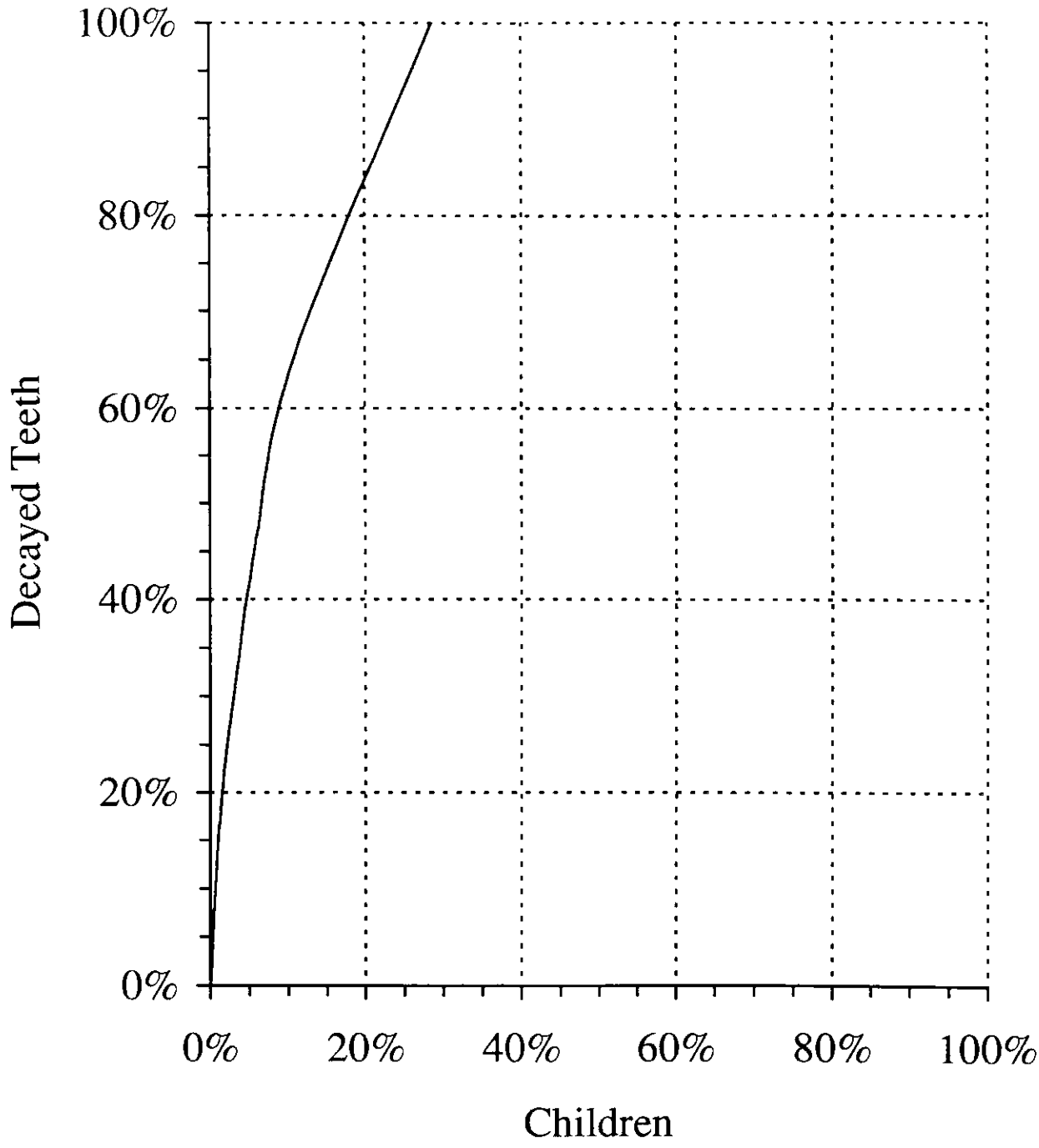

Figure 2. Distribution of decayed teeth.

Table 7. Caries experience by school.

School	Number of Children Examined	Decayed, Missing, and Filled Teeth (def + DMF)		Decayed Teeth (d + D)	
		Mean	sd	Mean	sd
Bayview	31	2.87	3.98	0.45	0.81
Blacksmith	25	4.08	3.51	0.76	1.23
Brookhaven	32	3.16	3.37	0.38	1.36
Cassandra	19	1.74	2.13	0.53	1.12
C H Best	40	2.78	3.13	0.90	1.91
Driftwood	27	4.41	3.79	1.00	1.14
Grenoble	68	3.40	3.64	0.44	1.12
Denlow	20	1.90	1.94	0.25	0.44
St. Augustine	20	2.60	3.25	0.45	0.69
St. Fidelis	18	1.89	2.00	0.17	0.38
St. Wilfrid	33	4.58	3.70	0.58	0.90
N T C S	24	1.46	1.89	0.04	0.20
Ernest	23	3.83	4.00	0.78	1.31
St. Gabriel	23	2.09	2.84	0.30	0.70
McKee	21	3.71	3.41	0.33	0.66
Total	424	3.09	3.38	0.51	1.11

Table 8. Oral pain in children over the last four weeks as reported by their parents.

	Pain in teeth		Pain in or bleeding of gums	
	Frequency	Percent	Frequency	Percent
no	356	91.5	353	90.7
yes	31	8.0	32	8.2
don't know	1	0.3	2	0.5
no answer	1	0.3	2	0.5

Table 9. Parent satisfaction with the oral health of their child.

	Parent satisfied with:					
	appearance of child's teeth		child's ability to chew		child's ability to speak	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
no	114	29.3	22	5.7	23	5.9
yes	271	69.7	366	94.1	365	93.8
don't know	4	1.0	1	0.3	1	0.3

Table 10. Results of logistic regression analyses investigating the relationship between clinical measures of a child's oral health and parent reported (subjective) measures of a child's oral health.

Dependent Variable (Parent Reported, Subjective Measures of Child's Oral Health)	Independent Variables (Findings of the Clinical Exam)	Odds Ratio	P
Has your child experienced tooth pain during the past 4 weeks? (0=no, 1=yes)	Number of Decayed Teeth (0, 1, or 2 or more)	1.99	0.004
Are you satisfied with the appearance of child's teeth? (0=no, 1=yes)	Fluorosis (codes 0 or 1 vs codes 2 to 7)	0.50	0.016
	Malocclusion (code 0 vs codes 1 to 7)	0.53	0.039

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APPENDIX 1.

Summary of Enamel Lesions

Examiner's Description	Frequency	ICD-DA #	Include in Basic Oral Health Assessment (WHO 1987)
hypoplasia	44	520.40	yes
hypomineralization	42	521.31	no
attrition	10	521.1	no
congenital abnormality	3	520.50 - 520.52	no
abrasion	1	521.2	yes
stain	1	520.80 - 520.88	no
Total	101		

Summary of Mucosal Lesions

Examiner's Description	Frequency	Include in Basic Oral Health Assessment (WHO 1987)
petechiae, trauma, scars	21	no
ulcer, abscess, fistula, cold sore, herpes	19	no
keratosis	11	no
pigmentation	7	no
other	11	no
Total	69	