A DENTAL HEALTH EDUCATION PROGRAMME FOR NURSERY SCHOOL CHILDREN

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DECLARATION

This thesis is the sole work of the author with the exception of the help and guidance from the individuals acknowledged in the text.

ABSTRACT

The purpose of this controlled investigation was to test the effectiveness of three dental health programmes designed to improve oral cleanliness and gingivitis in groups of 3-4 year old nursery schoolchildren in areas of urban deprivation in Edinburgh. A total of 349 children completed the study. The children were divided into 4 groups; a control group that received no dental health education and three experimental groups. One of these groups received daily toothbrushing instruction at school, a second group also took part in the school based brushing but in addition their parents were given dental health education at home. Parents of a third group of children received the home based dental health education only. Following baseline measurements, the dental health education programmes continued for about 5 and a half months when the children were re-examined. The programmes then ceased over the 6 week period of the summer vacation and the children were again examined on returning to school. A dental health education programme was deemed to have been successful only if there was no statistically significant and clinically important relapse in oral cleanliness and gingivitis at the third examination.

There was a relapse in the oral hygiene of the school brushing only group during the summer holiday but oral cleanliness and gingivitis had not relapsed in the two groups of children whose parents had received dental health education at home.

A cost benefit analysis (effort effectiveness) showed that of these two programmes, the programme that consisted of home based dental health education only cost the least for a unit improvement in oral cleanliness and gingivitis.

A questionnaire was used to record parents' attitudes towards toothbrushing practices at home. Children whose parents always helped them with toothbrushing had cleaner mouths and less gingivitis than children who always brushed their teeth by themselves.

It is concluded that dental health education, which included home visits, was more effective than daily supervised toothbrushing at school in improving and maintaining oral health in pre-school children and that parents should be encouraged to help young children with toothbrushing at home. Such an approach demands considerable resources and may only be suitable for groups of children with special needs.

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Lothian Regional Council Education Committee and Lothian Area Dental Ethical Committee are also acknowledged for their approval to proceed with the study. Also, Mr. John W.Craig, Chief Administrative Dental Officer, Lothian Health Board, for permission to undertake the study in the City of Edinburgh.

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CHAPTER 1

INTRODUCTION

Brushing teeth and gums daily with a fluoride toothpaste is one of the most important measures that individuals can carry out to improve their dental health. It is one of the four basic recommendations of the Health Education Authority (HEA 1989) and the Scottish Health Education Group (SHEG 1985).

Both the Health Education Authority (HEA) and the Scottish Health Education Group (SHEG) have recommended that toothbrushing skills should be taught to people of all ages. As most young children are incapable of brushing their teeth effectively their parents should be encouraged to brush their children's teeth at least once a day, preferably at night, until about the age of 6-7 years (Leatherman 1982, HEA 1989, SHEG 1989). In a recent circular issued by the Scottish Home and Health Department giving guidance to Health Boards in Scotland on the future of the Community Dental Service, it was recommended that dental health education, aimed at encouraging self-care, should be increased. (The National Health Community Dental Service DS/14/22B SSHD 1989).

There has been emphasis on oral hygiene instruction for many years. The report "Fit for the Future" of the Committee on Child Health Services in 1976 acknowledged the importance of establishing sound habits of dental health in children and recommended that dental

health education should be provided for mothers of young children (H.M.S.O. 1976). The Nuffield Inquiry into Dental Education (The Nuffield Foundation 1980) and the report of the Dental Strategy Review Group "Towards better dental health" (DHSS 1981) also stressed the value of dental health education and oral hygiene instruction.

One of the problems in interpreting the results of dental health education programmes is that it is difficult to demonstrate long term behavioural changes particularly on disease outcomes such as caries and gingivitis. This is partly because many studies reported in the literature are short, with short follow-up periods. In 1980, Horowitz and co-workers reported on the limited effectiveness of a school based plaque removal programme for 10-13 year olds in Connecticut. For three academic years the children brushed and flossed their teeth daily at school supervised by trained personnel. Plaque and gingivitis scores improved during the school terms but the improvements virtually disappeared during the summer vacation. (Horowitz et al, 1980). An identical finding was reported in a 2 year controlled clinical trial in Edinburgh (Sutcliffe et al 1984). It was shown to be possible to teach 3- and 4-year-old nursery school children how to brush their teeth daily at school and to maintain the habit during the school term. The preventive programme was well accepted by the children, their parents and the school staff but apparently it failed to make any impact on toothbrushing behaviour at home. The standard of oral cleanliness of the children relapsed during the long summer vacation in each of the cohorts studied. The programme had clearly failed to influence the parents'

supervision of the children at home.

Oral hygiene instruction and dental health education are more usually directed at primary and secondary school children when visiting their dentist or as part of a dental health programme at school. There are however some advantages in teaching toothbrushing to very young pre-school children. At this age they are learning other skills associated with personal hygiene which hopefully become established habits and lead to the adoption of good health practices in later life. In addition there is a close relationship between parents and children under the age of five. Aspects of personal care such as bathing and dressing are routinely carried out with the assistance of parents and it would seem appropriate to include toothbrushing along with these other daily procedures. Parents can therefore easily be involved.

The importance of involving parents as well as children in dental health education programmes is becoming more widely recognised. Lois Cohen in 1980, commenting on the greater amounts of untreated dental disease in adults than in children in countries where there were school based dental care systems, suggested that dental advice should be given to parents and children in the same environment rather than to children isolated from the family, for example when they are at school. More recently Ruth Holt and co-workers (1989) have reported trends for better dental health in the London Borough of Hillingdon amongst 10 year old children whose mothers had been provided with dental health education within 2-12 weeks of their child's birth.

In the United Kingdom children may attend nursery school from the age of 3 years, the age at which most mothers agree that toothbrushing should have become established (Todd 1975). Provision of education for the under fives has increased markedly in recent years. During the 1970s about 30% of children aged 3-4 years attended nursery school. This figure had risen to 48% by 1987 (Social Trends 1989). The Education, Science and Arts Select Committee have recently recommended that nursery education should be available for all three and four year old children if their parents desire it (H.M.S.O. 1989).

The general aim of the present study was to build upon the experiences gained in the earlier Edinburgh study and to test the value of combining school based toothbrushing programmes with advice given to parents at home.

CHAPTER 2

LITERATURE REVIEW

The majority of reports of dental health education programmes published in the literature deal with investigations conducted on school children and adolescents. Freed & Matthias (1980) evaluated 36 reports published between 1971 and 1975. Nearly half of the studies (47%) were conducted in schools and, in the instances when the ages of the subjects were given, 70% involved individuals under the age of 18. There were no references to young, pre-school children.

In this review no attempt has been made to provide a formal overview of the whole of dental health education, but to restrict the report to programmes for young children. There is in fact, little information available relating specifically to pre-school dental health education programmes. In a search spanning over 30 years between 1950 and 1981 Gail Levy (1984) identified only 27 programmes (the total number reviewed was not specified) involving pre-school children and some of these programmes also included older children. The majority of the studies were carried out in the USA. Levy's chief criticisms of these clinical trials were that the programmes were inadequately designed, there was lack of emphasis on the importance of fluoride and, because of inconsistent and inadequate reporting, she was unable to judge the quality and effectiveness of the programmes. She recommended that programmes involving dental

treatment should also provide dental health education and emphasised the need for parental involvement. She also stressed the importance of thorough reporting, evaluating the programmes and the value of assessing cost effectiveness.

In the present study a Medline computer search was made going back to 1965 which yielded over 450 references. This search provided an additional 14 programmes relating to pre-school dental health education not previously located in the literature by the author. References were only selected for this review if they reported specific details of the pre-school dental health education programme and included an initial and follow-up dental examination. A synopsis of sixteen studies is given in Table 1 and a summary in Table 2.

The age of the children ranged from 2-7 years but the most common age ranges quoted were 3-5 years. Eight of the programmes were school or school and home based and five were conducted in dental clinics or health centres. Five studies included parents at home in the scope of the study. Only 5 programmes had an independent control group. The need for conducting blind studies was mentioned in three studies but actually carried out in only two studies.

Eight studies recorded dental caries experience, 7 studies, which included specific advice on toothbrushing, reported plaque scores and 4 studies measured gingivitis.

The success of the programmes was reported in terms of reduced

levels of disease, improved oral hygiene and increased dental awareness. Follow up examinations ranged from none at all to periods extending over weeks, months and years.

None of the studies evaluated the difference between school based and home based programmes. Cost effectiveness was mentioned in only one study which described a survey of the dental health of 2-4 year old children at day nurseries who were participating in a dental health education programme which included a monthly prophylaxis (Cushing & Gelbier 1988). These research workers reported that the treatment need of the children was low and questioned the cost effectiveness of the monthly prophylaxis for all children.

The Hillingdon approach, though different from the present study has however, yielded some interesting and relevant results. The children in this controlled study were identified at birth and 2 types of home-based dental health education were compared - dental health education was given to one group of mothers by a dental health educator at home and dental health education leaflets sent by post to another group (Winter et al 1981)). At the age of 5 years the children received their first dental examination (Holt et al 1985). The authors reported significantly lower levels of dental caries and gingivitis in the children whose mothers were given dental health education at home compared with children whose mothers had been sent leaflets by post.

A small remaining number of children were examined again when they were 10 years old (Holt et al 1989) and although few statistically

significant results were observed there were still trends for better dental health among the children whose mothers had been visited at home.

This survey of the literature has revealed that there are no reported controlled studies of dental health education involving pre-school children which contrast home-based care with school-based care and include a cost benefit analysis.

Table 1.

A review of dental health education programmes for young children.

STUDY 1	
Author	Menczer L. (1956) Connecticut
Age of subjects	2-5 years
Numbers	9,420 No control group.
Programme	Four visits to a dental clinic in a health centre Visit 1. Dental examination for caries experience, prophylaxis and fluoride application. Visit 2. Dietary advice and fluoride application. Visit 3. Oral hygiene instruction and fluoride application. Visit 4. Review and fluoride application. Dental treatment is then commenced where necessary. Programme finishes when the children go to school.
Effectiveness	Not reported
Follow up examination	Every six months

STUDY 2	
Author	Compton et al (1959) Toronto
Age of subjects	2-4 years
Number	5,423 Retrospective comparison
Programme	Dental examination for caries experience and plaque accumulations at health centres and treatment offered. Parents given dental health education. 185 children received annual applications of topical fluoride.
Effectiveness	Mean dmft was reduced and the proportion of children caries free increased. No significant improvement in oral cleanliness.
Follow up examination	Annual.

STUDY 3

Author	Downer M.C. (1971), London
Age of subjects	5,6 and 7 years old
Number	86 - experimental group 100 - control group
Programme	Baseline examination at school for plaque accumulations and gingivitis. One lesson of dental health education lasting 20 minutes given to the experimental group by a dental auxilliary, including oral hygiene instruction. The children were given a toothbrush, toothpaste and a rinsing mug. A letter was sent to their parents asking them to encourage the maintenance of good oral hygiene practices at home.
Effectiveness	There were greater improvements in the oral hygiene and gingivitis in the 6 & 7 year olds in the experimental group than in the control group. The 5 year olds gained little from the programme.
Follow-up examination	After 8 weeks

STUDY 4

Author	Holst & Kohler (1975), Sweden.
Age of subjects	4 years
Number	2,698 Retrospective comparison
Programme	Programme commenced 1967-68. Baseline examinations at child health centres for dental caries. Dental health education given to parents on three occasions at child health centres when the children were 5-6 months, 9-12 months and 12-24 months old. Oral hygiene instruction and fluoride supplements were also given to the parents.
Effectiveness	Significant reductions in dental caries
Follow up examination	After 2 & 6 years.

STUDY 5

Author	Zavela et al (1975) Michigan
Age of subjects	3 - 5 years
Number	40 No control group.
Programme	No clinical data was recorded. Pre-school teachers were given 6 one-hour lessons over 2 weeks on how to set up a dental health education programme for pre-school children. One month later each teacher developed a dental health education programme including daily toothbrushing which lasted one week.
Effectiveness	The teachers dental knowledge improved and they were able to successfully carry out a dental health education programme including oral hygiene instruction. Most of the 4 and 5 year olds remembered the programme but the 3 year olds gained very litte.
Follow-up Examination	The teachers were tested immediately after their period of instruction and were observed carrying out the dental health education with the children. The children were questioned one week after the programme had finished.

STUDY 6

Author	Bassin et al (1977) Philadelphia
Age of subjects	2.5 - 4.5 years
Number	80 No control group.
Programme	Baseline examination - caries experience and plaque accumulations measured at school. Dental health education in the classrooms including a daily toothbrushing programme. Visits to a dental clinic where the children were given a prophylaxis, a fluoride treatment and a more detailed examination. A questionnaire designed for the parents revealed that their dental knowledge was limited. Weekly newsletters containing information about the programme were sent to the parents at home. The parents were encouraged to motivate their children towards dental health at home.
Effectiveness	No significant reductions in plaque accumulation. The children were less frightened during subsequent dental examinations.
Follow-up examination	Several months for some but not all of the children.

STUDY 7

Author	Ulvestad & Gilinsky (1977), Norway
Age of subjects	3 years
Number	121 examined in 1970 108 examined in 1973 100 examined in 1974 Retrospective comparison
Programme	Baseline examination of 3 year olds in 1970. Caries experience recorded at child health centres. Programme commenced 1971. Dental health education given to parents visiting child health centre when their children were 0-1 years and 1-3 years old. Fluoride supplements were given.
Effectiveness	Significant reductions in dental caries
Follow-up examination	After 2 and 3 years.

STUDY 8

Author	Tsamtsouris et al (1979), Boston
Age of subjects	Kindergarten - mean age 5.4 years
Number	72 Retrospective comparison
Programme	Oral hygiene instruction on one occasion at school. Supervised toothbrushing on five occasions at school. Plaque scores recorded before and after toothbrushing at school. Letter to parents requesting them not to brush their children's teeth at home or motivate them. Programme lasted 7 weeks
Effectiveness	Plaque scores decreased significantly indicating an improvement in the effectiveness of home brushing except between the 3rd and 4th visit. The effectiveness of the toothbrushing lessened without constant reinforcement.
Follow-up examination	4 months after the last school visit.

STUDY 9

Author	Klass & Rhoden (1981), Iowa
Age of subjects	2.5 - 6 years
Numbers	60 No control group.
Programme	Baseline examination for caries experience and plaque accumulations at school. 4 lessons each lasting 20 minutes of dental health education given to the children. Discussion with the parents lasting one hour planned to introduce basic preventive dentistry. Families offered a home visit for the purpose of oral hygiene instruction.
Effectiveness	Evaluated by discussion with the school staff and the parents who were appreciative of the programme.
Follow-up examination	A final examination of the children was planned but not carried out.

STUDY 10

Author	Poulsen et al (1983), Denmark
Age of subjects	3 and 6 years
Numbers	162, 3 year olds 207, 6 year olds No control group.
Programme	Baseline examination of all 3 and 6 year olds in the municipality of Ebeltoft for caries experience. A dental hygienist developed a communications network with certain key persons who were in contact with pre-school children. Appropriate preventive dental programmes were then developed in selected homes of pre-school children, in nursery school and kindergartens and in some dental clinics. The programme lasted 3 years.
Effectiveness	Dental caries experience recorded by dmfs and DMFS was reduced by 34% in the 3 year olds and 20% in the 6 year olds.
Follow-up examination	After 3 years.

STUDY 11

Author	Sutcliffe P, Rayner J.A. & Brown M.D. (1984) Edinburgh
Age of subjects	3-4 year olds
Numbers	172 experimental 157 control
Programme	There were three groups of children: 1. Children who spent one year at nursery school. 2. Children who spent two years at nursery school. 3. Children who spent two years at nursery school and one year at primary school. Following baseline examinations for plaque accumulations daily, supervised toothbrushing took place at nursery school for up to 2 years.
Effectiveness	Significant improvements in plaque scores during the school terms but deterioration after the summer holiday.
Follow-up examination	9 months after the baseline examination and 2 months after the preventive programme at school had finished.

STUDY 12

Author	Holt et al (1985), London
Age of subjects	5 year olds
Number	123 experimental 80 control
Programme	Dental health education was given to the mothers when their children 2-12 weeks, 6-8 months and 14-18 months old respectively. Fluoride supplements were offered. The children were examined for dental caries, gingivitis and plaque when they were five years old.
Effectiveness	These children had significantly lower levels of caries experience and gingivitis than a control group. No significant differences in plaque scores.
Follow-up examination	5 years (first examination)

STUDY 13

Author	Croucher et al (1985), England
Age of subjects	3-5 years
Number	Not given
Programme	Baseline examinations for plaque accumulations. Six week dentally orientated programme at school. (The Good Teeth Programme). There were three groups of children: 1. Programme and reinforcement and interviews with parents. 2. Programme and reinforcement 3. Programme Reinforcement over 6 months.
Effectiveness	Short term significant improvement in plaque scores only where parents had been involved and there had been reinforcement of the programme. Significant improvements in safe snack knowledge.
Follow-up examination	After 6 months

STUDY 14

Author	Schou L (1987), Edinburgh
Age of subjects	5-7 years
Number	164 No control group
Programme	DHE leaflets inserted into four different women's magazines in October/November 1984. 20 minute television cartoon commercial (Bugs Bunny) about dental care was shown over a 3 week period. School teachers were given a package of dental health material for the children to take home. 40 parents interviewed in December 1984. 124 parents interviewed in February 1985.
Effectiveness	High degree of recollection of campaign in general. Material for home use had the greatest impact. T.V. commercial less well remembered and the magazine insert least remembered. December sample had a higher opinion of the campaign than the February sample. More frequent brushers had a higher opinion of the campaign than less frequent brushers. 35% of children claimed to be eating less sweets than before the campaign and 34% claimed to be brushing their teeth more often.
Follow-up examination	Immediately after and 2 months after the television commercial.

STUDY 15

Author	Cushing & Gelbier (1988), London
Age of subjects	2 - 4 years
Number	1132 children 764 received a full examination No control group.
Programme	Baseline examination for plaque accumulations, caries experience and gingival bleeding. A dental care programme was introduced to children attending day nurseries in 1977. Dental health education was given to the children and their carers. Children were given a monthly prophylaxis with a fluoride toothpaste.
Effectiveness	77% caries free 25% had clean mouths (plaque present on not more than 4 teeth) About one third of the children had gingivitis.
Follow-up examination	None

STUDY 16

Author	Bullen et al (1988), Virginia
Age of subjects	3-5 years
Numbers	26 control (including 12 new patients) 24 experimental (including 12 recall patients).
Programme	The children were all new or recall patients attending the Paediatric Dental Clinic of the Medical College of Virginia School of Dentistry. Baseline examinations were carried out for plaque and gingivitis. 24 parents of the experimental group were shown how to brush their children's teeth and then were asked to complete the brushing 26 control parents observed oral hygiene instruction for their children only.
Effectiveness	Significant improvements in plaque scores of the total experimental group (both new and recall patients) but not in the control group. There were significant improvements in plaque scores of new patients as opposed to recall patients. There was no effect on gingivitis.
Follow-up examination	1 month.

Table 2

Summary of Table 1 - A review of dental health education for young children.

Study Number	Age In years	Site	Home involved	Independent control group	Blind examinations study	Disease measured	Toothbrushing programme	Follow-up examination
1	2-5	clinic	no	no	no	caries	no	6 month
2	2-4	clinic	no	no	no	plaque & caries	no	12 month
3	5-7	school	letter only	yes	yes	plaque, gingivitis	yes	8 week
4	4	clinic	no	no	no	caries	no	2 & 6 years
5	3-5	school	no	no	no	none	yes	1 week
6	2.5-4.5	school clinic	letter only	no	no	plaque & caries	yes	several months
7	3	clinic	no	no	no	caries	no	2 & 3 years
8	5	school	letter only	no	no	plaque	yes	4 month
9	2-6	school home	yes	no	no	plaque & caries	yes	none
10	3 & 6	school home & clinic	yes	no	no	caries	no	3 year
11	3-4	school	no	yes	no	plaque	yes	9, 18 & 24 months
12	5	clinic home	yes	yes	yes	caries, plaque, gingivitis	no	5 year
13	3-5	school home	yes	yes	not completely	plaque	no	6 month
14	5-7	school home	yes	no	-	none	no	2 month
15	2-4	school	no	no	no	caries, plaque, gingival bleeding	yes	1 month
16	3-5	clinic	no	yes	no	plaque, gingivitis	yes	1 month

CHAPTER 3

AIMS AND METHOD OF THE STUDY

3.1. PRIMARY AIM

The main aim of the study was to undertake a controlled comparison of three methods of improving oral cleanliness and gingivitis in pre-school children. The three regimes were:-

i) daily supervised toothbrushing at nursery school

ii) dental health education given to parents on 2 occasions at home

iii) daily supervised toothbrushing at nursery school plus dental health education given to parents on 2 occasions at home

The three health education programmes continued for 2 school terms, the spring and summer terms. No dental health education was given during the summer holiday and the effectiveness of the programmes was finally measured after the holiday when the children returned to school. The outcome of each regime was measured in terms of clinical changes (gingivitis and oral cleanliness) and cost. The success of the health education programmes was also gauged by the children's ability to maintain any improvements in their oral health over the duration of the summer holiday.

There were two further aims,

i) to measure changes in the uptake of dental care

ii) to measure changes in the oral health of children whose parents

reported changes in the supervision of their children's toothbrushing habits at home.

3.2. METHOD

3.2.1. Plan of investigation and selection of groups

The investigation was a controlled clinical trial lasting one academic year involving 558 young children initially aged 3 and 4 years. After obtaining permission to carry out the study from the Lothian Region Education Committee, the Lothian Health Board Community Dental Service and the local Ethical Committee (see Appendix 1), the Lothian Region's adviser for nursery school education was consulted. She was able to provide information on the number of children in the Region's nursery schools, those of the nursery schools who would co-operate and the schools that would benefit from the programme.

The children were selected from schools matched as closely as possible for size, social structure and their neighbourhood. It was originally planned to record social class data (i.e. occupation of the head of the household) but permission from the Department of Education for this was refused. This decision was respected and no reference to occupation was made on the questionnaires, details of which are given later.

There are 48 nursery schools and 99 nursery classes in the Department of Education of Lothian Regional Council. The schools selected for this study were not a representative sample of the Region's nursery schools and classes but with the exception of 2 schools were all situated in areas of urban deprivation. This was at the request of the adviser for nursery school education.

In 1984 the Scottish Development Department (SDD) carried out an analysis of areas of multiple deprivation in Scotland. This analysis, based on 1981 census data, used housing, economic and socio-demographic factors as indicators of urban deprivation. From this analysis Lothian Regional Council (LRC) produced a ranking of the "worst" areas of multiple deprivation in the Lothian Region and made comparisons with a previous similar exercise carried out in 1971 (Census 1981. Analysis of Multiple Deprivation in Lothian Region LRC 1984).

Eight of the ten nursery schools selected for the present study came from areas featured in the 1981 ranking and are listed in descending order of severity in the table below. The remaining two schools came from areas that were designated following the 1971 census. The school's address gives a broad indication of the catchment area.

"Worst" areas	Nursery School
Pilton	Inchview
	Silverknowes
Craigmillar	Greengables
Kaimes	Burdiehouse
Leith	Albany
	Stanwell
Old Town	Grassmarket
	High School Yards

The remaining two nursery schools, Westfield Court and Balgreen, situated in the Gorgie/Dalry area and were listed as deprived areas

in the 1971 survey but were considered to be relatively less disadvantaged by 1981. Nevertheless the schools had been selected by the Region's Adviser for inclusion in the study.

The plan was to divide the schools into four equally sized groups - one control and three experimental groups that would be large enough to sustain losses over the study period. There were appreciable losses in the earlier Edinburgh nursery school study (Sutcliffe et al 1984). In the present study there were initially around 150 children in each group in the expectation that the size of each group would fall to about 100 children by the end of the study.
A map of the City of Edinburgh and the location of the selected schools is given in Figure 1. The nursery schools were well distributed across the city.

Each school was assigned to one experimental group. It was not practical to have children participating in different regimes in the same school.

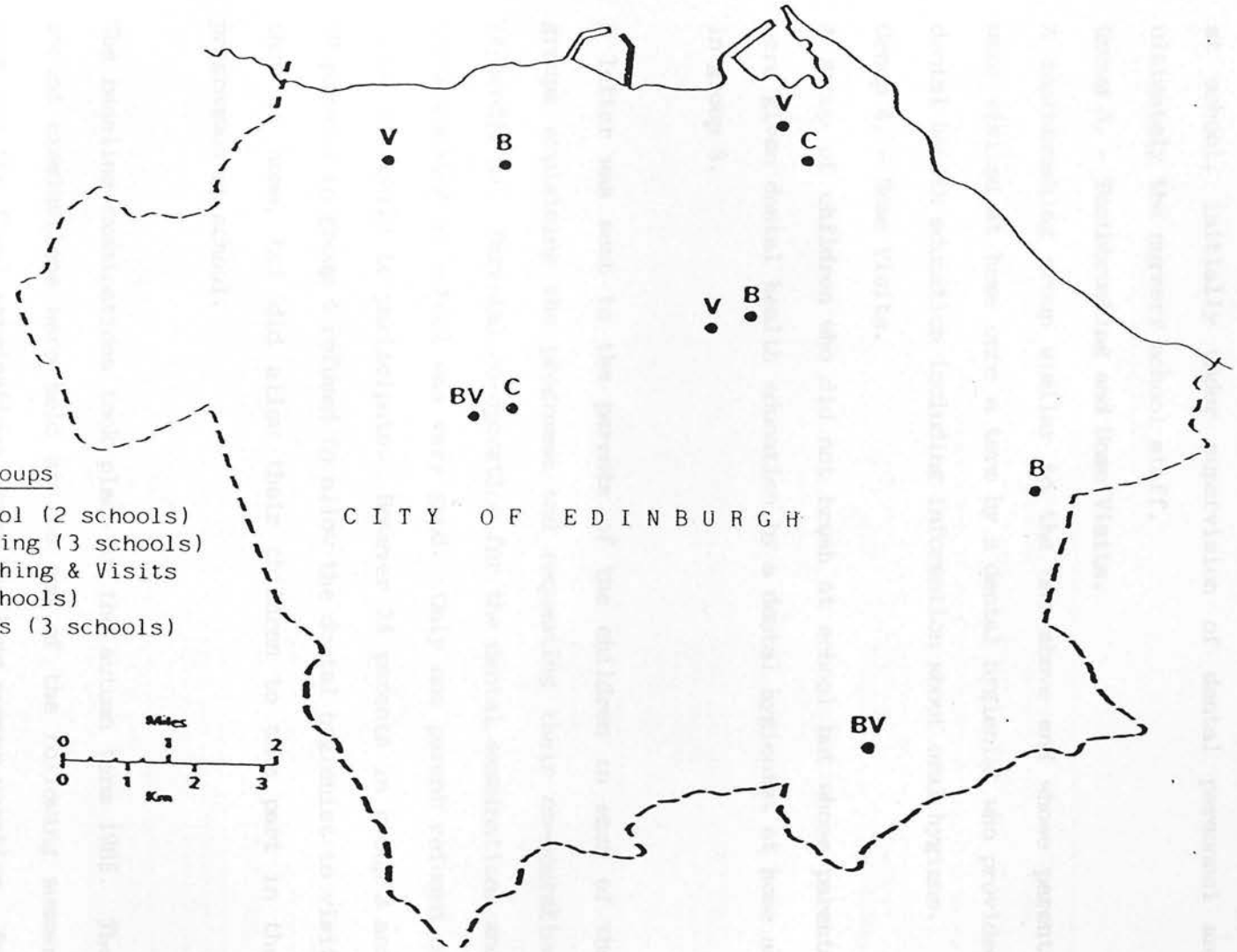
To achieve an initial balance the allocation of the children to the study groups was made after the baseline examinations at nursery school had been completed. The allocation of the schools to the study group could not be random as some schools did not have the staff or facilities to cope with a toothbrushing programme.

The groups were designated as follows:

Group 1. - Control.

A group of children who received dental examinations only at school.

Figure 1. Location of the control and experimental groups of the ten nursery schools



Group 2. - Toothbrushing.

A toothbrushing group who were taught how to brush their teeth daily at school, initially under supervision of dental personnel and ultimately the nursery school staff.

Group 3. - Toothbrushing and Home Visits.

A toothbrushing group similar to the one above and whose parents were visited at home once a term by a dental hygienist who provided dental health education including information about oral hygiene.

Group 4. - Home Visits.

A group of children who did not brush at school but whose parents were given dental health education by a dental hygienist at home as in group 3.

A letter was sent to the parents of the children in each of the groups explaining the programme and requesting their co-operation (Appendix 2). Parental co-operation for the dental examinations and toothbrushing at school was very good. Only one parent refused to allow his child to participate. However 34 parents in group 3 and 39 parents in group 4 refused to allow the dental hygienist to visit them at home, but did allow their children to take part in the programmes at school.

The baseline examinations took place in the autumn term 1985. The second examinations were held at the end of the following summer term and the final examinations after the long summer vacation. By this time some of the children had moved on to primary school. A plan of the investigation is shown in Figure 2. There were 2 dental hygienists involved with the study and their role in each of the

Figure 2. Plan of investigation

Date	Group 1 Control	Group 2 Brushing	Group 3 Brushing & Visits	Group 4 Visits
1985 August, September	Names and addresses and dates of birth from school roll. Letter to parents seeking permission to join the scheme and explaining the programme.			
October, November	Baseline examination	Baseline examination	Baseline examination	Baseline examination
1986 January		Toothbrushing begins at nursery school	Toothbrushing begins at nursery school	
February		Questionnaire 1 at nursery school	First home visit Questionnaire 1 Dental health education 1	First home visit Questionnaire 1 Dental health education 1
March, April			Second home visit Questionnaire 2 Dental health education 2	Second home visit Questionnaire 2 Dental health education 2
May, June	Second examination	Second examination	Second examination	Second examination
		Toothbrushing ceases	Toothbrushing ceases	
July	Summer vacation	Summer vacation	Summer vacation	Summer vacation
August, September	Final examination	Final examination	Final examination	Final examination
October, November		Questionnaire 2 at nursery school	Third home visit Questionnaire 3	Third home visit Questionnaire 3
	End of Study	End of Study	End of Study	End of Study

experimental groups is given in Figure 3.

3.2.2. The programme for each group

Group 1 - Control

The children in this group participated only in the dental examinations at school.

Group 2 - Toothbrushing

The children in this group were taught how to brush their teeth at school. Once the programme had become established the school staff supervised the toothbrushing assisted by the hygienist who visited the schools once every two weeks. The children were taught a simple scrub method of toothbrushing and the importance of cleaning every tooth surface was emphasised.

Most of the children attended nursery for either a morning or an afternoon session. For these children toothbrushing took place after the mid-session snack. In one school the children attended all day and they brushed their teeth after the midday meal.

Toothbrushing took place in the cloakrooms or classrooms depending on the facilities available at the schools. At the beginning of the study each child was given a named toothbrush and a named rinsing mug which had a picture on it to help identification. The toothbrushes were stored in racks or on trays out of reach of the children. To ensure a high standard of hygiene and to avoid cross infection, the named toothbrushes were soaked in a solution of Milton (sodium hypochlorite solution dilution of 1:80) for at least

Figure 3

The role of the dental hygienists in each experimental group.

Hygienist	Toothbrushing	Study Group Toothbrushing & home visits	Home visits
1 (A.F.)	a) supervised brushing b) completed questionnaires 1 & 2	a) supervised brushing	-
2 (F.K.)	-	a) health education at home b) completed questionnaires 1,2 & 3	a) health education at home b) completed questionnaires 1,2 & 3

30 minutes before use. They were then rinsed with cold water and given to the children. After use they were rinsed again and returned to soak in a fresh Milton solution, re-rinsed and allowed to dry. This procedure was carried out at every toothbrushing session by the school staff or the visiting hygienist. The toothbrushes were renewed as necessary and at least once a term. The toothpaste contained fluoride (Colgate MFP) and was dispensed by the school staff. The toothbrushing was always supervised and the children were encouraged to expectorate and not swallow the toothpaste after they had brushed their teeth.

Group 3 - Toothbrushing and home visits

The children in this group brushed their teeth daily at school. In addition their parents were given dental health education at home by a hygienist on two occasions, once during the spring term and once during the summer term. The dental health eduction was based on the policy document 'The Scientific Basis of Dental Health Education' published by the Health Education Council (1985). The relevant statements concern the importance of brushing teeth and gums daily with a fluoride toothpaste (a scrub technique was advised), the restriction of sugar containing foods and drinks to mealtimes and the need for regular dental attendance.

A new toothbrush was supplied for the child at each home visit by the hygienist.

Group 4 - Home visits

Parents of the children in this group were given dental health

education at home only, as in Group 3.

3.3. QUESTIONNAIRES

To assess any changes that may have occurred in the parents' attitudes to their children's toothbrushing and dental health over the study period, a questionnaire was devised for the study groups 2, 3 and 4. The control group was not involved in this part of the study in case the questions asked led to a spillover effect which would affect the parents' attitudes to dental health.

Parents of children in group 2 were interviewed when they were collecting their children from school. Two questionnaires were completed for this group - one at the beginning and one at the end of the study. The questionnaires for parents of groups 3 and 4 children were completed at each home visit before the dental health education was given. Dental health education was not given at the last visit. Copies of the three questionnaires are given in the Appendix 3. To achieve consistency the hygienists were asked to follow the details of the questionnaire closely.

3.4 THE DENTAL EXAMINATION

All of the children were examined by the same examiner (J A Rayner) who had standardised her method. The examinations took place in the classroom under uniform conditions according to the method described

by the World Health Organisation - Basic Methods, 2nd Edition, 1977. A portable light was used to provide a consistent source of illumination. Details of each child were dictated to an assistant who was so placed that the charts could be easily seen by the examiner. Charts completed earlier in the study were not available at subsequent examinations. A copy of the examination chart is given in the Appendix 4.

3.4.1. Standards of diagnosis and indices of dental health

a. Oral Hygiene

In the earlier nursery school study (Sutcliffe et al, 1984) oral cleanliness was measured by the debris index (DI-S) a component of the Simplified Oral Hygiene Index of Greene and Vermillion (1964). The index was adapted for the deciduous dentition. Although this index is frequently used to measure plaque (Freed, J R and Matthias, R E 1980) it has some disadvantages when looking at the effect of toothbrushing programmes on individual tooth surfaces since only six tooth surfaces were examined to compile the index. An index involving the examination of a larger number of surfaces was thought to be more appropriate. The Plaque Index (P.I.) of Silness and Loe (1964) was adopted and modified for the deciduous dentition. This index necessitates the examination of the buccal, lingual, mesial and distal surfaces of the following deciduous teeth - the second maxillary and mandibular molars, the maxillary right lateral incisor and the mandibular left lateral incisor.

The teeth were dried before examination using air from a chip syringe. It was originally intended to use an electrically driven

compressor and one was available, but the noise frightened the children. An explorer was used to identify plaque. The scoring system is as follows:

0 = No plaque.

1 = Film of plaque adhering to the free gingival margin and adjacent tooth area.

2 = Moderate accumulations of plaque within the gingival pocket or on the tooth and gingival margin that can be seen with the naked eye.

3 = Abundance of plaque within the gingival pocket and/or on the tooth and gingival margin.

$$\text{Plaque Index} = \frac{\text{sum of the scores for the tooth surfaces}}{6}$$

b. Gingivitis

The gingival index of Loe and Silness (G.I.) (1963) was used to record gingivitis. This index is based on the clinical characteristics of the different grades of gingival inflammation. The gingival units (buccal, lingual, mesial and distal) of the same six teeth scored in the plaque index were examined for inflammation. Each unit was given a score of 0-3.

0 = Absence of inflammation.

1 = Mild inflammation - slight change in colour and little change in texture.

2 = Moderate inflammation - moderate glazing, redness,

oedema and hypertrophy. Bleeding on pressure.

3 = Severe inflammation - marked redness and hypertrophy. Tendency to spontaneous bleeding. Ulceration.

$$\text{Gingival index} = \frac{\text{sum of the gingival scores}}{6}$$

The index for the child is thus an average score for the areas examined.

c. Dental Caries

The examination for dental caries was conducted using a plane mirror and an Ash No.54 sickle probe. A new probe was used after every twentieth examination. Radiographs were not used. Dental caries was measured using the dmf index according to criteria published by Jackson (1950). A pit or fissure was recorded as carious if with a little pressure the point of the probe stuck in the fissure and required a definite pull for its removal. In addition to teeth with dental caries, decayed teeth (d) included teeth which were both filled and decayed. Missing teeth (m) were presumed to have been extracted as a result of dental caries. Teeth lost as a result of trauma or exfoliation were not included with missing teeth. Filled teeth (f) were teeth that had been restored and were otherwise sound.

3.5. EFFORT EFFECTIVENESS

The cost of the different health education programmes was measured in terms of effort effectiveness which is the number of units of effectiveness per unit of effort (Hollis 1979). The input (or unit of effort) was the number of man hours that the hygienist spent in each preventive programme. The output (unit of effectiveness) was the improvement in Plaque and Gingival Index Scores.

CHAPTER 4

DUPLICATE EXAMINATIONS AND CONSISTENCY OF DIAGNOSIS

In a series of examinations during a clinical trial, errors may occur due to changes in diagnostic standards (examiner variability) and the need for consistent diagnosis of dental conditions is universally recognised. The World Health Organisation has recommended duplicate examinations of about 10% of the sample in the main survey (WHO 1977), but there is at present no generally approved method of testing examiner variability although there are a number of techniques available. The Federation Dentaire Internationale recommends the publication of paired 't' tests and reliability coefficients along with the results of a trial or survey (FDI 1982). Student 't' tests are frequently used in testing the frequency of diagnosis; reliability coefficients (Rugg-Gunn & Holloway 1974) are used by some workers and are numerically equivalent to Pearson's correlation coefficient (Downer et al 1979). The World Health Organisation recommends the use of proportion agreement (WHO 1987).

In this study data for oral cleanliness, gingivitis and dental caries were recorded at the duplicate examinations and the levels of agreement calculated using one or more of the following statistical tests.

1. Proportion agreement
2. Dice's coincidence index

3. The unweighted and weighted Kappa statistic
4. Paired 't' tests
5. Reliability coefficents

These are the most common approaches for testing the consistency of diagnosis that have been published in the dental literature.

Pearson's correlation coefficient has also been used by many workers for testing reproducibility (McAllan et al 1976, Addy et al 1986, Julien 1987) and initially was considered in the present study. However Bulman & Osborne (1989) have stated that correlation coefficients only measure the strength of a relationship between two variables, not the agreement between them. Bland & Altman (1986) have also criticised the correlation coefficient for testing examiner variability. The correlation coefficient has not therefore been used in this study.

The methods of calculating proportion agreement, Dice's coincidence index the Kappa statistics and reliability coefficients and the interpretation of the results are given in Appendix 5.

4.1. METHOD

Children in this study were selected for repeat examination by the recorder at the end of each examination.

Duplicate examinations took place on 10% of the children in the

survey. These children were selected by the recording assistant provided that they were willing to be re-examined. In order to reduce the possibility of the examiner remembering the oral status of a recently examined child there was as long a time lag as possible, between the first and duplicate examinations. It was not always possible to examine children again on the same day and some children were re-examined on a subsequent occasion usually when the examination team was returning to the school to examine children who had previously been absent.

4.1.1. Oral hygiene

Mean Plaque Index (P.I.) scores were arbitrarily arranged into the three standards of oral cleanliness, good, fair and poor, by dividing the population at the following scores,

0.0 - 0.49 = good

0.50 - 1.49 = fair

1.5+ = poor

These are different cut-off points from those later presented in the results for the complete oral hygiene data as the actual distributions of the P.I. scores were different. Consistency of diagnosis was analysed using proportion agreement, the unweighted and weighted Kappa statistic and paired 't' tests and reliability coefficients.

Duplicate examinations of oral cleanliness present a special problem. The examination involves the removal of plaque, a repeat examination on the same day will therefore reveal a different score which would be expected to be smaller. Since the standard of oral

cleanliness may be easily changed a duplicate examination carried out on a different day may also not be reliable.

4.1.2. Gingivitis

It was not possible to use the three divisions, good, fair and poor, for the duplicate data for gingivitis. This was because the prevalence of gingivitis was low and the degree of inflammation was mainly mild. For the reproducibility study gingivitis was recorded as present or absent (prevalence), together with mean number of sites affected (extent) and mean G.I. scores.

Consistency of diagnosis was analysed using proportion agreement, Dice's coincidence index and the Kappa statistic for prevalence Paired 't' tests and reliability coefficients were used for extent and mean G.I. scores.

4.1.3. Dental caries

Tooth status was recorded as sound or affected (i.e. decayed, missing or filled). Reproducibility of diagnosis was tested using proportion agreement, Dice's coincidence index and the Kappa statistics.

Mean dmft scores were compared using a 't' test and reliability coefficients.

The results of the duplicate examination for oral hygiene, gingivitis and dental caries in the study were compared with those published by other workers. The literature comparisons were made from 1975 onwards.

4.2. RESULTS

The examiner undertook 174 duplicate examinations. About half of the children (83) in the study had duplicate examinations on the same day and 91 children were examined on a subsequent occasion (Table 3). For the latter group an average number of 10 days elapsed between the first and duplicate examination (Table 4).

4.2.1. Proportion Agreement (P)

Ideally the value of P should be close to 100. The World Health Organisation first recommended that examiners should attempt to achieve 80% agreement between the results of duplicate examinations (WHO 1977) and this was the level aimed at in this study when it was set up. More recently WHO has suggested that although it is not possible to give precise definition of acceptable consistency, in general, agreement for most assessments should be in the range 85-90% (WHO 1987).

The results of the duplicate examinations expressed as proportion agreement for oral hygiene, gingivitis and dental caries together with information from other published studies are given in Table 5.

In this study the overall proportion agreement for oral hygiene was 63% and the value was 67% for children re-examined on the same day. The corresponding values for gingivitis were 83% and 82%, and 99% and 94% for dental caries.

Table 3

Numbers of children examined twice; numbers examined on the same day and numbers examined later.

Examination	Same Day n	Later n	Total
Baseline	49	7	56
Second	24	54	78
Third	10	30	40

Table 4

The average number of days between the first and duplicate examinations for children re-examined another day.

Examination	Number of children	Average Number of Days
Baseline	7	15
Second	54	12
Third	30	8
Overall	91	10

Table 5

Proportion agreement for duplicate examinations for oral hygiene, gingivitis and dental caries, together with data from other published studies

Study Reference	Age of Subjects	Proportion agreement Oral hygiene %	Gingivitis %	Dental Caries %
Shaw & Murray (1975)	11-13	-	-	74 - 80
Holst D (1975)	13	-	-	98
Holm A K (1975)	3-5	-	96	99
Poulsen et al (1976)	7	-	-	97
Lang et al (1977)	25-45	87.6*	-	91.3
Hamp et al (1979)	7-16	-	75.6 - 88.5	88 - 90
Mageean et al (1978)	5	-	-	97
Billie J (1980)	20	-	-	87
Kinirons et al (1980)	12	-	-	96
Holt et al (1982)	1-5	-	-	83
Holt et al (1985)	5	70 *	81	99.7
Chosack et al (1986)	5-6	-	-	98.2
King et al (1986)	12	93.9*	-	-
Cheung & Holt (1986)	8-10	-	71	73
Present study (all children)	3-4	63*	83	99
Present study (same day)	3-4	67*	82	94
Present study (later)	3-4	52*	82	98

* = destructive index used

N.B. Dental indices employed
Oral hygiene; good, fair, poor
Gingivitis; present, absent
Dental caries; sound,dmft

4.2.2. Dice's Coincidence Index

Nuttal and Paul (1985) have stated that it may be misleading to express agreement as the proportion of teeth that were diagnosed similarly. This is because poor agreement in the less frequently used diagnostic criteria may be obscured by superior agreement in the more frequently used choice and they recommend the use of Dice's coincidence index.

This index provides a measure of either the probability that a tooth (or surface) diagnosed as sound by the examiner on the first occasion will be diagnosed similarly on the second occasion, or the probability that a tooth or surface diagnosed as carious at the first occasion will be diagnosed carious at the second occasion.

Dice's index is thus a measure of 2 diagnostic choices (sound or decayed, present or absent) and provides a numerical value for the probability of agreement. The value of the index ranges from 1.0, which indicates complete association of the two choices, to 0.0 which indicates complete failure of association. Intermediate values give the proportional amount of association (Dice 1945).

The probability of agreement for the presence or absence of gingivitis was 0.71 (71%) and 0.88 (88%) respectively.

The probability of agreement for teeth diagnosed as sound or carious in this study was 0.95 (95%) and 0.97 (97%) respectively.

These values together with those for children re-examined on the

same day and later are given in Table 6.

It was possible to make comparisons with one other study for dental caries only. There were no Dice's indices for gingivitis in the literature reviewed.

4.2.3.a. Unweighted Kappa Statistic (K)

The Kappa statistic (Cohen 1960) has been recommended as a more appropriate measure of quantifying agreement as it takes into account agreement that could have occurred by chance (Fleiss and Chilton 1983, Hunt 1986).

Bulman & Osborne (1989) suggest that it is probably the most reliable method of assessing examiner agreement. The Kappa values for oral hygiene (good, fair and poor) gingivitis (present/absent) and dental caries (sound/affected teeth) are given in Table 7 together with information from other published studies.

The values of the unweighted Kappa Statistic for oral hygiene was 0.39 for all children and 0.50 for children re-examined on the same day. The corresponding values for gingivitis were 0.58 and 0.59, and 0.84 and 0.84 for dental caries.

b. Weighted Kappa Statistic (Kw)

Unweighted Kappa only considers areas of total agreement and does not take into account near misses. When analysing data which has been divided for example into good,fair and poor, a weighting factor can be applied in order to make a realistic contribution to the

Table 6

Dice's Coincidence Index for 39 examiners in the Scottish 12-year-old dental survey (1988/89)* compared with the present study

Scottish 12-year-old survey

Number of Examiners		Dice's Index Caries	Dice's Index Gingivitis
	Caries present		
2		1.00	-
1		0.92	-
1		0.86	-
1		0.80	-
2		0.75	-
3		0.67	-
1		0.00	
	Caries absent		
7		1.00	-

Present study

Caries present		Gingivitis present	
All children	0.97	All children	0.71
same day	0.95	same day	0.73
later	0.99	later	0.68
Caries absent		Gingivitis absent	
All children	0.95	All children	0.88
same day	0.92	same day	0.79
later	0.98	later	0.88

* Pitts & Davies (1990)

Table 7

Kappa(K) and weighted Kappa (Kw) values for duplicate examinations for oral hygiene, gingivitis and dental caries together with data from other published studies.

Study reference		Age of Subject	Kappa Statistic Oral hyiene K	Oral hyiene Kw	Gingivitis K	Dental caries K
Fleiss et al	(1979)	11		-	-	0.88 - 0.92
Markkanen et al	(1979)	18-62		-	0.76	-
Palin et al	(1982)	9-10		-	-	0.89
Markkanen et al	(1985)	30+	0.41	0.48	0.56	-
Bedi R	(1988)			-	-	0.86
Holt R et al	(1988)	1-3		-	-	0.84 - 0.89
Present Study (all children)		3-4	0.39	0.50	0.58	0.84
Present Study (same day)		3-4	0.50	0.66	0.59	0.84
Present Study (later)		3-4	0.29	0.32	0.57	0.84

N.B. Dental indices employed
Oral hygiene; good, fair, poor
Gingivitis; present, absent
Dental caries; sound, dmft

Kappa statistic. In this study the weighting system devised by Cicchetti (1976) has been applied to the data for oral hygiene. The weighted Kappa statistic was not used for the duplicate data for gingivitis or dental caries as gingival inflammation was only recorded as being present or absent, and dental caries was recorded as sound or affected teeth.

The Kw value for oral hygiene was 0.50 for all children and 0.66 for children re-examined on the same day. Details of the weighting system used are given in Appendix 5. The Kw values are included in Table 7.

4.2.4. Paired 't' tests

The duplicate data was also analysed using paired 't' tests on mean mouth scores for oral hygiene, gingivitis and dental caries. The mean values are given in Table 8. It was only possible to make comparisons with information from three other studies. Very few research workers have published actual mean mouth scores for replicate data, most frequently only the result of the significance test is published.

In the present study the mean oral hygiene values at the first and duplicate examinations were 1.91 and 1.65. The differences between these two values was statistically significant ($p<0.001$). Statistically significant differences in oral hygiene scores were also observed in children who were re-examined on the same day.

No statistically significant differences in the mean gingival scores

Table 8

Mean values for oral hygiene, gingivitis, extent of gingivitis and dental caries together with data from other published studies.

		Mean Values			
		Oral hygiene	Gingivitis		Dental Caries
		mean P.I.	mean G.I.	mean sites affected	mean dmft
Burt et al (1978)	Exam 1	-	0.57	-	-
	repeat	-	0.62	-	-
Chosack (1986)	Exam 1	-	-	-	3.63
	repeat	-	-	-	3.91
Mander & Mairwaring 1980	Exam 1	10.10	-	-	-
	repeat	9.30	-	-	-
Present study (all children)	Exam 1	1.91*	0.30	1.02	1.62
	repeat	1.65	0.28	0.91	1.61
Present study (same day)	Exam 1	1.93*	0.32	1.02	1.48
	repeat	1.67	0.34	0.97	1.44
Present study (later)	Exam 1	1.91*	0.28	1.01	1.76
	repeat	1.64	0.23	0.88	1.77

* = $p<0.001$

were found between the two examinations. The mean values were 0.30 and 0.28. There were also no statistically significant differences in the mean number of gingival sites affected. 1.02 sites were scored as affected at the first examination and 0.91 sites at the repeat examination. The corresponding values when children were re-examined the same day were 1.02 sites and 0.97 sites.

The mean dmft values for caries experience at the first and second examinations were 1.62 and 1.61 respectively. The difference between these two values was not statistically significant. There were also no statistically significant differences in caries experience for children re-examined on the same day. The mean values were 1.48 and 1.44 respectively.

4.2.5. Reliability Coefficients

As many published methods of demonstrating repeatability do not allow the influence of error to be quantified, Rugg-Gunn and Holloway (1974) recommended that reliability coefficients together with error variances should be used to express reproducibility in oral epidemiology. The coefficient of reliability is the ratio of true to total variance where total variance is the sum of true and error variance. Rugg-Gunn & Holloway (1974) also pointed out that direct comparisons of reliability coefficients between studies might be misleading unless the true variances were first shown to be similar.

The value of the reliability coefficient in many of the studies published in the literature is frequently greater than 0.90 and with

the exception of one of the studies reviewed, is calculated for dental caries only (Table 9) using the formula given in Appendix 5.

As reliability coefficients are numerically equivalent to Pearson's correlation coefficient (r), their use as measures of examiner reliability should be carefully assessed as they may be flawed with the same faults as the correlation coefficient described by Bulman & Osborne (1989). Further research into the use of reliabiltiy coefficients in dental epidemiological studies would be welcomed.

In the present study the reliability coefficient for oral hygiene was 0.92 for all children, 0.89 for children re-examined on the same day and 0.90 for children re-examined later. The corresponding values for gingivitis were 0.71, 0.74 and 0.72 and for dental caries 0.96, 0.97 and 0.97.

4.3. SUMMARY

Intra-examiner agreement has been measured for plaque accumulations, gingivitis and dental caries for all children and for children re-examined the same day, and for children re-examined on another occasion. The results are summarised in Table 10.

Proportion agreement for plaque accumulations was low for all children. However higher levels of reproducing plaque scores were observed when children were re-examined on the same day compared with children re-examined later. The weighted Kappa statistic of

Table 9

Values of reliability coefficients published by other workers.

Author	Oral hygiene	Gingivitis	Dental Caries
Rugg-Gunn et al (1976)	-	-	0.92 - 0.95
Howat et al (1978)	-	-	0.98
Mander & Mainwairing (1980)	0.95	-	-
Ashley & Sainsbury (1981)	-	-	0.91
Heiftz et al (1985)	-	-	0.96
Addy et al (1986)	-	-	0.98
Blinkhorn et al (1985)	-	-	0.93
Wight & Blinkhorn (1988)	-	-	0.92 - 0.96
Present study - all children	0.92	0.71	0.96
Present study - same day	0.89	0.74	0.97
Present study - later	0.90	0.72	0.97

N.B. Dental indices employed
Oral hygiene; mean P.I.
Gingivitis; mean G.I.
Dental caries; mean dmft

Table 10

Summary for reproducibility of diagnosis.

Statistical test	Oral hygiene	Gingivitis	Dental caries
Proportion agreement	numbers of children with good, fair, poor	children with & without gingivitis	numbers of sound & dmf teeth
(WHO recommendation)	same day = 67% later = 52% all children = 63%	same day = 82% later = 82% all children = 83%	same day = 94% later = 98% all children = 99%
Dice		children with & without gingivitis	number of sound & dmf teeth
		same day = 0.73 - 0.79 later = 0.68 - 0.88 all children = 0.71 - 0.88	same day = 0.92 - 0.97 later = 0.95 - 0.99 all children = 0.95 - 0.97
Kappa	number of children with good, fair, poor	children with & without gingivitis	number of sound & dmf teeth
	same day = 0.50 (moderate) later = 0.29 (fair) all children = 0.39 (fair)	same day = 0.59 (moderate) later = 0.57 (moderate) all children = 0.58 (moderate)	same day = 0.84 (perfect) later = 0.84 (perfect) all children = 0.84 (perfect)

Table 10 continued/..

	Oral hygiene	Gingivitis	Dental caries
Weighted Kappa	number of children with good, fair, poor same day = 0.66 (substantial) later = 0.32 (fair) all children = 0.50 (moderate)		
Paired 't'	mean P.I. same day = p<0.001 later = p<0.001 all children = p<0.001	mean G.I. same day = n.s. later = n.s. all children = n.s. n.s. = no significant difference	mean dmft same day = n.s. later = n.s. all children = n.s.
Reliability coefficient (F.D.I. recommendation)	mean P.I. same day = 0.89 later = 0.90 all children = 0.92	mean G.I. same day = 0.74 later = 0.72 all children = 0.71	mean dmft same day = 0.97 later = 0.97 all children = 0.96

0.66 represents substantial agreement and the value of the reliability coefficient was high. There were few reports of oral hygiene reproducibility studies in the literature and it was difficult to make comparisons with the results of other workers. Nevertheless these results were found to compare quite favourably with those published by Koran (1975a, 1975b) for clinical judgement in medicine.

Proportion agreement for gingivitis between the first and duplicate examination was good and is comparable to that of other workers. Dice's coincidence index was acceptable but the Kappa statistic for the presence and absence of gingivitis represented only moderate agreement. The value of the reliabilty coefficient was also small, however there were no statistically significant differences in the mean mouth scores or the mean number of sites affected (extent) between the first and duplicate examinations. No important differences in the diagnosis of gingivitis were observed when children underwent duplicate examinations on the same day or when children were re-examined on another occasion.

Proportion agreement between the first and duplicate examination for dental caries was high, the Kappa value represented substantial to perfect agreement and the values of Dice's index and the reliability coefficient were also high. No statistically significant differences were observed in mean dmft between the first and duplicate examination. As with gingivitis no differences on diagnosis for dental caries was noted for children re-examined on the same day and children re-examined later.

The replicate data for dental caries in this study compared well with that of other workers.

4.4. DISCUSSION

In this study children aged 3-4 years underwent duplicate examinations for oral cleanliness, gingivitis and dental caries in the classroom.

Some of the difficulties in reproducing reliable plaque scores have already been mentioned. Other difficulties were the informal atmosphere in nursery classes and the age of the subjects. The children may have eaten a snack and in some cases may have brushed their teeth between the two evaluations. Dental plaque was not disclosed because it was thought to be impractical with such young children and in addition would have necessitated a professional tooth cleaning programme afterwards. The tendency to develop gingivitis is low in pre-school children compared with older children (James 1963, Mackler and Crawford 1973, Matsson 1978). These factors probably contributed to the difficulties encountered when attempting to reproduce gingival scores.

In contrast to plaque and gingivitis it is easier to accurately reproduce dmft or DMFT scores. The dental caries index is simple to calculate and is based on relatively objective diagnostic criteria.

These differences in duplicating data for dental diseases are

reflected in the number of reported studies in the literature. There are relatively few published reports involving the duplication of plaque and gingivitis scores compared with the number for dental caries. In addition most studies have been conducted with older children or adults and there are very few reports involving pre-school children. Cushing & Gelbier (1988) carried out a study of the dental health of children aged 1-4 years attending day nurseries in London. They reported that it was not practicable to re-examine a subsample of children to check for examiner error.

Another study designed to test the effectiveness of dental health education on mothers with young children in the London Borough of Hillingdon however, has given results for the reproducibility of diagnosis of caries, plaque and gingivitis (Holt et al 1985). The children in this study were examined during their first year at primary school in nearby community dental clinics. The percentage reproducibility for the diagnosis of caries, plaque and gingivitis in the Edinburgh nursery school study compares favourably with the London five year olds (Table 5).

For various reasons, difficulties were encountered when attempting to make comparisons with information from other published studies. In general where results of reproducibility studies are reported, very little information is given and is frequently limited to a few lines or a small paragraph. Very few authors report on how their data was handled i.e. from raw scores, mean scores, present/absent etc. Results of statistical tests are frequently given with no details of how the analysis was carried out.

MacLaurin et al (1985) in a study of handicapped children in Birmingham simply reported that a reproducibility study was carried out with respect to oral cleanliness, calculus and periodontal treatment requirements and that there were no statistically significant differences between the first and second examinations. No further information was given. Some research workers measure interexaminer reliability for dental caries only when data for plaque and gingivitis is also being recorded (Gibson et al 1981, Addy et al 1986). In two separate studies of the dental health of adolescents in Glasgow and the Lothian region of Scotland, Blinkhorn et al (1985) and Wight & Blinkhorn (1988) stated that no attempt was made to assess inter-examiner reliability for plaque and gingivitis.

More recently in a national dental health survey in Scotland of 12 year old children, as part of the Scottish Health Boards' Dental Epidemiological Programme, 40 Community Dental Officers underwent a training and callibration course to record dental caries, oral cleanliness and gingivitis. Inter-examiner agreement was measured for dental caries only. The authors reported that it was not practicable to make repeated assessments of oral cleanliness or periodontal disease on the same subjects (Pitts & Davies 1990).

Some authors report that reproducibility of diagnosis was assessed but give no results (Cahen et al 1987) and other workers give no information at all (Horowitz et al 1980, Saxby & Anderson 1987, Wierzbicka et al 1987, Klock et al 1989).

The importance of being able to consistently diagnose dental

conditions has been recognised for some years (Jackson 1950, Slack et al 1958, WHO 1977 & 1987). It would be helpful if epidemiologists routinely carried out reproducibility studies when collecting dental data and fully reported their results.

It is concluded that the examiner in this study was able to diagnose plaque accumulations, gingivitis and dental caries to an acceptable level of reproducibility and the results are broadly comparable to those published by other workers on similar populations.

CHAPTER 5

RESULTS

5.1. PRESENTATION OF RESULTS

5.1.1. Oral hygiene.

The results for oral cleanliness are expressed as mean P.I. values for mouths and for the teeth and tooth sites measured. There is a theoretical objection to this conventional way of presenting mean P.I. scores because it is the mean value of an arbitrarily weighted score. To compensate for this the full range of plaque scores was divided into three subgroups, designated good, fair and poor, thus converting the quantitative score to a qualitative score.

The results for oral hygiene are therefore presented as mean P.I. scores and proportions of children with good, fair and poor oral hygiene.

5.1.2. Gingivitis.

The results for gingivitis are also expressed as mean G.I. values for mouths and for teeth and teeth sites. There is the same theoretical objection to the conventional way of presenting mean G.I. scores. To overcome this objection gingivitis is also presented as the prevalence, extent and degree of gingivitis (Jackson 1965).

5.1.3. Dental caries.

Dental caries is expressed as sound or dmft. It was not possible to evaluate the effect of the health education on dental caries because the study was too short. It has been recommended that reliable estimations of the incidence of dental caries should not be made with a mirror and probe for study intervals of less than three years when the teeth have erupted before the study began (Horowitz 1968). The dmft index was used to demonstrate the initial balance of the groups and to provide evidence of the uptake of dental care.

5.2. NUMBERS OF PARTICIPATING CHILDREN

The 558 children seen at the baseline examination (the A group in Table 11a) were well balanced for age and dental status. No statistically significant differences were found between the initial values of the dental indices in the control group and the initial values in any of the three experimental groups.

During the examination sessions every effort was made to return to the nursery or primary schools to examine children who had been absent from school. In spite of this 209 (37%) were lost from the study by the final examination. The numbers and proportions of children lost from the study are given in Table 12.

Of the total number of children seen at the baseline examination 406 were seen at all three examinations. Of the 209 children "lost" from the study, 55 had left the district (26%) and 73 refused the home visit (35%). Thirty four out of the 130 parents in group 3 refused the home visit and 39 out of 149 parents in group 4. Fifty one of these 73 children completed the programme at school but were excluded from the evaluation. This unwillingness to comply with the programme is obviously important and is considered later. Other losses were due to children being absent (53 children (25%)) from one or more examinations and 28 children (13%) were lost in the move from nursery to primary school. The results presented are for the 349 children who completed the programme. There were no statistically significant differences between the groups in the proportions of children who were lost from the study and those who

Table 11a

A comparison of the initial status of all participating children (A) and all children who completed the study (B) in the control group, with each of the experimental groups.

	control				brushing				brushing + home visits				home visits			
	A_1 n = 146		B_1 n = 112		A_2 n = 133		B_2 n = 89		A_3 n = 130		B_3 n = 71		A_4 n = 149		B_4 n = 77	
	mean	s.e.	mean	s.e.	mean	s.e.	mean	s.e.	mean	s.e.	mean	s.e.	mean	s.e.	mean	s.e.
mean age	3.92	0.04	3.95	0.05	3.85	0.04	3.87	0.05	3.83	0.04	3.79	0.06	3.90	0.04	3.88	0.06
mean P.I.	1.70	0.11	1.65	0.12	1.88	0.17	1.95	0.22	1.87	0.18	1.60	0.21	1.69	0.11	1.56	0.14
mean G.I.	0.28	0.04	0.30	0.04	0.27	0.05	0.26	0.05	0.29	0.04	0.28	0.06	0.29	0.05	0.30	0.07
mean dmft	1.81	0.26	1.75	0.29	2.40	0.33	2.54	0.41	1.73	0.03	1.54	0.31	1.37	0.23	1.54	0.29
mean dt	1.52	0.22	1.45	0.25	1.73	0.26	1.88	0.34	1.38	0.27	1.31	0.31	1.15	0.20	1.32	0.33
mean mt	0.16	0.09	0.15	0.11	0.48	0.15	0.49	0.19	0.11	0.06	0.17	0.11	0.07	0.03	0.13	0.06
mean ft	0.13	0.06	0.15	0.08	0.19	0.06	0.17	0.07	0.25	0.07	0.13	0.06	0.15	0.05	0.16	0.07

t tests A_1 compared with A_2, A_3 and A_4 - none significant
B_1 compared with B_2, B_3 and B_4 - none significant

Table 11b

A comparison of the initial status of all participating children in the control group A_1, with each of the experimental groups (A_2, A_3 & A^4). The values of t and the associated probability (p)

	Group					
	A_1 v A_2		A_1 v A_3		A_1 v A_4	
	t	p	t	p	t	p
mean age	1.16	0.25	1.48	0.14	0.44	0.66
mean PI	0.91	0.36	0.81	0.42	0.08	0.93
mean GI	0.21	0.83	0.17	0.86	0.20	0.84
mean dmft	1.42	0.16	0.19	0.85	1.29	0.20
mean dt	0.61	0.54	0.41	0.68	1.21	0.23
mean mt	1.86	0.06	0.46	0.65	0.96	0.34
mean ft	0.65	0.52	1.27	0.20	0.22	0.82

Table 11c

A comparison of the initial status of all children in the control group who completed the study B_1 with each of the experimental groups (B_2, B_3 & B_4). The values of t and the associated probability (p).

	group					
	B_1 v B_2		B_1 v B_3		B_1 v B_4	
	t	p	t	p	t	p
mean age	1.03	0.31	1.95	0.05	0.89	0.37
mean PI	1.18	0.24	0.21	0.83	0.47	0.64
mean GI	0.58	0.56	0.33	0.74	0.04	0.96
mean dmft	1.62	0.11	0.30	0.76	0.30	0.76
mean dt	1.04	0.30	0.34	0.73	0.30	0.76
mean mt	1.58	0.12	0.10	0.92	0.15	0.88
mean ft	0.15	0.88	0.22	0.82	0.04	0.97

Table 12

Numbers of participating children and numbers lost from the study

Group	Numbers seen at each examination			Numbers seen at all examinations	Number whose parents refused home visit	Number in the completed programme	Number lost	Proportion %
	Exam.1	Exam.2	Exam.3					
Control	145	133	117	112	-	112	33	23
Brushing	134	102	99	89	-	89	45	33
Brushing + visits	130	107	104	95	34	71	59	45
visits	149	120	115	110	39	77	72	48
Total	558	462	435	406	73	349	209	37

completed the study ($chi^2=5.72$).

The losses of children from the study had no effect on the initial balance. For the 349 children who completed the study (group B in Table 11a), no statistically significant differences were found between the baseline values in the control group compared with the other three groups (Tables 11b & 11c).

5.3. THE SEX AND MEAN AGES OF THE CHILDREN

Although more girls (190) than boys (159) participated in the study the composition of individual groups were reasonably similar. The numbers of boys and girls and their mean ages are given in Table 13.

The mean ages of the 349 children who were seen at each examination were 3.87, 4.45 and 4.71 years. The mean ages of the children in each study group are given in Table 14. There were no statistically significant differences in mean ages between the groups at each examination except that the girls were slightly older than the boys in group 2, the difference was statistically significant (Table 13).

Table 13

Numbers, mean ages and standard error of the mean of boys and girls at each examination by group

Group	Numbers	mean age Baseline Exam	s.e.	Second Exam	s.e.	Third Exam	s.e.
1.Control							
boys	48	3.93	(0.07)	4.43	(0.07)	4.73	(0.07)
girls	64	3.96	(0.06)	4.45	(0.06)	4.76	(0.07)
2.Brushing							
boys	40	3.76	(0.07)*	4.37	(0.07)*	4.55	(0.11)*
girls	49	3.97	(0.06)	4.61	(0.07)	4.85	(0.07)
3.Brushing + home visits							
boys	35	3.81	(0.08)	4.45	(0.09)	4.66	(0.07)
girls	36	3.78	(0.09)	4.42	(0.09)	4.65	(0.09)
4.Home visits							
boys	36	3.94	(0.08)	4.52	(0.08)	4.79	(0.09)
girls	41	3.82	(0.09)	4.39	(0.09)	4.63	(0.09)

* denotes statistical significance $p<0.05$

Table 14

Mean ages and standard errors of the mean at each examination by group.

Group	baseline examination		second examination		third examination	
	mean age	s.e.	mean age	s.e.	mean age	s.e.
Control	3.95	0.05	4.44	0.05	4.74	0.05
Brushing	3.87	0.05	4.50	0.05	4.72	0.06
brushing + home visits	3.79	0.06	4.43	0.06	4.66	0.06
home visits	3.87	0.05	4.45	0.06	4.71	0.06

5.4. ORAL HYGIENE

5.4.1. Mean Plaque Index (PI) values

At the baseline examination the four groups of children were balanced with respect to their oral hygiene status (Table 15). There were no statistically significant differences in oral cleanliness between boys and girls (Table 16). At the second examination the mean P.I. scores of the experimental groups had decreased significantly when compared with the control group. This improvement was 1.36 P.I. units in group 2, an improvement of 65%. In group 3 there was a reduction of 1.56 P.I. units (74%) and 1.37 units in group 4 (65%). There was no difference in mean P.I. scores between the sexes in any of the groups at the second examination.

At the final examination the oral hygiene of the children in group 2 had deteriorated. There was no longer a statistically significant difference when compared with the control group. Although there were small increases in the mean P.I. scores of groups 3 and 4 at the third examination, the children in these groups had cleaner mouths than the control group and the differences were statistically significant. The mean P.I. scores at each examination are illustrated in Figure 4. There were no statistically signficant differences in mean P.I. scores between the sexes at the final examination.

5.4.2. Standards of oral hygiene (good, fair, poor)

The mean P.I. scores at the first examination ranged from 0.0 - 12.0 which is the maximum possible score. The scores were divided

Table 15

Mean Plaque Index (P.I.) scores and standard error of the mean of the experimental groups compared with the control group

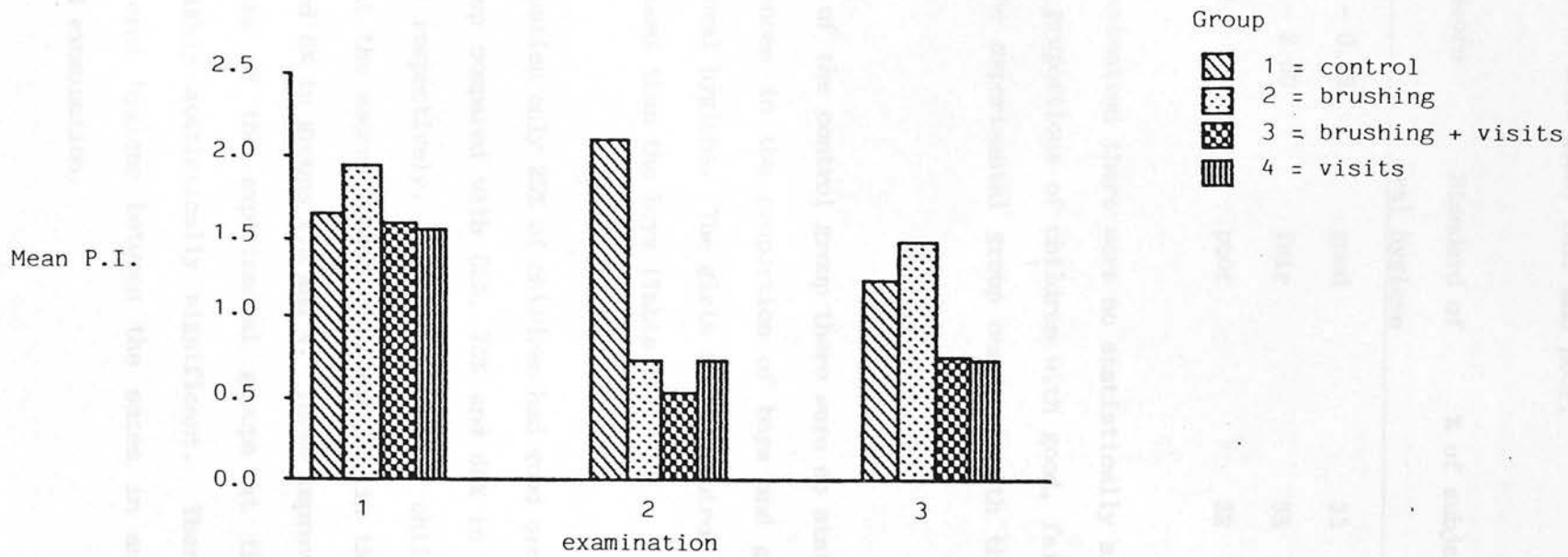
examination	group	mean P.I.	s.e.	t	sig
baseline	control	1.65	0.12	1.24	n.s.
	brushing	1.95	0.22		
second	control	2.10	0.15	7.68	p<0.001
	brushing	0.74	0.07		
third	control	1.22	0.12	1.53	n.s.
	brushing	1.47	0.13		
baseline	control	1.65	0.12	0.21	n.s.
	brushing + visits	1.60	0.21		
second	control	2.10	0.15	8.11	p<0.001
	brushing + visits	0.54	0.06		
third	control	1.22	0.12	3.16	p<0.01
	brushing + visits	0.75	0.09		
baseline	control	1.65	0.12	0.48	n.s.
	visits	1.56	0.14		
second	control	2.10	0.15	7.04	p<0.001
	visits	0.73	0.09		
third	control	1.22	0.12	2.68	p<0.01
	visits	0.74	0.12		

Table 16

Mean Plaque Index (P.I.) scores for boys and girls at each examination.

Group	Sex	Mean P.I. Values Baseline Examination Mean	s.e.	Second Examination Mean	s.e.	Third Examination Mean	s.e.
Control							
	boys	1.42	(0.18)	2.29	(0.23)	1.37	(0.21)
	girls	1.82	(0.16)	1.96	(0.19)	1.10	(0.14)
Brushing							
	boys	2.02	(0.31)	0.77	(0.11)	1.47	(0.19)
	girls	1.89	(0.32)	0.72	(0.09)	1.50	(0.18)
Brushing and home visits							
	boys	1.50	(0.27)	0.46	(0.07)	0.69	(0.11)
	girls	1.69	(0.31)	0.61	(0.10)	0.79	(0.13)
Home visits							
	boys	1.70	(0.10)	0.76	(0.15)	0.98	(0.21)
	girls	1.44	(0.09)	0.71	(0.12)	0.53	(0.12)

Figure 4. Mean P.I. scores at each examination for each group



arbitrarily as follows into good, fair and poor.

P.I.Score	Standard of oral hygiene	% of subjects
0.00 - 0.82	good	33
0.83 - 2.00	fair	35
2.01+	poor	32

At the baseline examination there were no statistically significant differences in the proportions of children with good, fair or poor oral hygiene in the experimental group compared with the control group (Table 17).

With the exception of the control group there were no statistically significant differences in the proportion of boys and girls with good, fair or poor oral hygiene. The girls in the control group had poorer oral cleanliness than the boys (Table 18).

At the second examination only 25% of children had good oral hygiene in the control group compared with 62%, 73% and 66% in the three experimental groups respectively. The proportion of children with poor oral hygiene at the second examination was 46% in the control group and 2%, 0% and 6% in groups 2,3 and 4. These improvements in the oral cleanliness of the experimental groups at the second examination were highly statistically significant. There was no difference in the oral hygiene between the sexes in any of the groups at the second examination.

Table 17

Proportion of children with good, fair or poor oral hygiene - a comparison of the control group with each experimental group

examination	group	good %	fair %	poor %	(chi)²	sig.
baseline	control	29	37	34	2.08	n.s.
	brushing	35	28	37		
second	control	25	29	46	53.14	p<0.001
	brushing	62	36	2		
third	control	54	22	23	6.10	p<0.05
	brushing	37	33	30		
baseline	control	29	37	34	3.01	n.s.
	brushing + visits	41	30	30		
second	control	25	29	46	56.15	p<0.001
	brushing + visits	73	27	0		
third	control	54	22	23	13.24	p<0.001
	brushing + visits	59	37	4		
baseline	control	29	37	34	1.90	n.s.
	visits	31	44	25		
second	control	25	29	46	42.72	p<0.001
	visits	66	27	6		
third	control	54	22	23	6.79	p<0.05
	visits	73	16	12		

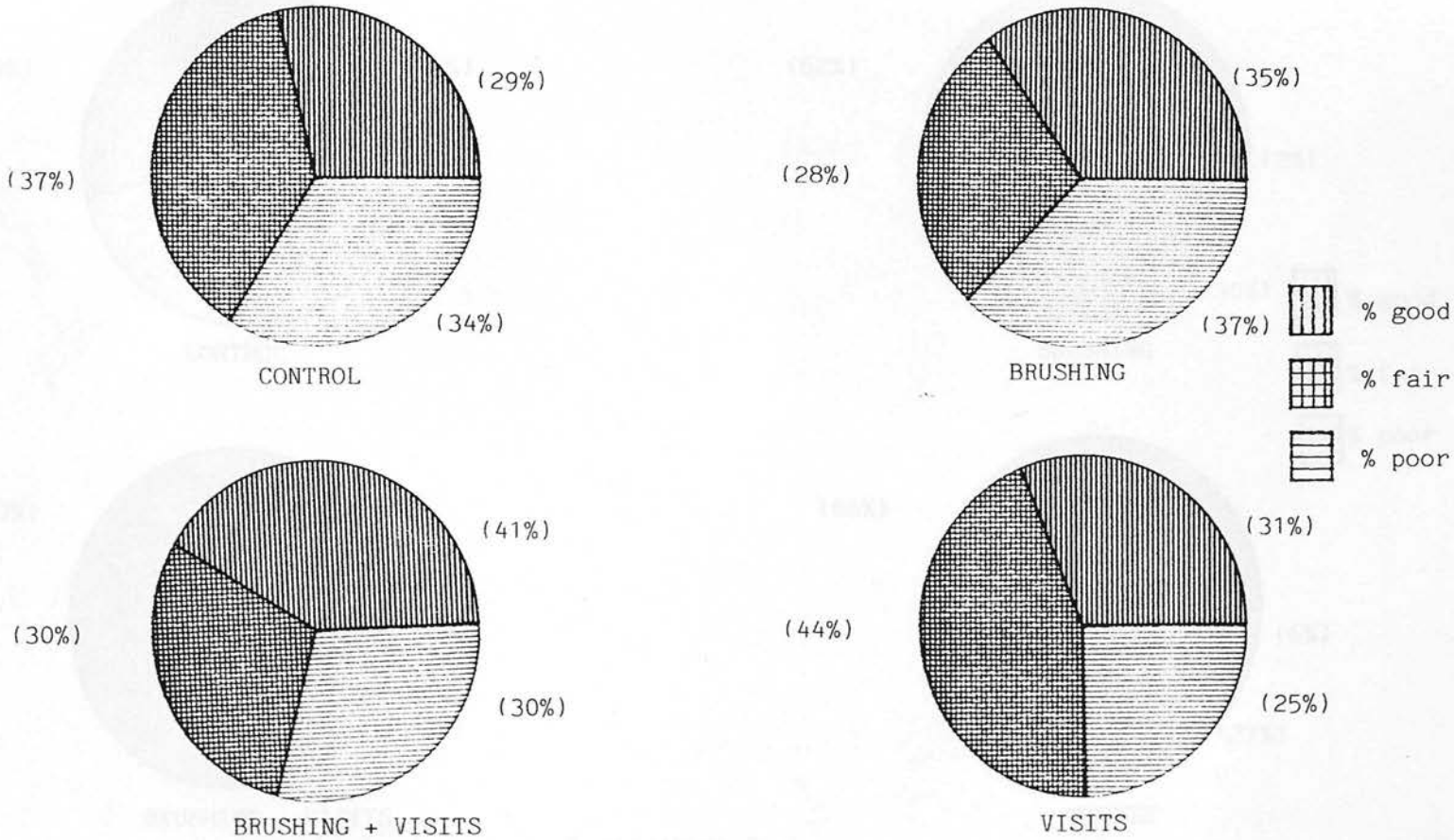
Table 18

Proportion of boys and girls with good, fair or poor oral hygiene - a comparison between boys and girls.

group			good %	fair %	poor %	(chi)²	sig.
Baseline examination							
control	boys	48	35	46	18	8.63	p<0.05
	girls	64	23	31	45		
brushing	boys	40	37	22	40	1.12	n.s.
	girls	49	33	33	35		
brushing + visits	boys	35	43	29	29	0.11	n.s.
	girls	36	39	31	31		
visits	boys	36	28	42	31	1.29	n.s.
	girls	41	34	46	19		
Second examination							
control	boys	48	25	21	54	2.84	n.s.
	girls	64	25	34	41		
brushing	boys	40	57	40	2	0.57	n.s.
	girls	49	65	33	2		
brushing + visits	boys	35	83	17	0	2.36	n.s.
	girls	36	64	36	0		
visits	boys	36	67	25	8	0.48	n.s.
	girls	41	66	29	5		
Third examination							
control	boys	48	50	23	27	0.86	n.s.
	girls	64	58	22	20		
brushing	boys	40	35	35	30	0.21	n.s.
	girls	49	39	31	31		
brushing + visits	boys	35	63	31	6	1.03	n.s.
	girls	36	56	42	3		
visits	boys	36	61	25	14	5.38	n.s.
	girls	41	83	7	10		

The proportion of children in group 2 with good oral hygiene had fallen at the final examination and the proportion with poor oral hygiene had increased. This deterioration in the oral cleanliness of the brushing groups was statistically significant when compared with the control group ($(chi)^2 = 6.10$ $p<0.05$). The proportions of children with good, fair and poor oral hygiene at each examination are illustrated in the Pie charts, Figures 5, 6 & 7. At the third examination the proportion of children in group 3 with good oral hygiene had fallen and with poor oral hygiene had increased slightly when compared with the control group. The children's teeth in group 3 were still cleaner than the control group and the difference was statistically significant at the final examination ($(chi)^2 = 13.24$ $p<0.001$). In group 4 there was a higher proportion of children with good oral hygiene and fewer with poor oral hygiene compared with the control group and the differences were statistically significant at the final examination ($(chi)^2 = 6.79$ $p<0.05$). There was no difference in oral cleanliness between boys and girls in any group at the third examination.

Figure 5. Proportion of children with good, fair and poor oral hygiene at the baseline examination



Examination 1

Figure 6. Proportion of children with good, fair and poor oral hygiene at the second examination

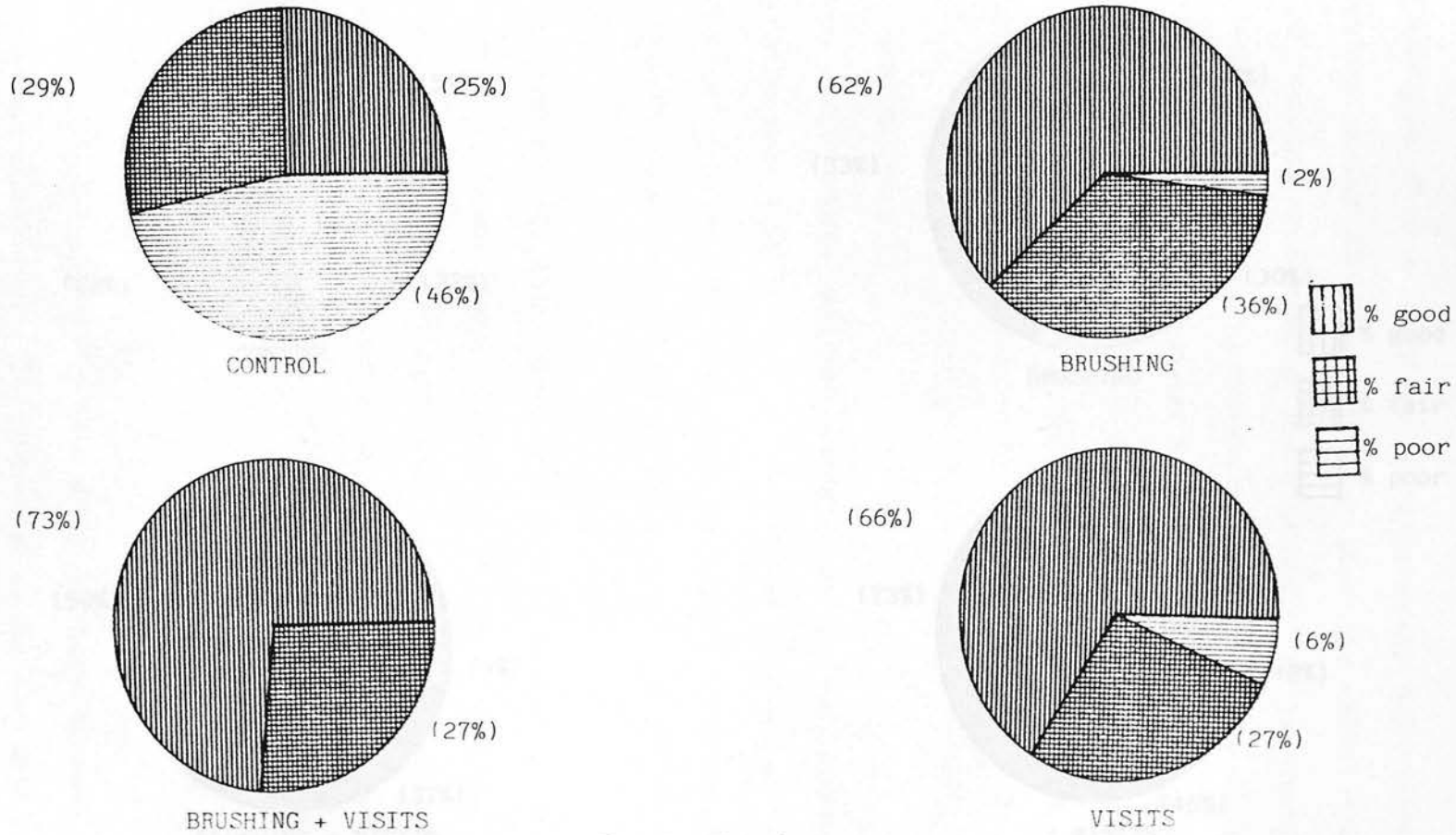
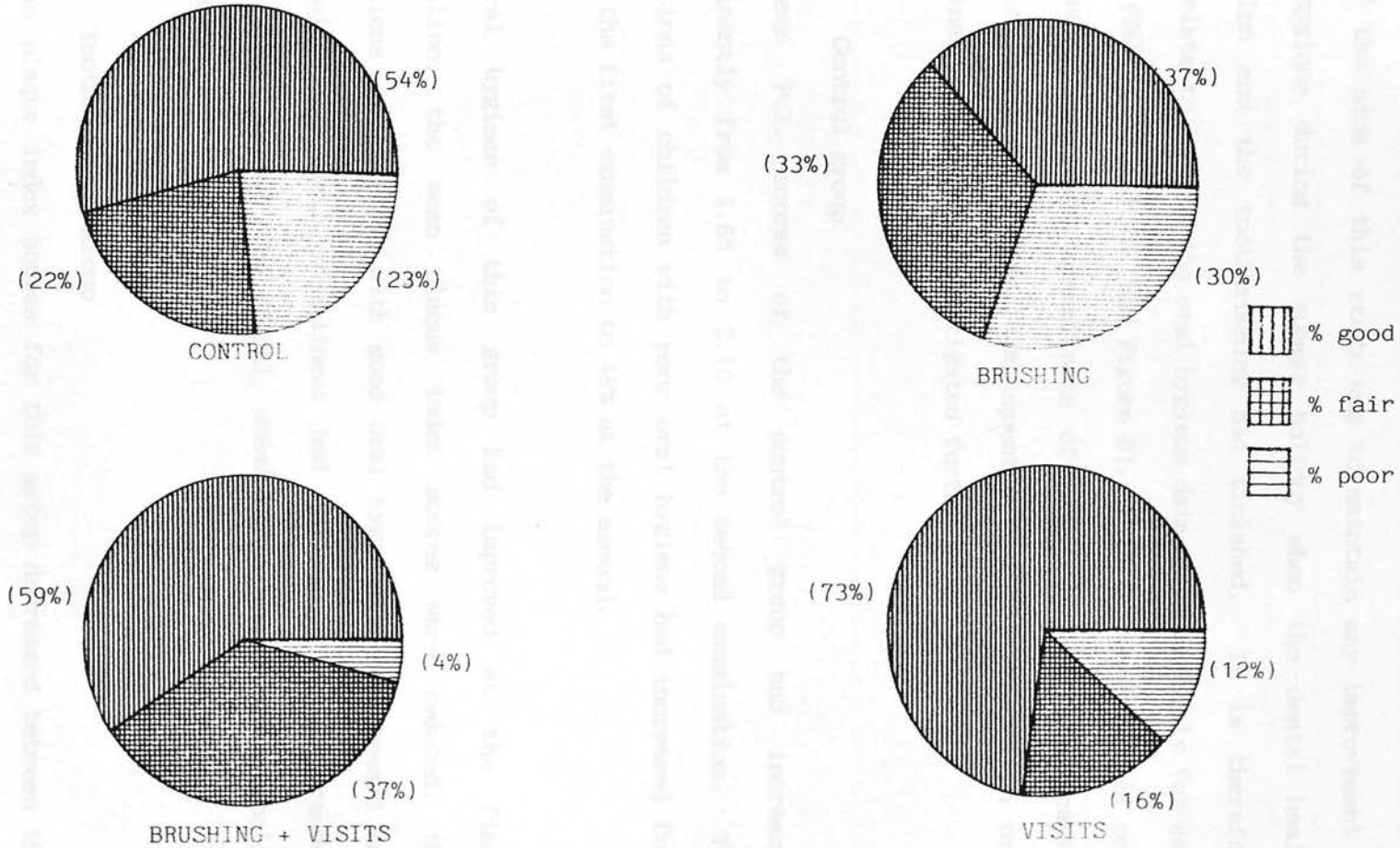


Figure 7. Proportion of children with good, fair and poor oral hygiene at the final examination



Examination 3

5.5. ORAL HYGIENE OF THE CHILDREN IN EACH GROUP BETWEEN THE THREE EXAMINATIONS.

One of the aims of this study was to maintain any improvement in oral hygiene during the summer holiday when the dental health education and the toothbrushing had finished. It is therefore appropriate to look at the oral hygiene data longitudinally for each group (Tables 19 and 20, and Figure 8). With the exception of only 1 occasion, the oral cleanliness of boys was not significantly different from the girls. Consequently, sex differences in oral cleanliness will not be investigated further.

5.5.1. Control group

The mean P.I. scores of the control group had increased significantly from 1.65 to 2.10 at the second examination. The proportions of children with poor oral hygiene had increased from 34% at the first examination to 46% at the second.

The oral hygiene of this group had improved at the final examination, the mean plaque index scores were reduced, the proportions of children with good oral hygiene had increased and those with poor oral cleanliness had fallen. The differences between the second and final examination were statistically significant.

5.5.2. Toothbrushing group

The mean plaque index scores for this group decreased between the first and second examination. The proportion of children with good

Table 19

Mean Plaque Index (P.I.) scores and standard error of the mean - a comparison between the examinations for each group

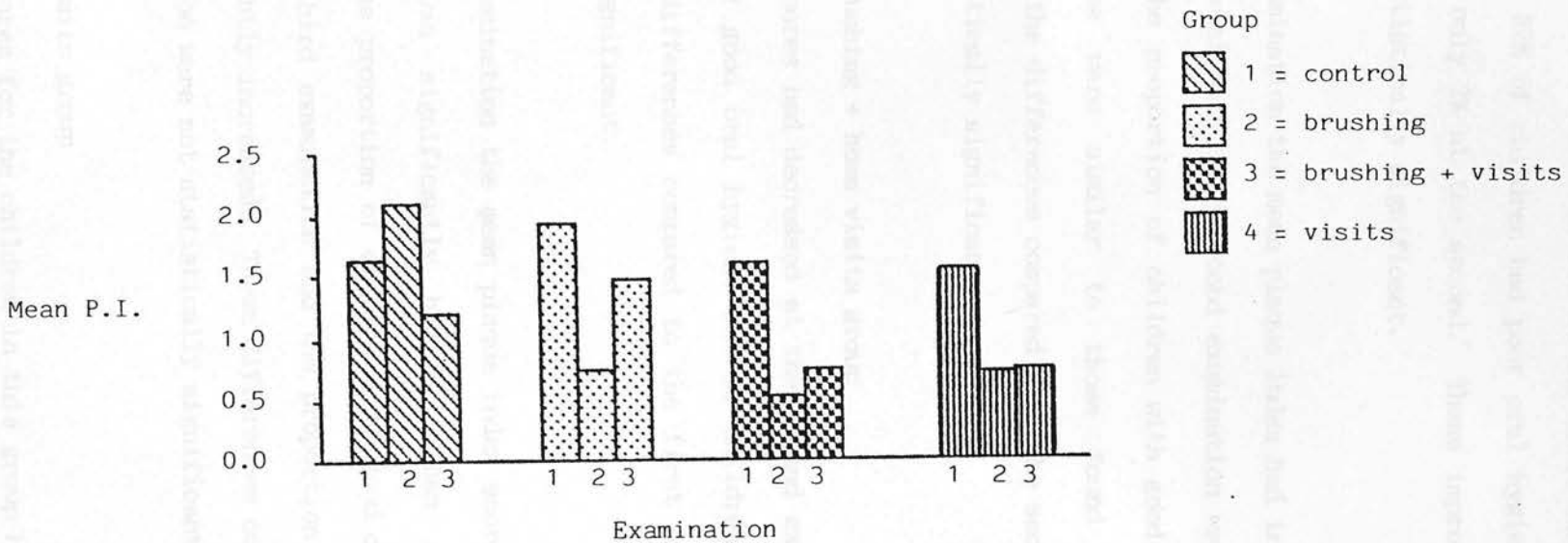
group	examination	mean P.I.	s.e.	t	sig.
control	baseline	1.65	0.12	2.76	p<0.01
	second	2.10	0.15		
	second	2.10	0.15	7.01	p<0.001
	third	1.22	0.12		
brushing	baseline	1.95	0.22	5.62	p<0.001
	second	0.74	0.07		
	second	0.74	0.07	5.74	p<0.001
	third	1.49	0.13		
brushing + visits	baseline	1.61	0.21	5.13	p<0.001
	second	0.54	0.06		
	second	0.54	0.06	2.13	p<0.05
	third	0.74	0.09		
visits	baseline	1.56	0.14	6.14	p<0.001
	second	0.73	0.09		
	second	0.73	0.09	0.13	n.s.
	third	0.74	0.12		

Table 20

Proportion of children with good, fair or poor oral hygiene. - a comparison between the examinations for each group.

group	examination	good %	fair %	poor %	(chi)²	sig.
control	baseline	29	37	34	3.79	n.s.
	second	25	29	46		
	second	25	28	46	21.76	p<0.001
	third	54	22	23		
brushing	baseline	35	28	37	5.01	p<0.001
	second	62	36	2		
	second	62	36	2	27.20	p<0.001
	third	37	33	30		
brushing + visits	baseline	41	30	30	27.63	p<0.001
	second	73	27	0		
	second	73	27	0	5.15	n.s.
	third	59	36	4		
visits	baseline	31	44	25	20.96	p<0.001
	second	66	27	6		
	second	66	27	6	3.83	n.s.
	third	73	16	12		

Figure 8. Mean P.I. scores for each group at each examination



oral hygiene had increased from 35% at the first examination to 62% at the second. 37% of children had poor oral hygiene at the first examination but only 2% at the second. These improvements in oral hygiene were statistically significant.

At the final examination the mean plaque index had increased and the difference compared with the second examination was statistically significant. The proportion of children with good, fair and poor oral cleanliness were similar to those found at the first examination and the differences compared with the second examination were also statistically significant.

5.5.3. Toothbrushing + home visits group

The mean P.I. scores had decreased at the second examination. 73% of children had good oral hygiene and no children had poor oral hygiene. The differences compared to the first examination were statistically significant.

At the final examination the mean plaque index score had increased slightly and was significantly higher than at the second examination. The proportion of children with good oral hygiene had fallen at the third examination and the proportion with poor oral hygiene had slightly increased. These differences compared with the second examination were not statistically significant.

5.5.4. Home visits group

The mean P.I. scores for the children in this group had decreased at the second examination. The proportions with good oral hygiene

increased and those with poor oral hygiene had decreased. The differences in oral cleanliness between the first and second examinations were statistically significant.

At the third examination the mean P.I. scores were almost the same as at the second examination. The proportions of children with good and poor oral hygiene had increased slightly at the final examination, but the differences between the second and final examinations were not statistically significant.

5.6. DISTRIBUTION OF PLAQUE ACCUMULATIONS ON INDIVIDUAL TEETH.

To look for changes in the distribution of plaque accumulation in the mouth, a mean plaque score was calculated for each tooth included in the Silness & Loe index. In addition, mean scores were calculated for buccal, lingual, mesial and distal tooth surfaces in the maxilla and in the mandible in each group at the three examinations. The most important comparisons are between the first and second, and between the second and third examination.

5.6.1. Mean plaque score per tooth (Tables 21-28, Figures 9-12).

In general, mean plaque scores were greater on maxillary teeth than on mandibular teeth, greater on the right hand side than on the left hand side and greater on molar than on incisor teeth.

At the second examination, mean plaque index scores had increased significantly on maxillary teeth but not on mandibular teeth in the control group (Figure 13). Significant improvements in all maxillary and mandibular teeth were observed in the three experimental groups at the second examination. At the final examination mean plaque index scores on all teeth had improved significantly in the control group and deteriorated significantly in group 2 since the second examination (Figure 14). Mean plaque index scores on maxillary teeth only had increased slightly in group 3 at the final examination but plaque accumulations on mandibular teeth were not significantly different from the second examination.

In group 4 at the final examination plaque accumulations on both maxillary and mandibular teeth had not altered significantly since the second examination.

5.6.2. Mean plaque score per tooth surface (Tables 29-36, Figures 15-18).

In general mean plaque accumulations were greatest on buccal surfaces, almost identical on mesial and distal surfaces and lowest on lingual surfaces. At the second examination plaque accumulations in the control group had increased significantly on maxillary buccal, mesial and distal, and on mandibular, lingual tooth surfaces (Figure 19).

With the exception of maxillary lingual surfaces in group 4, plaque accumulations in the three experimental groups had decreased significantly on all other tooth surfaces between the first and second examinations. At the final examination, plaque accumulations in the control group had decreased significantly on all tooth surfaces since the second examination (Figure 20).

In group 2, with the exception of lingual surfaces, plaque accumulations had increased significantly on all other tooth surfaces since the second examination.

In groups 3 and 4, plaque accumulations on maxillary buccal surfaces had increased between the second and third examinations but all other tooth surfaces were not statistically significantly different from the second examination.

5.7. GENERAL SUMMARY FOR ORAL HYGIENE

There were considerable changes in the oral hygiene of the children during the study. The oral hygiene of the control group had deteriorated by the second examination and improved by the final examination.

The oral hygiene of the children in group 2 who brushed their teeth daily at school for approximately five and a half months, improved during the study but deteriorated during the summer holiday after the preventive programme had been suspended.

The oral cleanliness of children in group 3 (school brushing and home visits) deteriorated slightly during the summer holiday but was still signficantly improved compared with the control group. In group 4 (home visits only) levels of oral hygiene improved during the study and were maintained during the summer vacation.

There were unexplained changes in plaque accumulations on individual teeth and surfaces in the control group during the study; a deterioration between the baseline and second examination, and an improvement between the second and final examination.

The children in the three experimental groups were able to clean all teeth and keep most surfaces clean when the preventive programme was in operation but this improvement was only maintained in the two home visits group when the programme had ceased.

The children in this study were able to clean mandibular teeth more effectively than maxillary teeth and incisor teeth more effectively than molar teeth. There were greater plaque accumulations on the right hand side of the mouth compared with the left.

Table 21

A comparison of the mean Plaque Index (P.I.) values for the right maxillary second deciduous molar (55) between each examination for each group.

Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig.
E/ or 55	Control	1	0.52	0.04	4.38	p<0.001
		2	0.80	0.06		
		2	0.80	0.06	3.64	p<0.001
		3	0.58	0.05		
	Brushing	1	0.61	0.07	2.83	p<0.01
		2	0.41	0.04		
		2	0.41	0.04	3.39	p<0.01
		3	0.61	0.06		
	Brushing + visits	1	0.53	0.08	2.50	p<0.05
		2	0.30	0.04		
		2	0.30	0.04	1.47	n.s.
		3	0.39	0.05		
	Visits	1	0.47	0.06	2.34	p<0.05
		2	0.33	0.05		
		2	0.33	0.05	0.42	n.s.
		3	0.35	0.05		

Table 22

A comparison of the mean Plaque Index (P.I.) values for the right maxillary second deciduous incisor (52) between each examination for each group.

Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig
B/ or 52	Control	1	0.27	0.04	2.13	p<0.005
		2	0.37	0.04		
		2	0.37	0.04	0.88	n.s.
		3	0.33	0.04		
	Brushing	1	0.36	0.05	4.86	p<0.001
		2	0.07	0.02		
		2	0.07	0.02	5.88	p<0.001
		3	0.37	0.05		
	Brushing + visits	1	0.32	0.05	4.58	p<0.001
		2	0.08	0.02		
		2	0.08	0.02	2.97	p<0.01
		3	0.20	0.03		
	Visits	1	0.35	0.05	4.10	p<0.001
		2	0.15	0.03		
		2	0.15	0.03	1.97	n.s.
		3	0.24	0.05		

Table 23

A comparison of the mean Plaque Index (P.I.) values for the left maxillary second deciduous molar (65) between each examination for each group.

Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig
/E or 65	Control	1	0.45	0.04	2.72	p<0.05
		2	0.63	0.06		
		2	0.63	0.06	4.76	p<0.001
		3	0.35	0.05		
	Brushing	1	0.55	0.07	3.48	p<0.001
		2	0.30	0.04		
		2	0.30	0.04	3.02	p<0.01
		3	0.47	0.06		
	Brushing + visits	1	0.45	0.07	3.38	p<0.01
		2	0.20	0.03		
		2	0.20	0.03	0.36	n.s.
		3	0.21	0.04		
	Visits	1	0.44	0.05	3.53	p<0.001
		2	0.24	0.04		
		2	0.24	0.04	0.24	n.s.
		3	0.23	0.05		

Table 24

A comparison of the mean Plaque Index (P.I.) values for the right mandibular second deciduous molar (85) between each examination for each group.

Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig
E/ or 85	Control	1	0.57	0.05	0.80	n.s.
		2	0.62	0.05		
		2	0.62	0.05	7.86	p<0.001
		3	0.27	0.04		
	Brushing	1	0.57	0.07	6.75	p<0.001
		2	0.14	0.02		
		2	0.14	0.02	4.06	p<0.001
		3	0.31	0.04		
	Brushing + visits	1	0.48	0.06	5.06	p<0.001
		2	0.14	0.03		
		2	0.14	0.03	0.08	n.s.
		3	0.14	0.03		
	Visits	1	0.48	0.05	6.73	p<0.001
		2	0.15	0.03		
		2	0.15	0.03	1.01	n.s.
		3	0.12	0.03		

Table 25

A comparison of the mean Plaque Index (P.I.) values for the left mandibular second deciduous lateral incisor (72) between each examination for each group.

Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig
/B or 72	Control	1	0.17	0.03	1.32	n.s.
		2	0.23	0.04		
		2	0.23	0.04	3.01	p<0.01
		3	0.11	0.02		
	Brushing	1	0.30	0.05	3.90	p<0.001
		2	0.07	0.03		
		2	0.07	0.03	2.29	p<0.05
		3	0.18	0.04		
	Brushing + visits	1	0.15	0.04	3.45	p<0.001
		2	0.02	0.01		
		2	0.02	0.01	2.01	p<0.05
		3	0.08	0.03		
	Visits	1	0.18	0.03	2.45	p<0.05
		2	0.11	0.03		
		2	0.11	0.03	0.19	n.s.
		3	0.10	0.03		

Table 26

A comparison of the mean Plaque Index (P.I.) values for the left mandibular second deciduous molar (75) between each examination for each group.

Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig
/E or 75	Control	1	0.48	0.04	0.37	n.s.
		2	0.45	0.05		
		2	0.45	0.05	5.89	p<0.001
		3	0.16	0.03		
	Brushing	1	0.49	0.06	6.17	p<0.001
		2	0.10	0.02		
		2	0.10	0.02	3.45	p<0.001
		3	0.24	0.04		
	Brushing + visits	1	0.45	0.08	4.79	p<0.001
		2	0.06	0.02		
		2	0.06	0.02	0.57	n.s.
		3	0.07	0.02		
	Visits	1	0.41	0.05	5.84	p<0.001
		2	0.11	0.02		
		2	0.11	0.02	2.11	p<0.05
		3	0.06	0.02		

Table 27

A comparison of the mean Plaque Index (P.I.) values for all the maxillary teeth between each examination for each group.

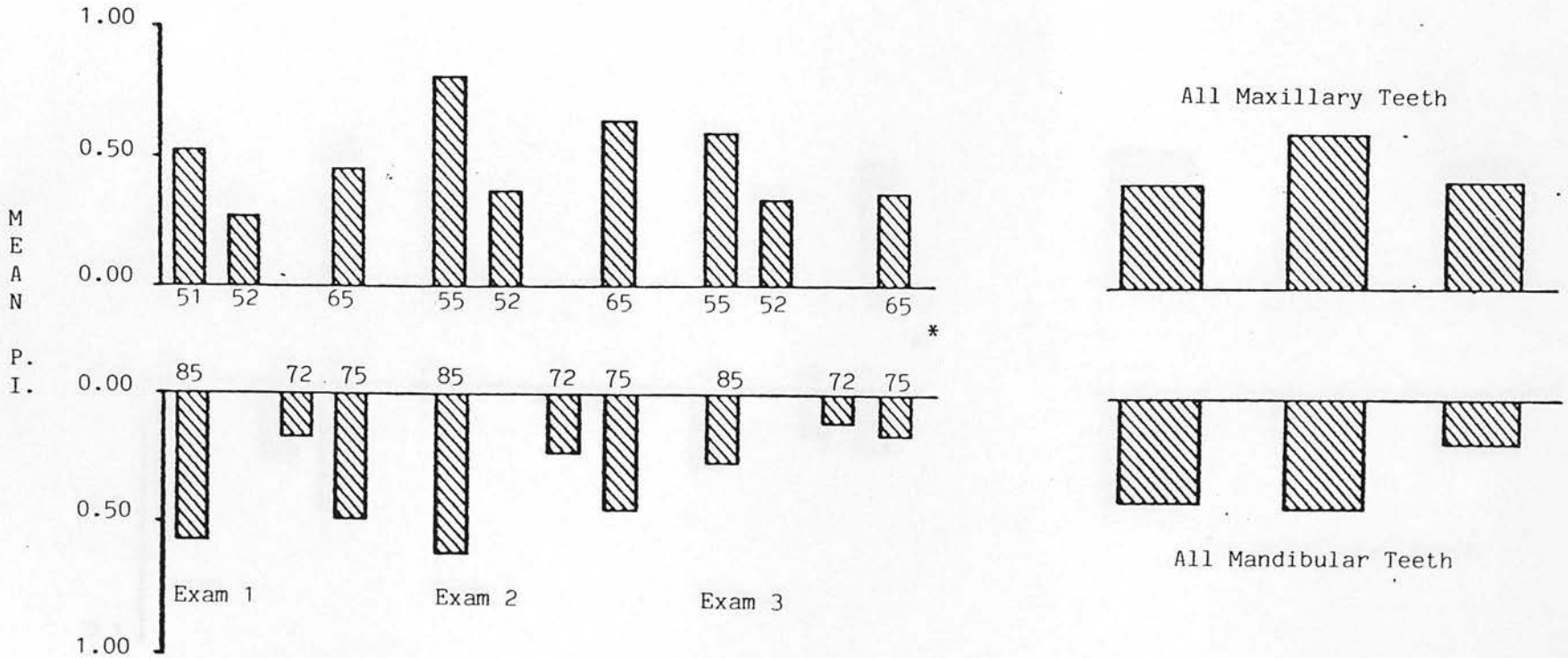
Group	Examination number	Mean tooth Score	s.e.	t	sig
Control	1	0.41	0.03	3.97	p<0.001
	2	0.60	0.04		
	2	0.60	0.04	4.27	p<0.001
	3	0.42	0.04		
Brushing	1	0.51	0.06	4.11	p<0.001
	2	0.26	0.02		
	2	0.26	0.02	5.29	p<0.001
	3	0.48	0.04		
Brushing + visits	1	0.43	0.06	4.02	p<0.001
	2	0.19	0.02		
	2	0.19	0.02	2.07	p<0.05
	3	0.27	0.03		
Visits	1	0.42	0.04	4.21	p<0.001
	2	0.24	0.03		
	2	0.24	0.03	0.86	n.s.
	3	0.27	0.04		

Table 28

A comparison of the mean Plaque Index (P.I.) values for all mandibular teeth between each examination for each group.

Group	Examination number	Mean tooth Score	s.e.	t	sig
Control	1	0.41	0.03	0.64	n.s.
	2	0.43	0.04		
	2	0.43	0.04	7.79	p<0.001
	3	0.18	0.02		
Brushing	1	0.45	0.05	6.67	p<0.001
	2	0.10	0.02		
	2	0.10	0.02	4.37	p<0.001
	3	0.24	0.03		
Brushing + visits	1	0.36	0.05	5.59	p<0.001
	2	0.07	0.01		
	2	0.07	0.01	1.00	n.s.
	3	0.09	0.02		
Visits	1	0.36	0.03	6.94	p<0.001
	2	0.12	0.02		
	2	0.12	0.02	1.15	n.s.
	3	0.10	0.02		

Figure 9. CONTROL GROUP - Mean P.I.scores per tooth



* F.D.I. Notation

Figure 10. BRUSHING GROUP - Mean P.I. scores per tooth

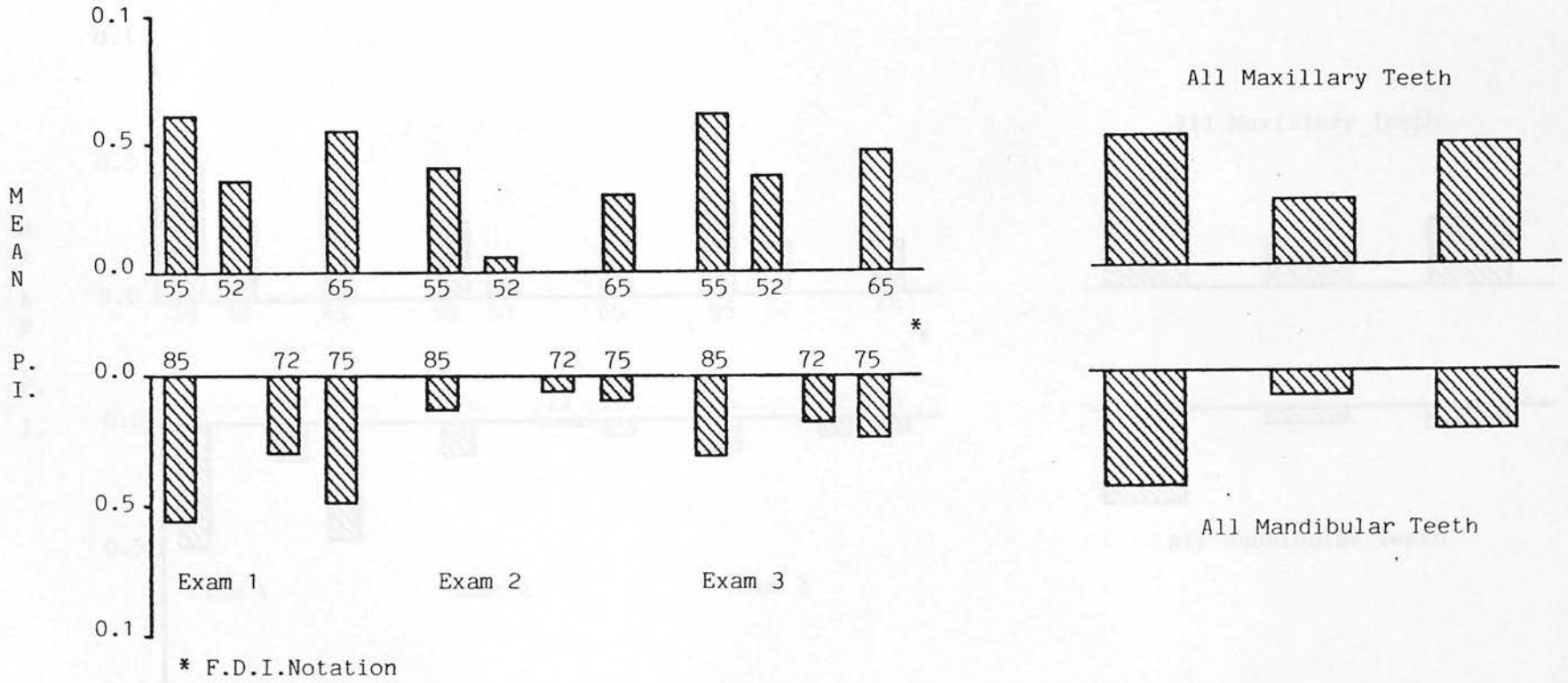


Figure 11. BRUSHING + HOME VISITS GROUP - Mean P.I.scores per tooth

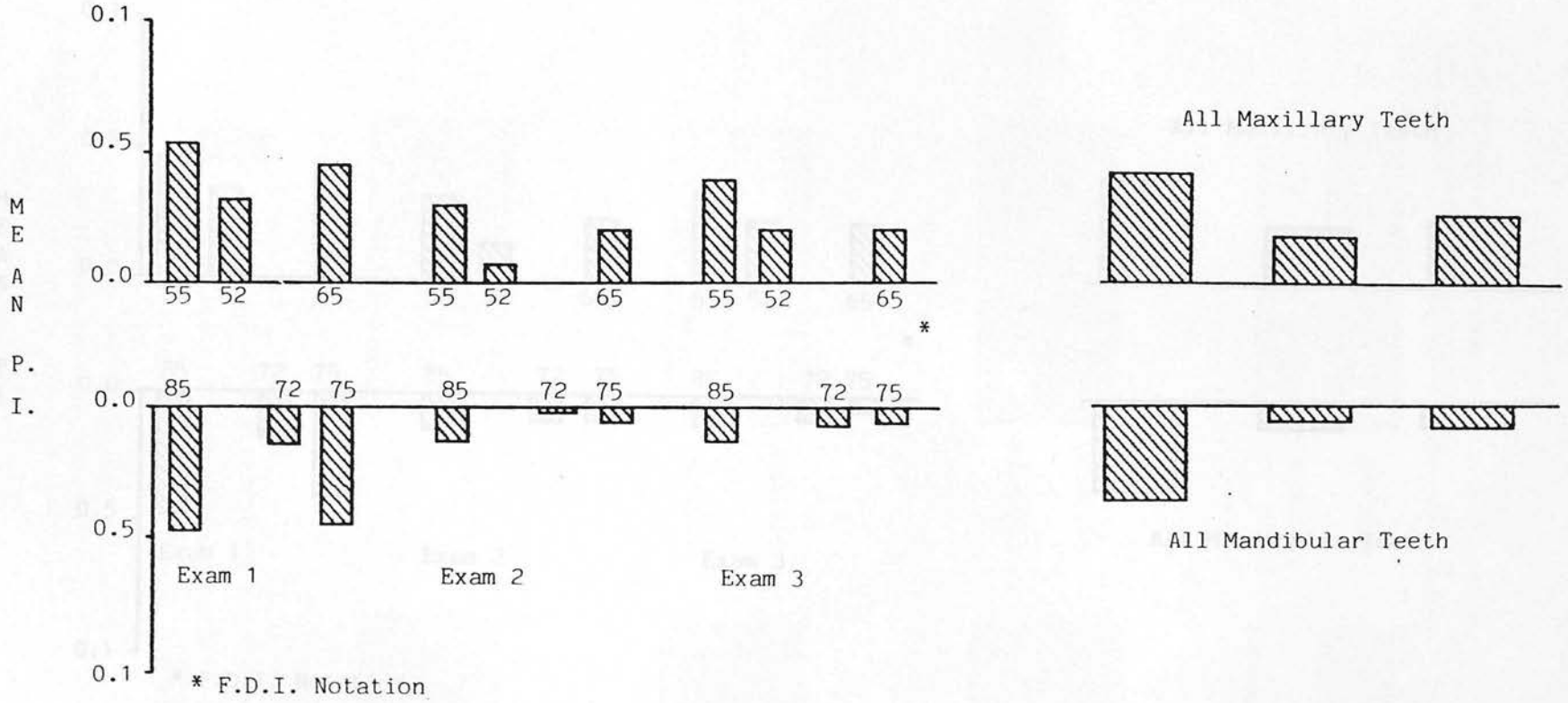


Figure 12. HOME VISITS GROUP - Mean P.I. scores per tooth

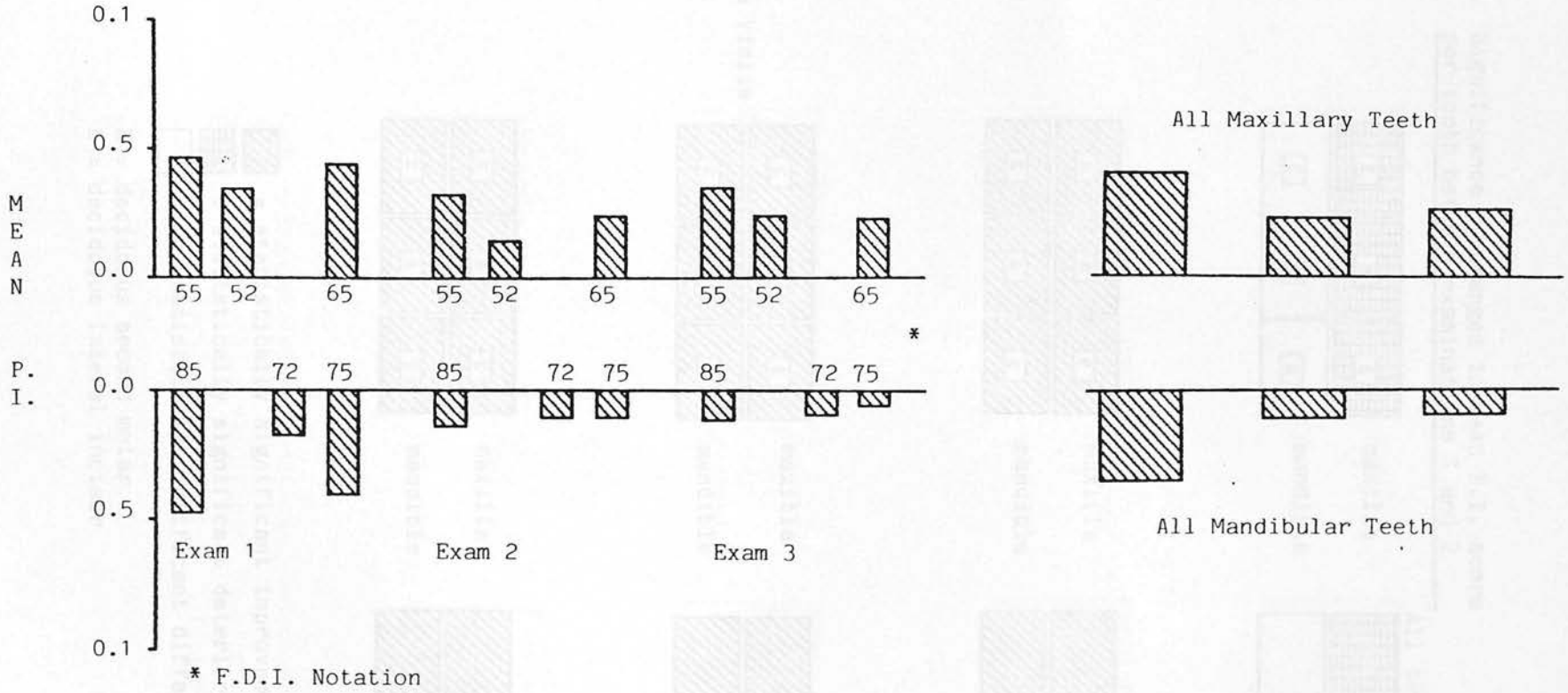
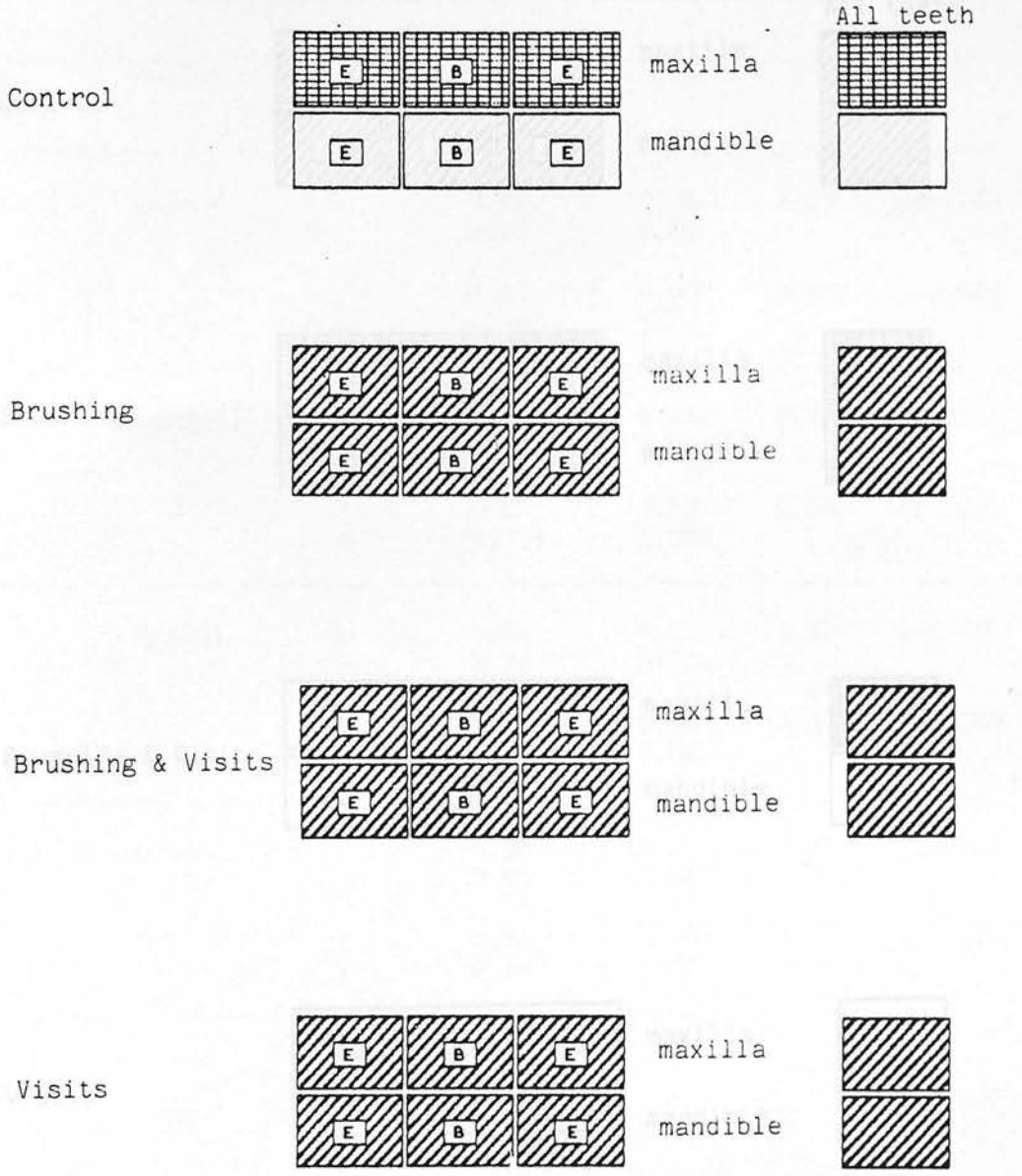


Figure 13. Significance of changes in mean P.I. score per tooth between examinations 1 and 2



= statistically significant improvement

= statistically significant deterioration

= no statistically significant difference

E = deciduous second molar
B = deciduous lateral incisor

Figure 14. Significance of changes in mean P.I. score per tooth between examinations 2 and 3

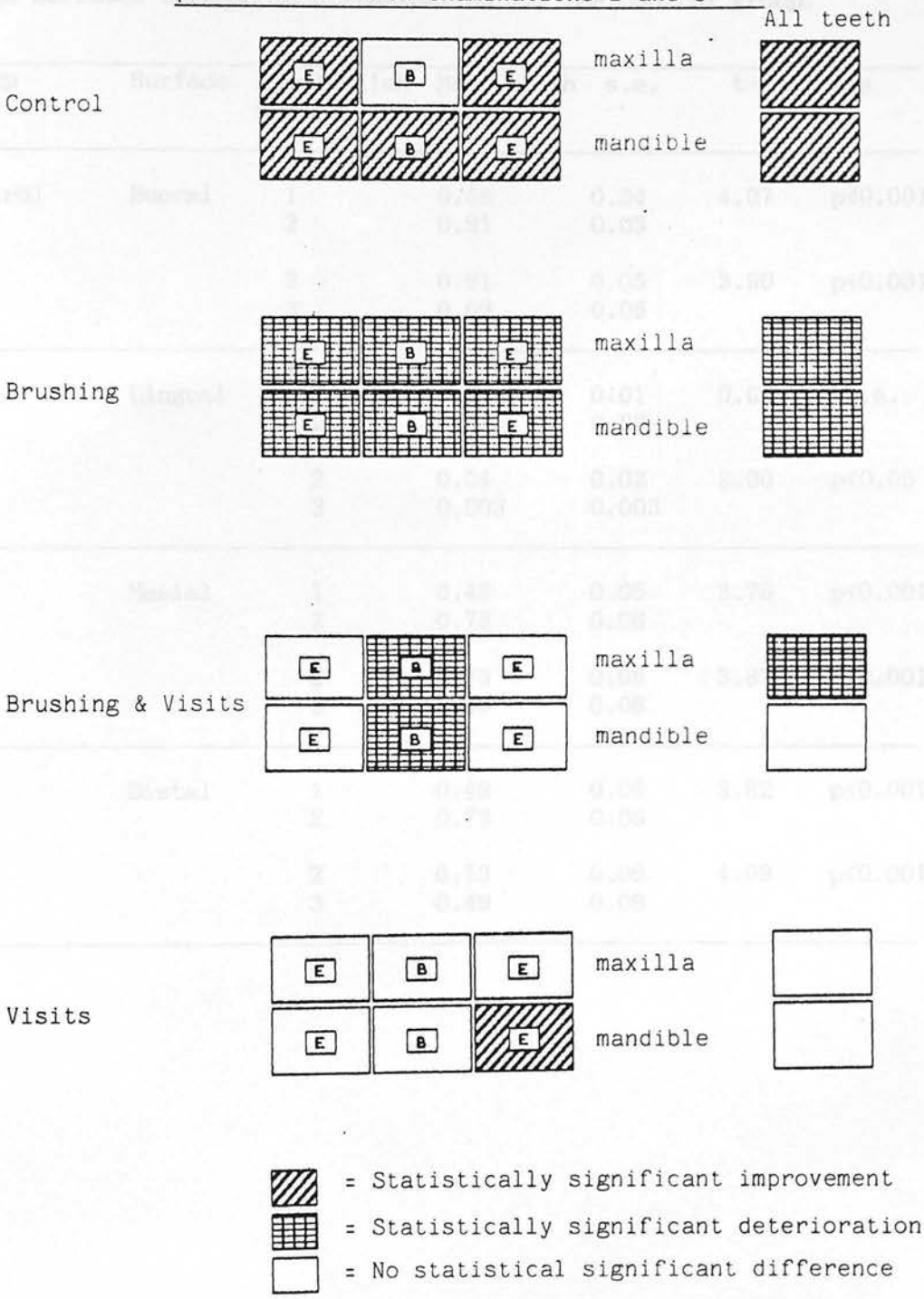


Table 29

A comparison of mean plaque accumulations on individual maxillary tooth surfaces between each examination for the control group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig
Control	Buccal	1	0.68	0.04	4.07	p<0.001
		2	0.91	0.05		
		2	0.91	0.05	3.90	p<0.001
		3	0.69	0.05		
	Lingual	1	0.02	0.01	0.62	n.s.
		2	0.04	0.02		
		2	0.04	0.02	2.00	p<0.05
		3	0.003	0.003		
	Mesial	1	0.48	0.05	3.76	p<0.001
		2	0.73	0.06		
		2	0.73	0.06	3.87	p<0.001
		3	0.49	0.06		
	Distal	1	0.48	0.05	3.82	p<0.001
		2	0.73	0.06		
		2	0.73	0.06	4.09	p<0.001
		3	0.49	0.06		

Table 30

A comparison of mean plaque accumulations on individual mandibular tooth surfaces between each examination for the control group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig
Control	Buccal	1	0.45	0.04	1.04	n.s.
		2	0.40	1.04		
		2	0.40	1.04	5.15	p<0.001
		3	0.20	0.03		
	Lingual	1	0.36	0.03	2.21	p<0.05
		2	0.46	0.04		
		2	0.46	0.04	7.04	p<0.001
		3	0.21	0.03		
	Mesial	1	0.41	0.04	0.50	n.s.
		2	0.44	0.05		
		2	0.44	0.05	6.43	p<0.001
		3	0.15	0.03		
	Distal	1	0.40	0.04	0.62	n.s.
		2	0.44	0.05		
		2	0.44	0.05	6.13	p<0.001
		3	0.16	0.03		

Table 31

A comparison of mean plaque accumulations on individual maxillary tooth surfaces between each examination for the brushing group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig
Brushing	Buccal	1	0.73	0.06	3.42	p<0.001
		2	0.50	0.04		
		2	0.50	0.06	5.50	p<0.001
		3	0.79	0.06		
	Lingual	1	0.27	0.06	4.46	p<0.001
		2	0.007	0.005		
		2	0.007	0.005	0.71	n.s.
		3	0.01	0.01		
	Mesial	1	0.51	0.07	3.59	p<0.001
		2	0.27	0.03		
		2	0.27	0.03	4.67	p<0.001
		3	0.56	0.06		
	Distal	1	0.51	0.07	3.62	p<0.001
			0.27	0.03		
		2	0.27	0.03	4.86	p<0.001
		3	0.56	0.06		

Table 32

A comparison of mean plaque accumulations on individual mandibular tooth surfaces between each examination for the brushing group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig
Brushing	Buccal	1	0.49	0.05	6.40	p<0.001
		2	0.13	0.02		
		2	0.13	0.02	4.51	p<0.001
		3	0.31	0.03		
	Lingual	1	0.46	0.05	4.61	p<0.001
		2	0.18	0.03		
		2	0.18	0.03	1.53	n.s.
		3	0.24	0.03		
	Mesial	1	0.43	0.06	6.51	p<0.001
		2	0.06	0.02		
		2	0.06	0.02	3.55	p<0.001
		3	0.21	0.04		
	Distal	1	0.44	0.06	7.18	p<0.001
		2	0.04	0.0		
		2	0.04	0.02	4.05	p<0.001
		3	0.21	0.04		

Table 33

A comparison of mean plaque accumulations on individual maxillary tooth surfaces between each examination for the brushing and visits group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig
Brushing & visits	Buccal	1	0.61	0.07	2.82	p<0.01
		2	0.40	0.04		
		2	0.40	0.04	2.50	p<0.05
		3	0.55	0.05		
	Lingual	1	0.14	0.04	3.37	p<0.001
		2	0.00	0.00		
		2	No Plaque			
		3	No Plaque			
	Mesial	1	0.48	0.07	4.08	p<0.001
		2	0.19	0.03		
		2	0.19	0.03	1.63	n.s.
		3	0.27	0.04		
	Distal	1	0.49	0.07	4.15	p<0.001
		2	0.19	0.03		
		2	0.19	0.03	1.43	n.s.
		3	0.26	0.04		

Table 34

A comparison of mean plaque accumulations on individual mandibular tooth surfaces between each examination for the brushing and visits group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig
Brushing & visits	Buccal	1	0.43	0.06	4.70	p<0.001
		2	0.14	0.03		
		2	0.14	0.03	0.39	n.s.
		3	0.12	0.03		
	Lingual	1	0.34	0.05	4.92	p<0.001
		2	0.08	0.02		
		2	0.08	0.02	1.09	n.s.
		3	0.12	0.02		
	Mesial	1	0.34	0.06	5.29	p<0.001
		2	0.04	0.01		
		2	0.04	0.01	1.15	n.s.
		3	0.07	0.02		
	Distal	1	0.34	0.06	5.43	p<0.001
		2	0.04	0.01		
		2	0.04	0.01	1.38	n.s.
		3	0.07	0.02		

Table 35

A comparison of mean plaque accumulations on individual maxillary tooth surfaces between each examination for the visits group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig
Visits	Buccal	1	0.69	0.05	4.35	p<0.001
		2	0.45	0.04		
		2	0.45	0.04	2.15	p<0.05
		3	0.57	0.06		
	Lingual	1	0.06	0.02	1.02	n.s.
		2	0.03	0.02		
		2	0.03	0.02	1.62	n.s.
		3	0.00	0.00		
	Mesial	1	0.48	0.06	3.87	p<0.001
		2	0.24	0.04		
		2	0.24	0.04	0.63	n.s
		3	0.28	0.06		
	Distal	1	0.48	0.06	3.70	p<0.001
		2	0.24	0.04		
		2	0.24	0.04	0.14	n.s.
		3	0.25	0.06		

Table 36

A comparison of mean plaque accumulations on individual mandibular tooth surfaces between each examination for the visits group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig
Visits	Buccal	1	0.48	0.04	6.28	p<0.001
		2	0.15	0.03		
		2	0.15	0.03	0.27	n.s.
		3	0.14	0.03		
	Lingual	1	0.30	0.04	2.75	p<0.01
		2	0.17	0.03		
		2	0.17	0.03	1.83	n.s.
		3	0.11	0.02		
	Mesial	1	0.34	0.04	6.38	p<0.001
		2	0.08	0.02		
		2	0.08	0.02	0.33	n.s.
		3	0.07	0.02		
	Distal	1	0.34	0.04	6.38	p<0.001
		2	0.08	0.02		
		2	0.08	0.02	0.65	n.s.
		3	0.06	0.02		

Figure 15. CONTROL GROUP - Mean P.I. surface scores

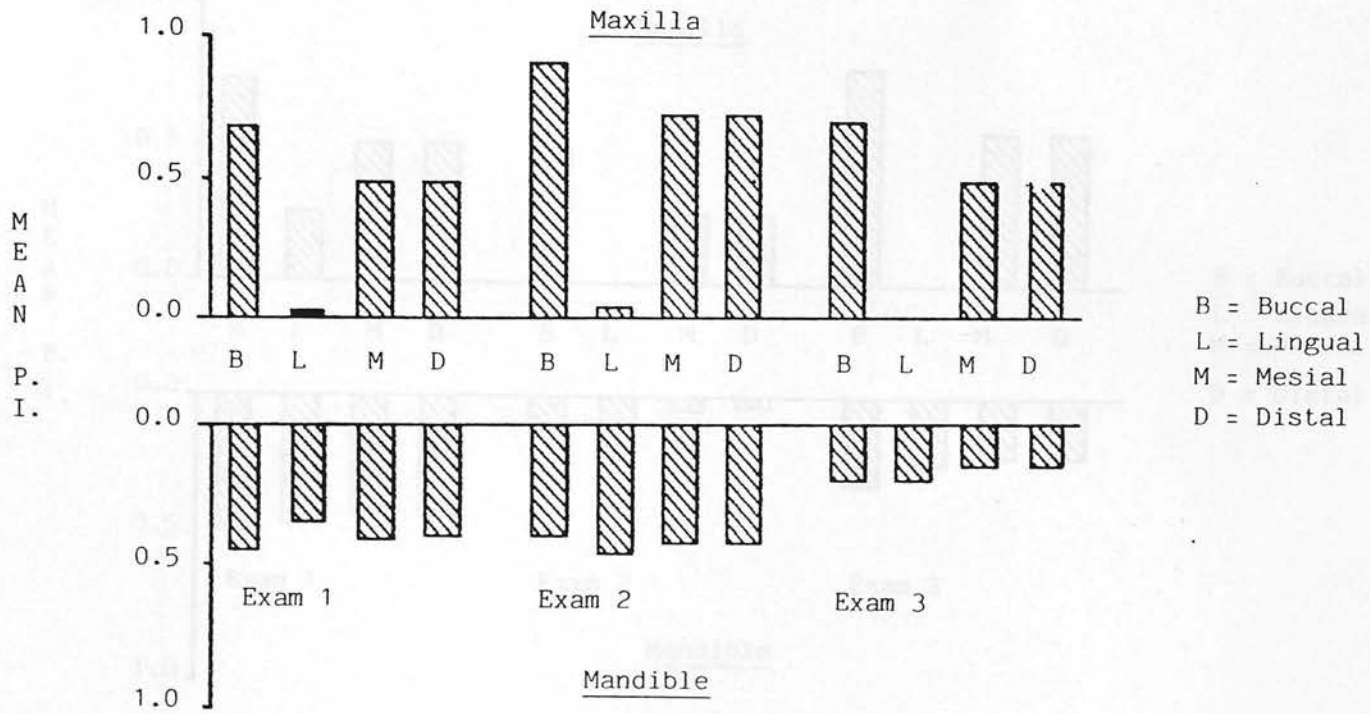


Figure 16. BRUSHING GROUP - Mean P.I. surface scores

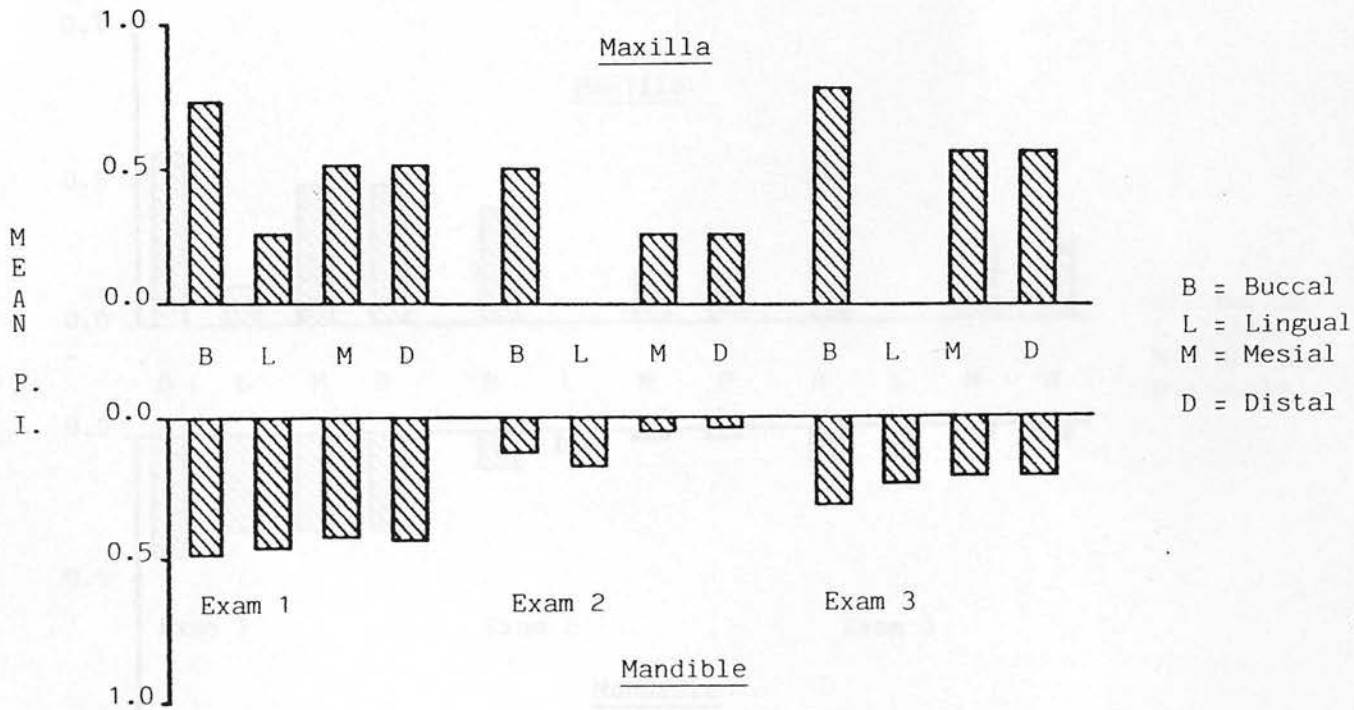


Figure 17. BRUSHING & HOME VISITS GROUP - Mean P.I. surface scores.

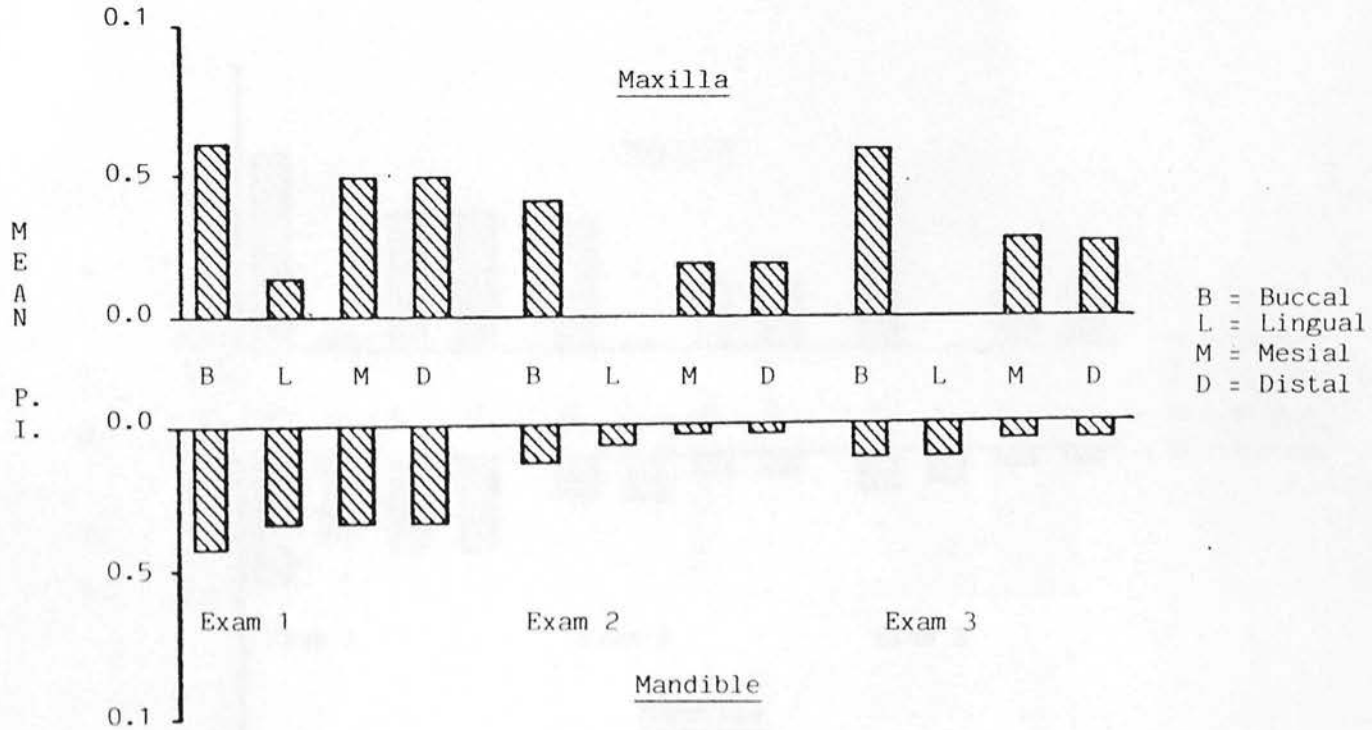


Figure 18. HOME VISITS GROUP - Mean P.I. surface scores

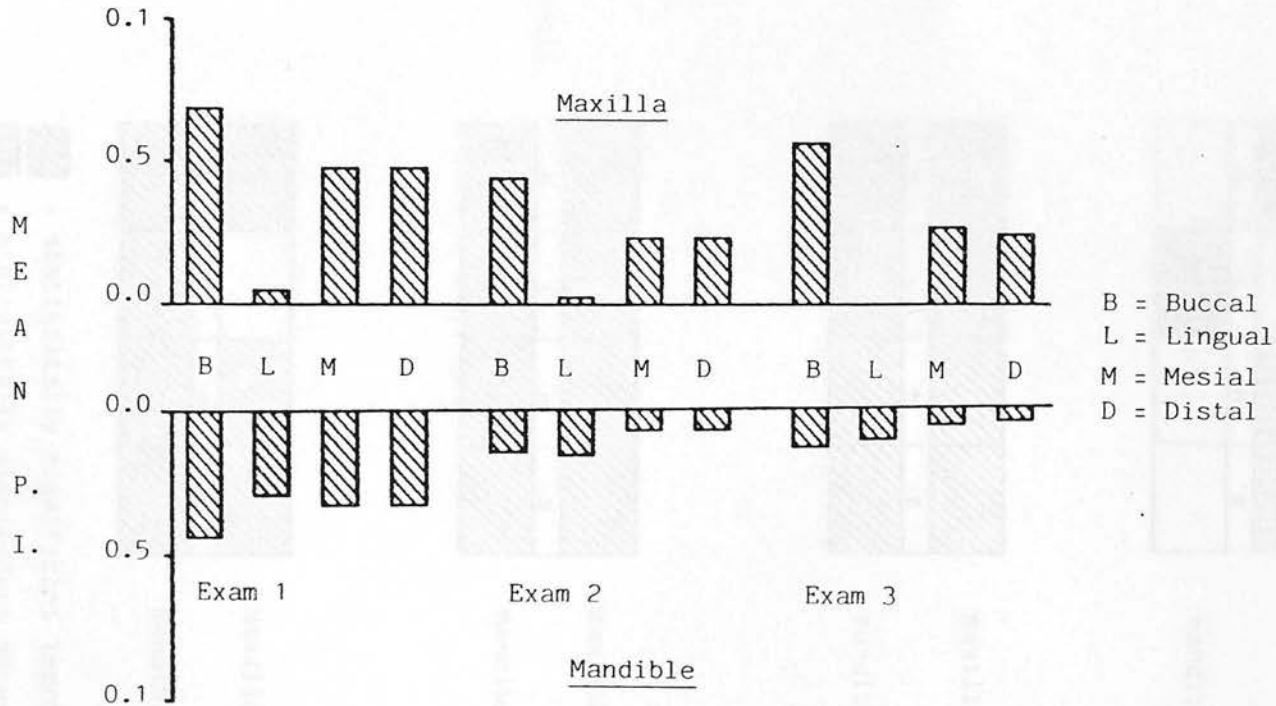


Figure 19. Significance of changes in surface distribution of plaque between examinations 1 and 2.

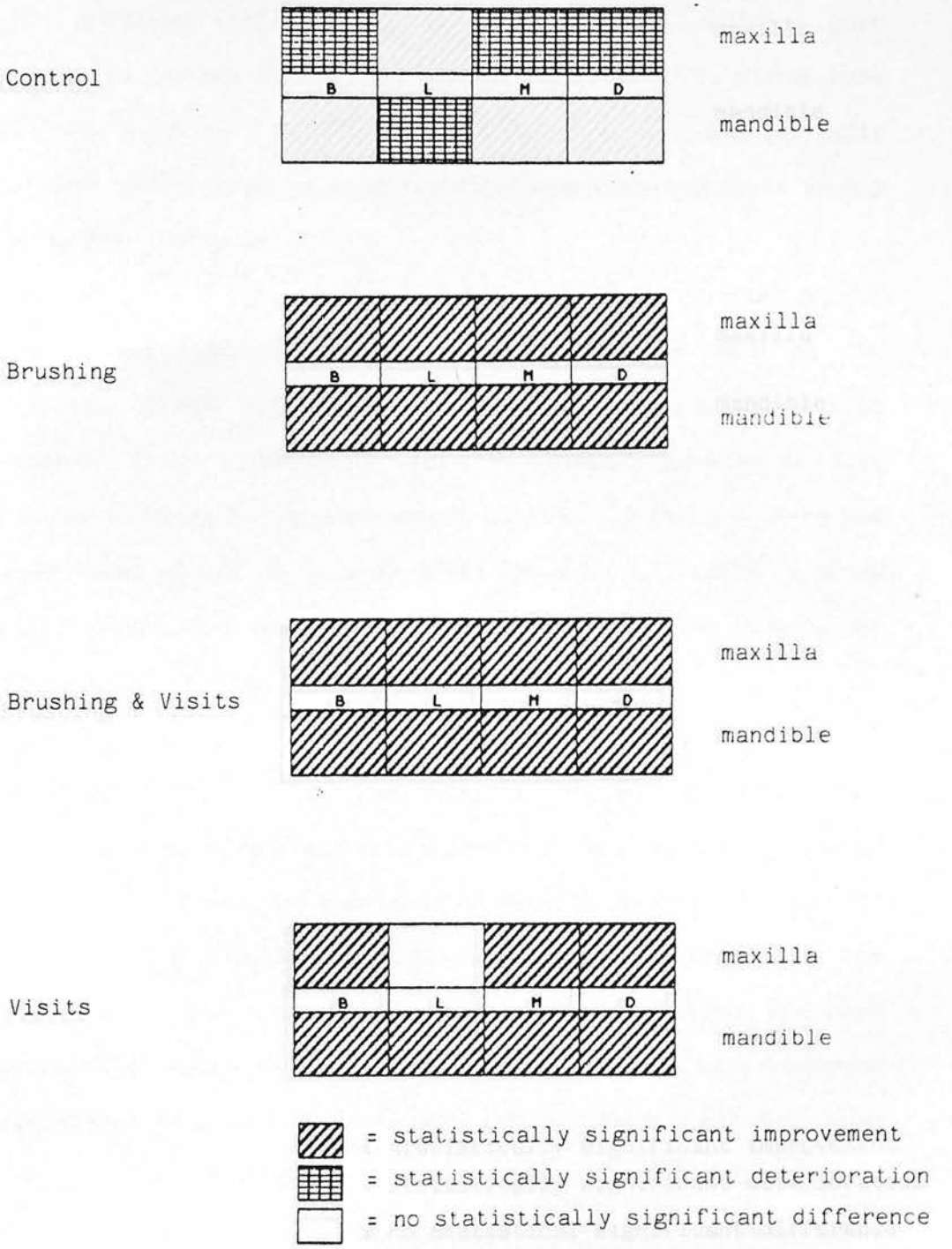
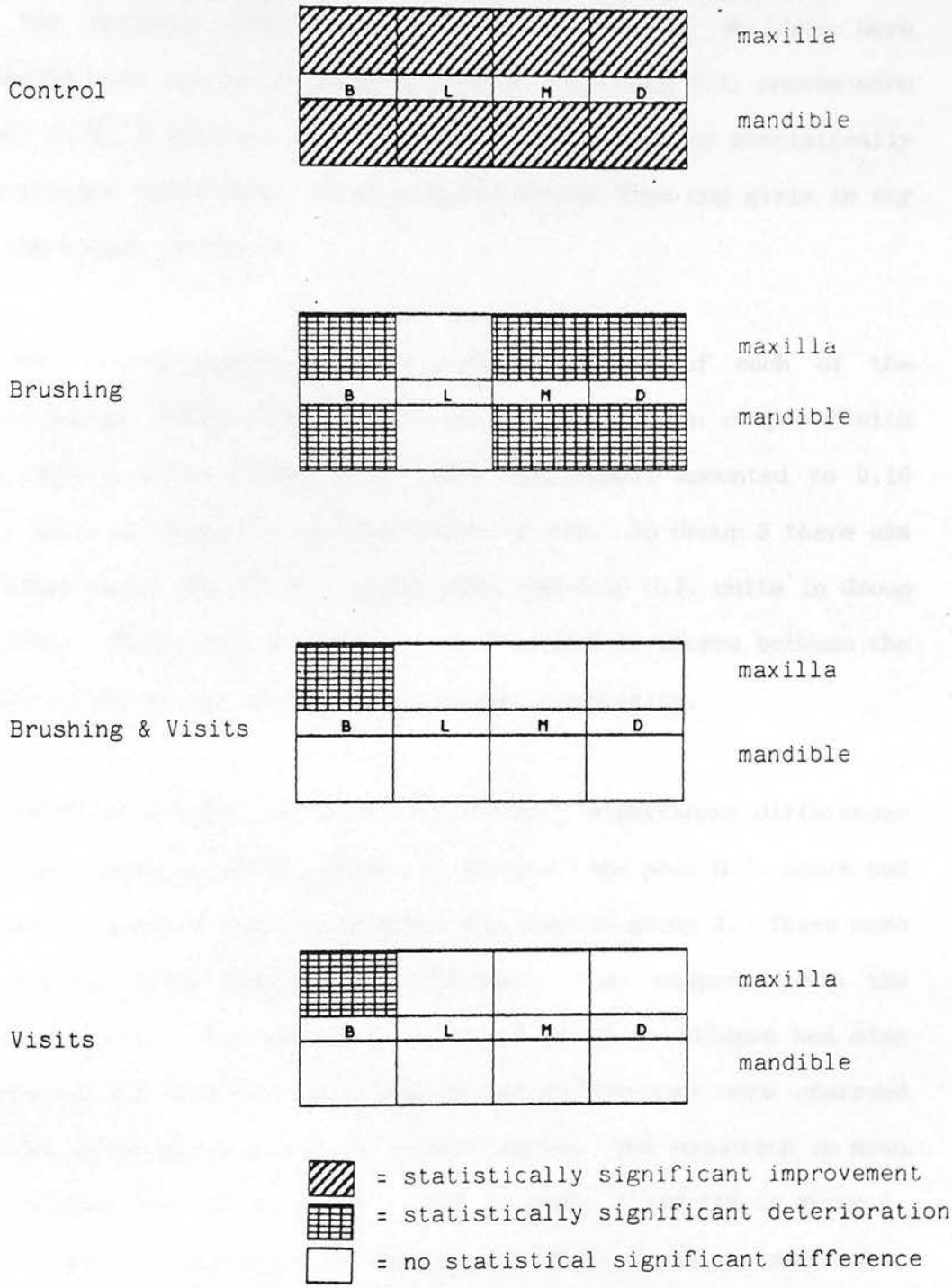


Figure 20. Significance of changes in surface distribution of plaque between examinations 2 and 3.



5.8. GINGIVITIS

5.8.1. Mean Gingival Index (G.I.) scores

At the baseline examination the four groups of children were balanced with respect to gingival status. The mean G.I. scores were 0.30, 0.26, 0.28 and 0.30 (Table 37). There were no statistically significant differences in gingivitis between boys and girls in any of the groups (Table 38).

At the second examination the gingival status of each of the experimental groups had improved significantly when compared with the control group (Table 37). This improvement amounted to 0.16 G.I. units in Group 2 - an improvement of 41%. In Group 3 there was an improvement of 0.27 G.I. units (69%) and 0.30 G.I. units in Group 4 (76%). There were no differences in mean G.I. scores between the sexes in any of the groups at the second examination.

By the third examination these statistically significant differences were no longer apparent, except in group 4; the mean G.I. score had fallen in group 2 and had remained the same in group 3. There were no statistically significant differences when compared with the control group. The mean G.I. score of group 4 children had also decreased and statistically significant differences were observed between these children and the control group. The reduction in mean G.I. values was 11% in group 2, 33% in group 3 and 61% in group 4. There was no statistically significant differences in mean G.I. scores between the sexes at the third examination (Table 38). The mean G.I. values at each examination are illustrated in the bar

Table 37

Mean Gingival Index (G.I.) values - a comparison of the control group with each of the experimental groups at the three examinations

examination	group	number	mean GI	s.e.	t	sig.
baseline	control	112	0.30	0.04	0.57	n.s.
	brushing	89	0.26	0.05		
second	control	112	0.39	0.05	2.10	p<0.05
	brushing	89	0.23	0.05		
third	control	112	0.18	0.04	0.29	n.s.
	brushing	89	0.16	0.04		
baseline	control	112	0.30	0.04	0.33	n.s.
	brushing + visits	71	0.28	0.06		
second	control	112	0.39	0.05	4.39	p<0.001
	brushing + visits	71	0.12	0.03		
third	control	112	0.18	0.04	0.98	n.s.
	brushing + visits	71	0.12	0.03		
baseline	control	112	0.30	0.04	0.04	n.s.
	visits	77	0.30	0.07		
second	control	112	0.39	0.05	4.82	p<0.01
	visits	77	0.09	0.02		
third	control	112	0.18	0.04	2.33	p<0.05
	visits	77	0.07	0.02		

Table 38

Mean Gingival Index (G.I.) values and standard error of the mean for boys and girls at each examination

Group		Mean G.I.Values					
		Baseline Examination		Second Examination		Third Examination	
		Mean	s.e.	Mean	s.e.	Mean	s.e.
Control							
	boys	0.32	(0.08)	0.47	(0.10)	0.27	(0.09)
	girls	0.29	(0.05)	0.32	(0.06)	0.11	(0.03)
Brushing							
	boys	0.18	(0.07)	0.19	(0.07)	0.16	(0.04)
	girls	0.32	(0.08)	0.26	(0.07)	0.16	(0.05)
Brushing and home visit							
	boys	0.16	(0.06)	0.09	(0.03)	0.09	(0.04)
	girls	0.39	(0.09)	0.14	(0.04)	0.14	(0.04)
Home visit							
	boys	0.37	(0.10)	0.11	(0.04)	0.08	(0.02)
	girls	0.23	(0.09)	0.08	(0.03)	0.05	(0.03)

chart in Figure 21.

Summary

The mean G.I. values had improved significantly in the three experimental groups by the second examination. The differences compared with the control group were only statistically significant in group 4 at the final examination but there was a trend towards lower values in the other two experimental groups.

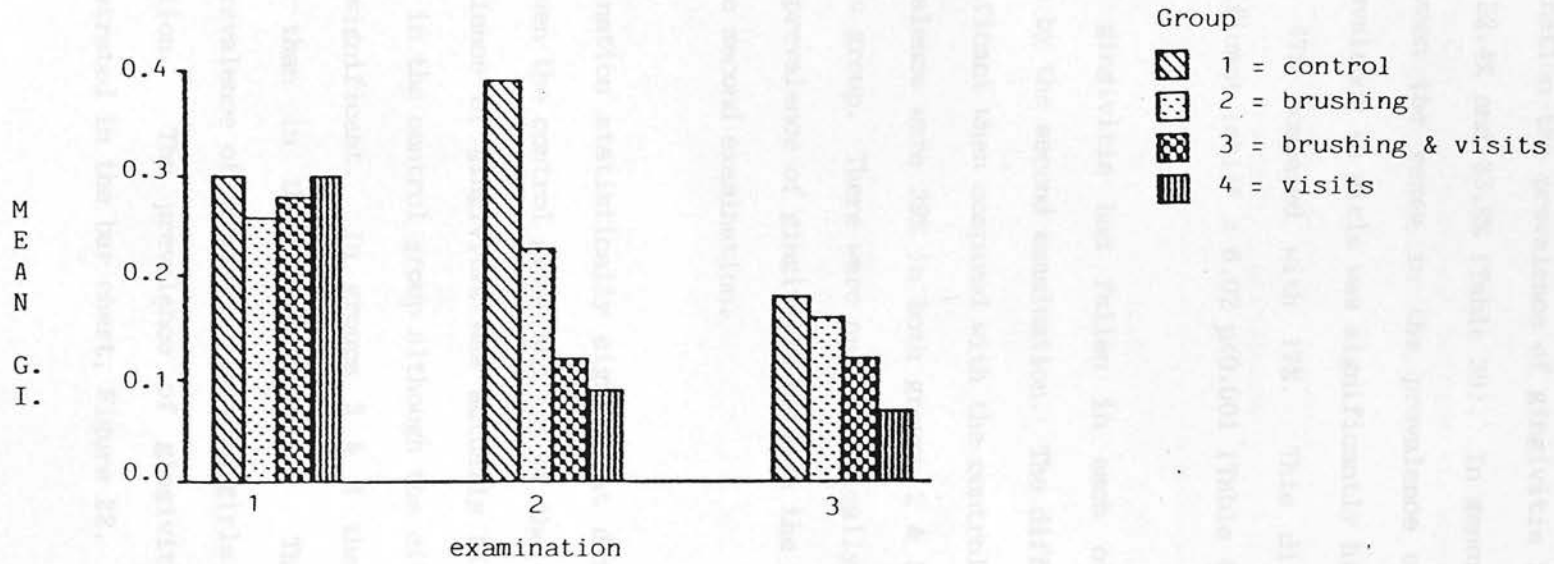
Although the statistical management of the mean G.I. scores has been carried out in the conventional way (Loe & Silness, 1963) there are theoretical objections to this approach because the Gingival Index is compiled from a mixture of quantitative and qualitative data. To overcome this type of difficulty Jackson (1965) suggested that when studying the epidemiology of gingivitis three different indices should be considered; the prevalence, the extent, and the degree. He recommended that these factors should be considered separately rather than combining them into one all-embracing index. Using the information given by the Loe & Silness index, the data in this study has been analysed accordingly.

5.8.2. Prevalence, extent and degree of gingivitis

a. The prevalence of gingivitis

The prevalence of gingivitis is the number of children in the study possessing at least one inflammed gingival site.

Figure 21. Mean G.I.scores at each examination for each study group



At the first examination the prevalence of gingivitis in each group was 44.6%, 32.6%, 32.4% and 33.8% (Table 39). In general there was no difference between the sexes in the prevalence of gingivitis except that the prevalence in girls was significantly higher than in boys in group 3, 47% compared with 17%. This difference was statistically significant $(chi)^2 = 6.02$ $p<0.001$ (Table 40).

The prevalence of gingivitis had fallen in each of the three experimental groups by the second examination. The differences were statistically significant when compared with the control group. The reductions in prevalence were 39% in both groups 2 & 3 and 52% in group 4 - the visits group. There were no statistically significant differences in the prevalence of gingivitis between the sexes in any of the groups at the second examination.

At the final examination statistically significant differences no longer existed between the control group and any of the experimental groups. The prevalence of gingivitis was actually higher in the brushing group than in the control group although the difference was not statistically significant. In groups 3 & 4 the prevalence values were lower than in the control group. There was no difference in the prevalence of gingivitis between girls and boys at the final examination. The prevalence of gingivitis at each examination is illustrated in the bar chart, Figure 22.

Summary

There was a statistically significant reduction of 39% in the prevalence of gingivitis in groups 2 and 3, and a reduction of over

Table 39

Prevalence of gingivitis - a comparison between the control and each experimental group at the three examinations.

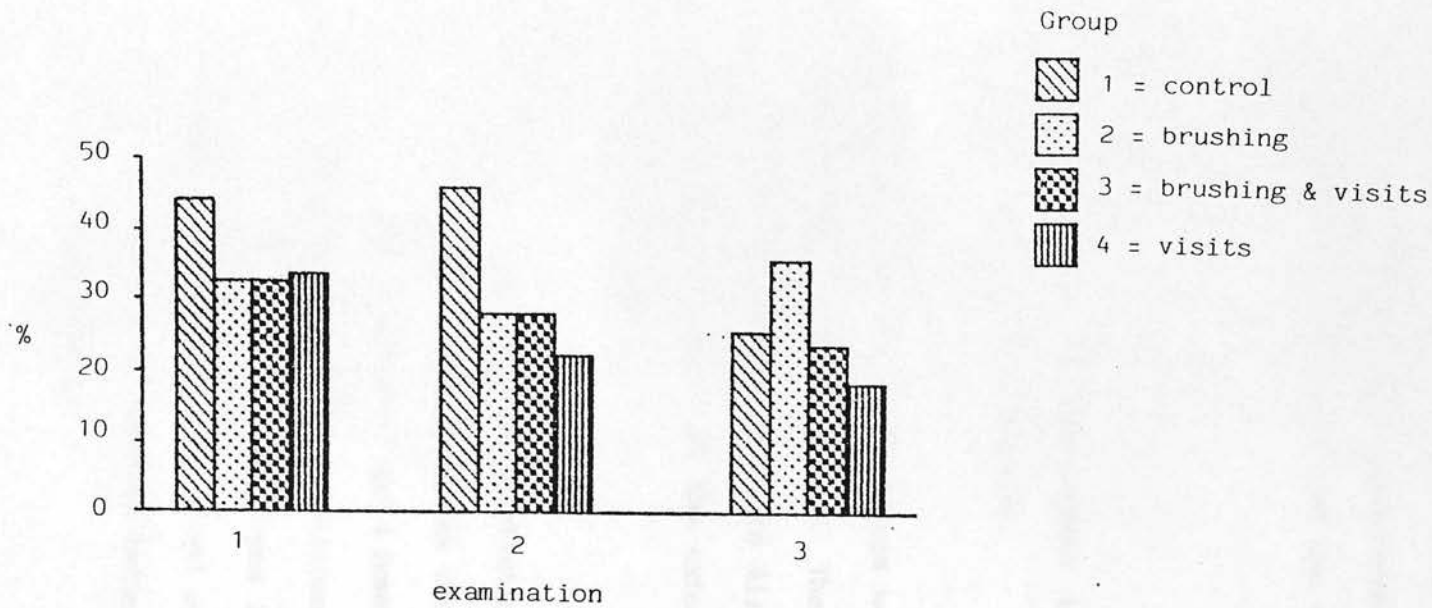
examination	group	number	prevalence %	$(chi)^2$	sig
baseline	control	50	44.6	2.54	n.s.
	brushing	29	32.6		
second	control	52	46.4	6.30	p<0.05
	brushing	25	28.1		
third	control	29	25.9	1.92	n.s.
	brushing	32	36.0		
baseline	control	50	44.6	2.23	n.s.
	brushing & visits	23	32.4		
second	control	52	46.4	5.33	p<0.05
	brushing & visits	20	28.2		
third	control	29	25.9	0.15	n.s.
	brushing & visits	17	23.9		
baseline	control	50	44.6	1.81	n.s.
	visits	26	33.8		
second	control	52	46.4	10.64	p<0.01
	visits	17	22.1		
third	control	29	25.9	1.14	n.s.
	visits	14	18.2		

Table 40

Prevalence of gingivitis - a comparison between boys and girls in each study group at the three examinations.

examination	group		number	prevalence %	(chi)²	sig
Baseline	control	boys	22	44	0.007	n.s.
	control	girls	28	46		
	brushing	boys	11	27	0.49	n.s.
	brushing	girls	18	37		
	brushing & visits	boys	6	17	6.02	p<0.001
	brushing & visits	girls	17	47		
	visits	boys	16	54	2.61	n.s.
	visits	girls	10	28		
Second	control	boys	23	48	0.007	n.s.
	control	girls	29	45		
	brushing	boys	7	17	3.14	n.s.
	brushing	girls	18	37		
	brushing & visits	boys	9	36	0.03	n.s.
	brushing & visits	girls	11	31		
	visits	boys	9	25	0.09	n.s.
	visits	girls	8	19		
Third	control	boys	13	27	0.001	n.s.
	control	girls	16	25		
	brushing	boys	16	40	0.25	n.s.
	brushing	girls	16	33		
	brushing & visits	boys	5	14	2.56	n.s.
	brushing & visits	girls	12	33		
	visits	boys	9	25	1.34	n.s.
	visits	girls	5	12		

Figure 22. The prevalence of gingivitis at each examination for each group



50% in group 4 at the second examination. At the third examination there were no statistically significant reductions in the prevalence of gingivitis between the control group and the three experimental groups.

b. The extent of gingivitis

The extent of gingivitis is the mean number of gingival sites affected in those children who had gingivitis.

At the first examination the four study groups were balanced with respect to the mean number of sites affected. The mean values were 4.06, 4.62, 5.00 and 5.01 respectively (Table 41). There were no statistically significant differences in the extent of gingivitis between boys and girls (Table 42).

At the second examination there was not a statistically significant difference between the brushing group 2 and the control group. The mean number of affected sites in groups 3 and 4 however, had fallen, and the differences were statistically significant when compared with the control group. The fall in group 3 was 2.1 units or 46% and 2.1 units or 44% in group 4. At the second examination there were no statistically significant differences between the sexes in the extent of gingivitis in any groups.

There was a trend towards a lower extent of gingivitis in the three experimental groups at the final examination but the differences when compared with the control group only reached statistical significance in group 4. The reductions amounted to 1.2 units in

Table 41

Extent of gingivitis - a comparison of the mean number of affected sites in the control group compared with the experimental groups at the three examinations.

examination	group	number	mean no. of affected sites	s.e.	t	sig
baseline	control	50	4.06	0.41	0.79	n.s.
	brushing	29	4.62	0.60		
second	control	52	4.65	0.41	0.51	n.s.
	brushing	25	4.28	0.61		
third	control	29	3.69	0.53	1.85	n.s.
	brushing	32	2.47	0.40		
baseline	control	50	4.06	0.41	1.24	n.s.
	brushing & visits	23	5.00	0.67		
second	control	52	4.65	0.41	4.12	$p<0.001$
	brushing & visits	20	2.50	0.32		
third	control	29	3.69	0.53	1.29	n.s.
	brushing & visits	17	2.88	0.33		
baseline	control	50	4.06	0.41	1.24	n.s.
	visits	26	5.01	0.82		
second	control	52	4.65	0.41	2.76	$p<0.01$
	visits	17	2.58	0.39		
third	control	29	3.69	0.53	2.41	$p<0.01$
	visits	14	2.21	0.30		

Table 42

Extent of gingivitis - a comparison between boys and girls in each study group at the three examinations.

Group	number		mean no. of affected sites	s.e.	t	sig
Baseline examination						
control	boys	22	4.23	0.74	0.36	n.s.
control	girls	28	3.93	0.46		
brushing	boys	11	4.00	1.04	0.80	n.s.
brushing	girls	18	5.00	0.74		
brushing & visits	boys	6	5.71	0.91	0.14	n.s.
brushing & visits	girls	17	4.94	0.86		
visits	boys	16	4.68	0.82	0.59	n.s.
visits	girls	10	5.70	1.73		
Second examination						
control	boys	23	5.26	0.73	1.34	n.s.
control	girls	29	4.17	0.43		
brushing	boys	7	5.86	1.26	1.57	n.s.
brushing	girls	18	3.67	0.72		
brushing & visits	boys	9	2.22	0.28	0.81	n.s.
brushing & visits	girls	11	2.73	0.56		
visits	boys	9	2.67	0.60	0.20	n.s.
visits	girls	8	2.50	0.53		
Third examination						
control	boys	13	4.92	0.98	2.23	$p<0.05$
control	girls	16	2.68	0.42		
brushing	boys	16	2.25	0.41	0.54	n.s.
brushing	girls	16	2.69	0.70		
brushing & visits	boys	5	4.00	0.89	1.73	n.s.
brushing & visits	girls	12	2.41	0.19		
visits	boys	9	2.00	0.17	0.72	n.s.
visits	girls	5	2.60	0.81		

group 2, a reduction of 33%, 0.8 units in group 3, a reduction of 22% and 1.5 units in group 4, a 40% reduction. At the third examination there were no differences in the extent of gingivitis between the sexes in any of the experimental groups, but boys in the control group had significantly more affected sites than girls. The extent of gingivitis at each examination is illustrated in the bar chart, Figure 23.

Summary

There was no difference between the extent of gingivitis in the brushing group 2 and the control group at the second examination. In groups 3 and 4 there was a statistically significant reduction in the extent of gingivitis of 46% and 44% respectively at the second examination. Statisticallly significant differences existed between the control group and group 4 only at the third examination.

c. The degree of gingivitis

The degree of gingivitis is the severity of gingival inflammation as determined by colour and swelling. The degree of gingivitis in this study was scored on a range from 1-3. At all of the examinations the degree of gingivitis was almost entirely mild; 97% of gingival sites affected were given a score of 1. A very small proportion of sites (4%) scored 2 and no sites were given a score of 3 (Table 43). There were no important shifts in the degree of inflammation in any of the groups at any of the examinations. The degree of gingivitis at each examination is illustrated in the Pie charts, Figures 24, 25 & 26.

Figure 23. The extent of gingivitis at each examination for each group

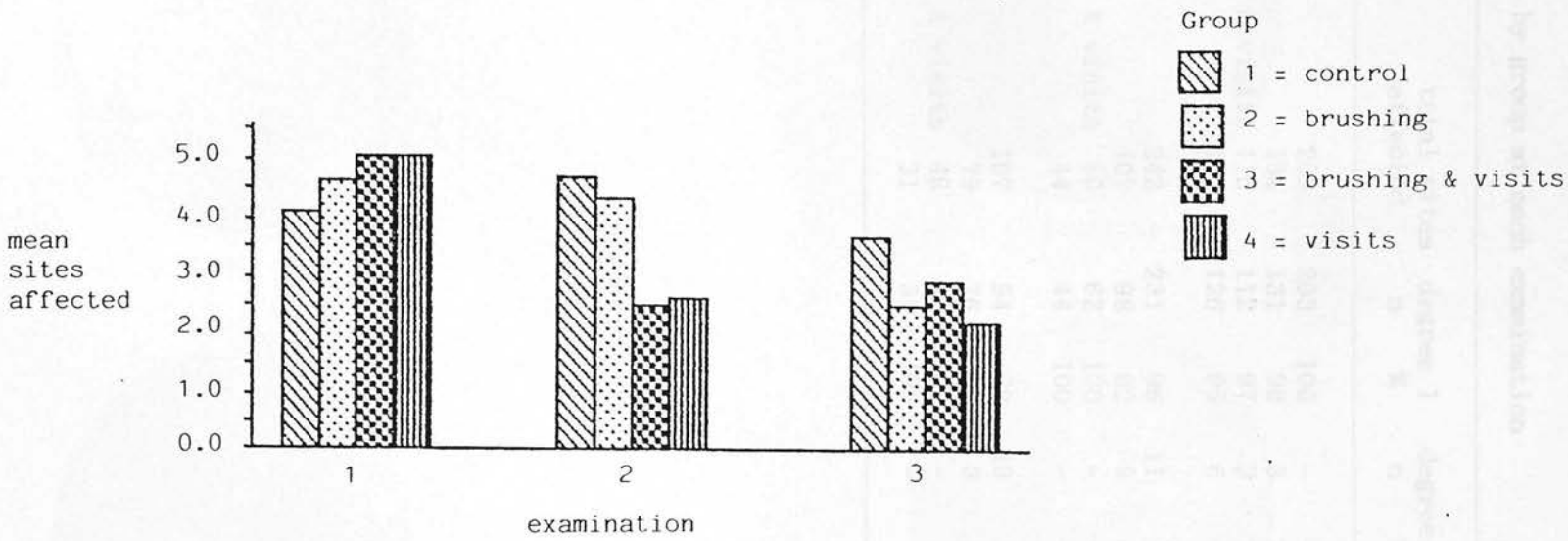


Table 43

Degree of gingivitis by group at each examination

examination	group	total sites affected	degree 1 n	degree 1 %	degree 2 n	degree 2 %	degree 3 n	degree 3 %
baseline	control	203	203	100	-	-	-	-
	brushing	134	131	98	3	2	-	-
	brushing & visits	115	112	97	3	2	-	-
	visits	132	126	95	6	4	-	-
second	control	242	231	96	11	4	-	-
	brushing	107	98	92	9	8	-	-
	brushing & visits	50	62	100	-	-	-	-
	visits	44	44	100	-	-	-	-
third	control	107	94	88	13	12	-	-
	brushing	79	76	96	3	4	-	-
	brushing & visits	49	49	100	-	-	-	-
	visits	31	31	100	-	-	-	-

Figure 24. Degree of gingivitis for each group at the baseline examination

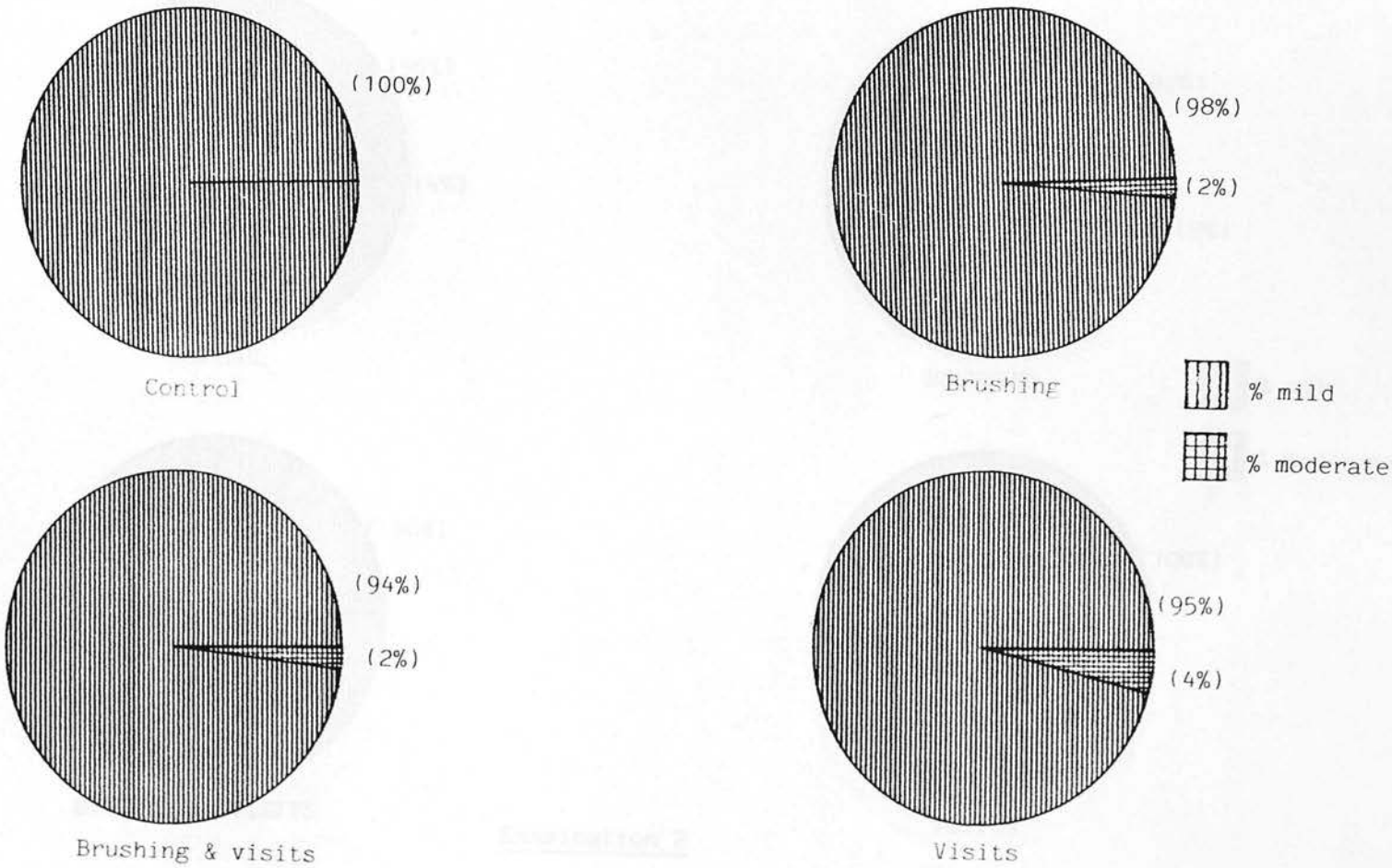


Figure 25. Degree of gingivitis for each group at the second examination

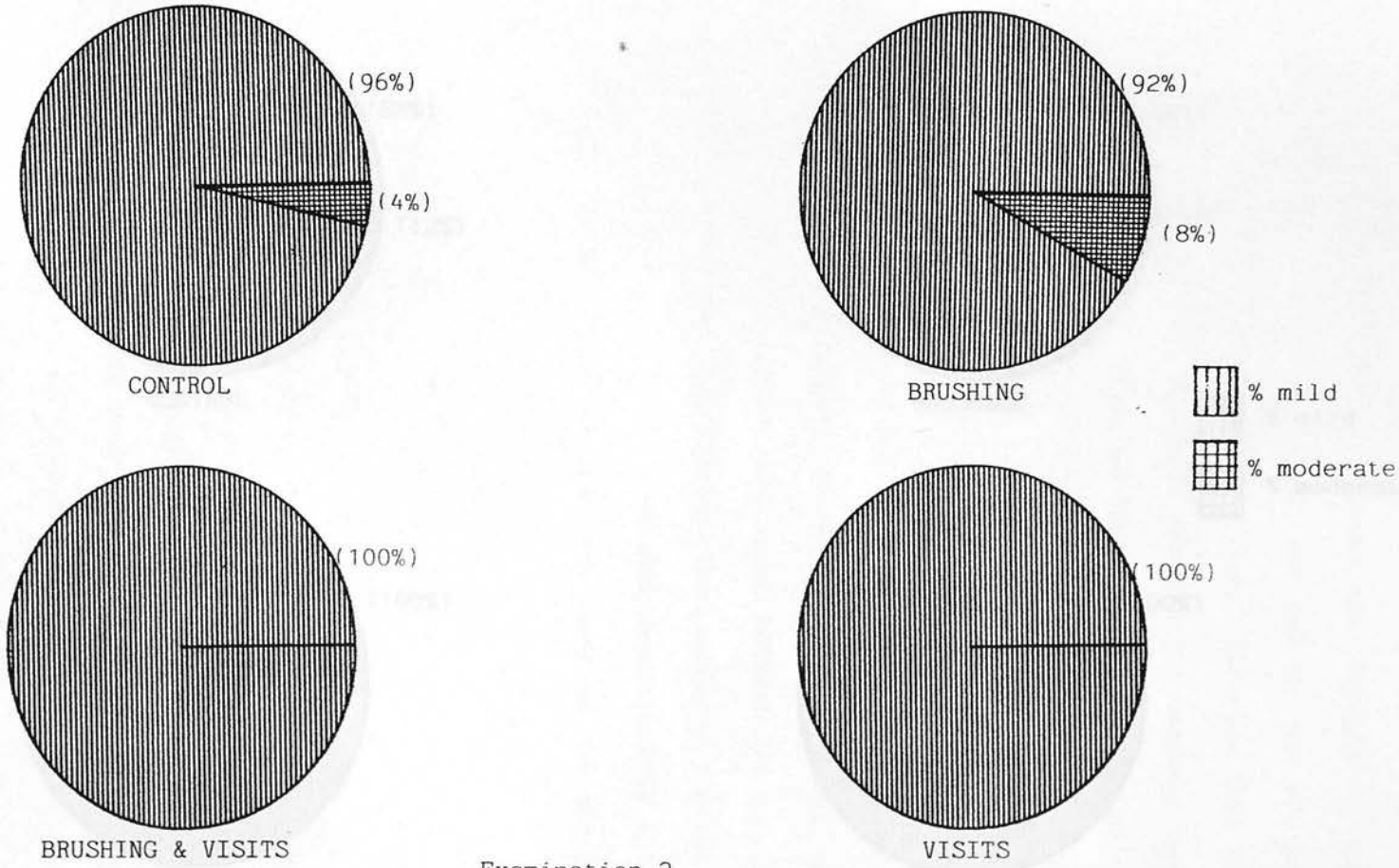
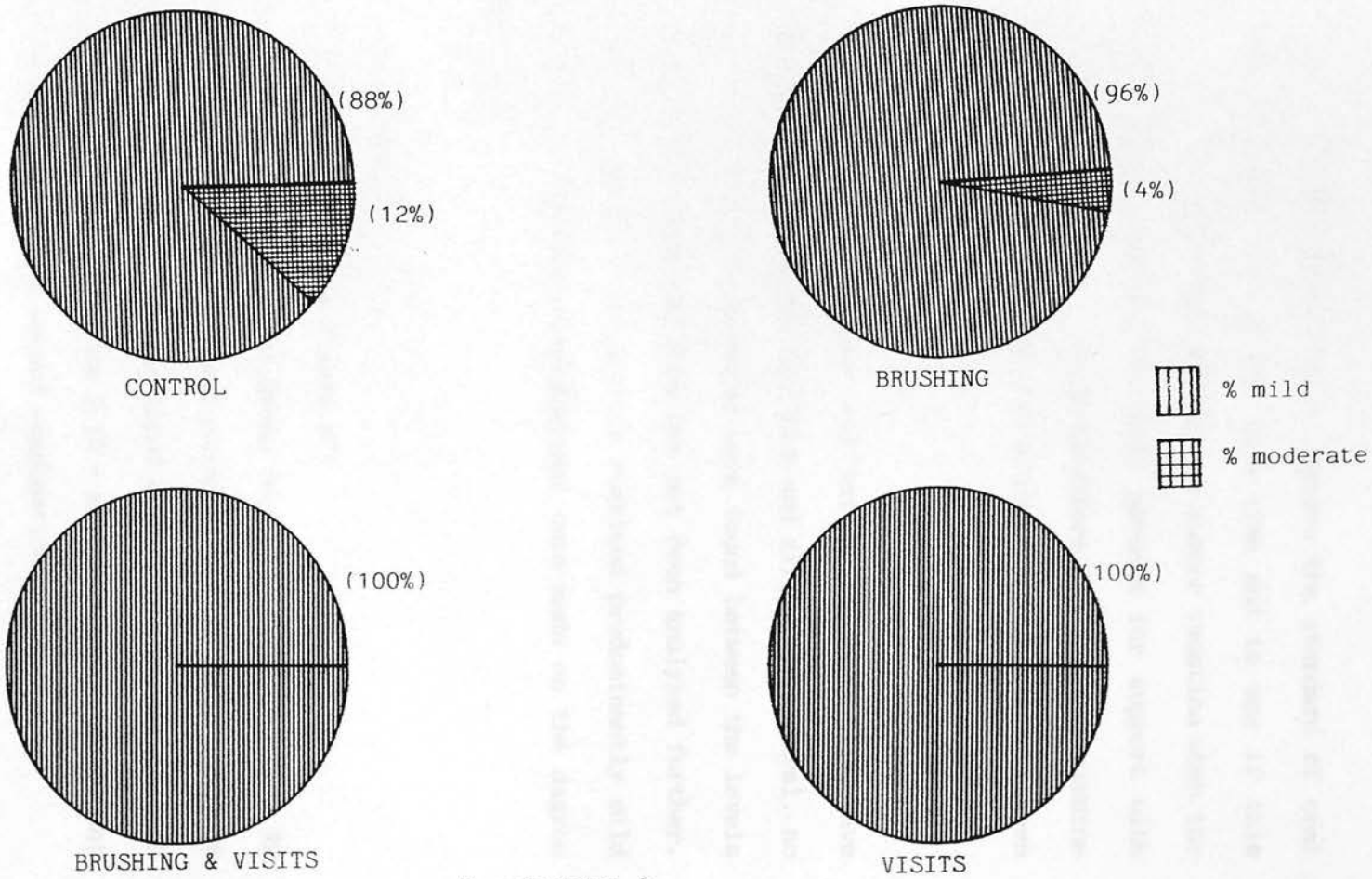


Figure 26. Degree of gingivitis for each group at the final examination



Examination 3

5.9. THE CHANGES IN GINGIVITIS IN EACH STUDY GROUP

One of the aims of this study was to improve the standard of oral health of the children during the term time and to see if this improvement could be maintained during the summer vacation when the children were solely dependent on their parents for support with their oral hygiene practices. It is therefore important to examine the data for each group separately on a longitudinal basis between the school examinations.

Mean G.I. scores, the prevalence and extent of gingivitis have already been analysed separately for boys and girls. In general, no statistically significant differences were found between the levels of gingivitis in the sexes and this has not been analysed further. Similarly, as the degree of gingivitis remained predominantly mild during the study no further investigations were made on the degree of inflammation.

5.9.1. Control group

a. Mean G.I.scores (Table 44 & Figure 27)

The mean G.I. score of the control group increased from 0.30 to 0.39 between the first and second examination. The increase was not statistically significant. By the third examination gingivitis had improved - the mean G.I. score was 0.18 - a significant improvement of 54% when compared with the second examination.

b. Prevalence (Table 45 & Figure 28)

The prevalence of gingivitis increased from 45% to 46% between the

Table 44

Changes in Mean Gingival Index (G.I.) scores in each study group between the examinations

group	mean G.I. values Ex.1	Ex.2	Ex.3	% reduction between the examinations Ex.1-2 %	sig	Ex.2-3 %	sig
control	0.30	0.39	0.18	-30	n.s.	54	p<0.001
brushing	0.26	0.23	0.16	11	n.s.	30	n.s.
brushing + visits	0.28	0.12	0.12	57	p<0.01	0	n.s.
visits	0.30	0.09	0.07	70	p<0.01	22	n.s.

Figure 27. Mean G.I. scores for each group at each examination

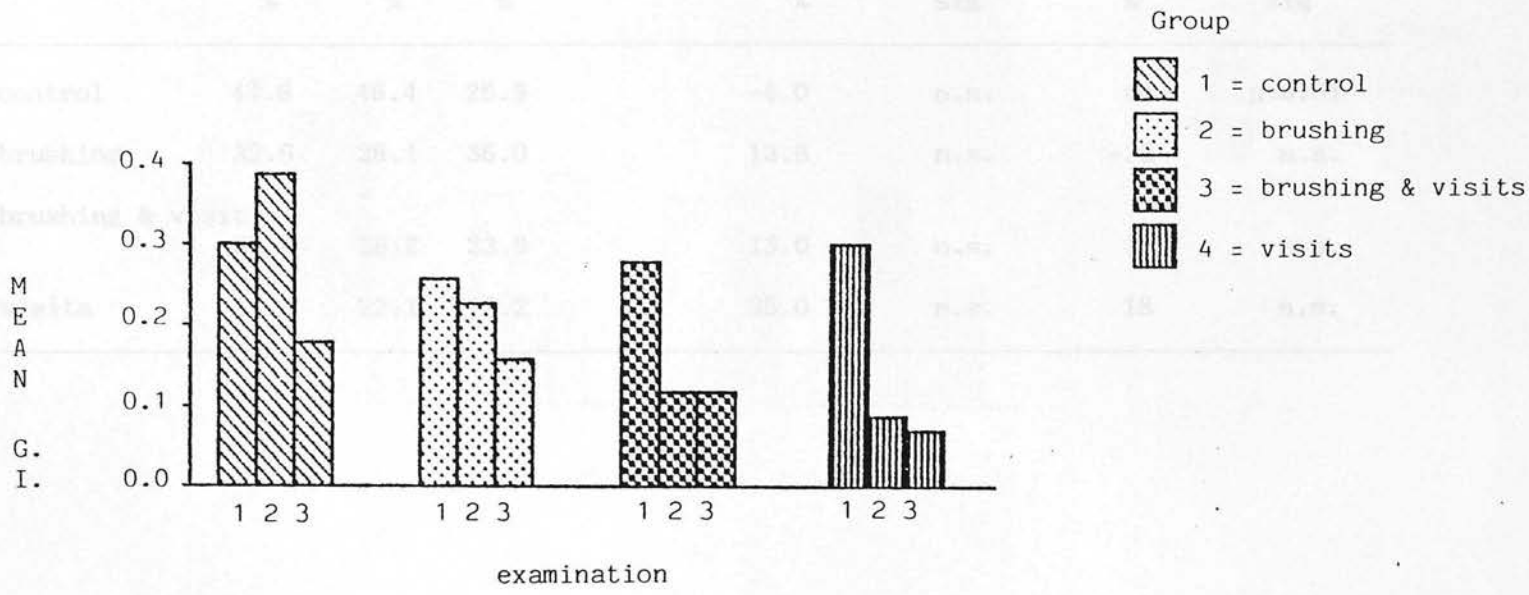
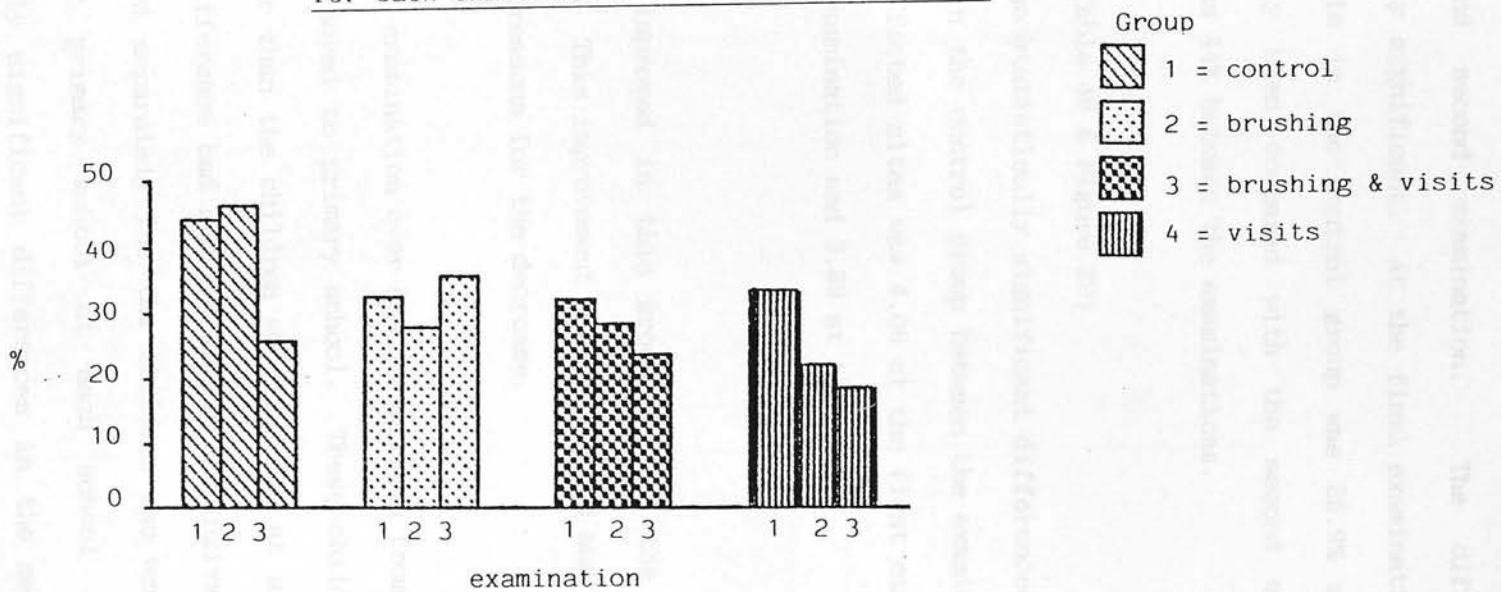


Table 45

Changes in the prevalence of gingivitis in each study group between the examinations

group	prevalence at each exam. Ex.1 %	Ex.2 %	Ex.3 %	% reduction between exams. Ex.1-2 %	sig	Ex.2-3 %	sig
control	44.6	46.4	25.9	-4.0	n.s.	44	p<0.01
brushing	32.6	28.1	36.0	13.8	n.s.	-22	n.s.
brushing & visit	32.4	28.2	23.9	13.0	n.s.	15	n.s.
visits	33.8	22.1	18.2	35.0	n.s.	18	n.s.

Figure 28. The prevalence of gingivitis for each group for each examination



baseline and second examination. The difference was not statistically significant. At the final examination the prevalence of gingivitis in the control group was 25.9% and had decreased significantly when compared with the second examination. The reduction was 44% between the examinations.

c. **Extent** (Table 46 & Figure 29)

There were no statistically significant differences in the extent of gingivitis in the control group between the examinations. The mean number of affected sites was 4.06 at the first examination, 4.65 at the second examination and 3.69 at the third.

Summary

Gingivitis improved in this group between the second and third examination. This improvement was unexpected and attempts were made to find out reasons for the decrease.

At the final examination over 60% of children from each of the study groups had moved to primary school. These children were about 12 months older than the children who remained at nursery. To see if this age difference had had any effect on gingival health, the data was analysed separately for the children who were finally seen at nursery or primary school at each school examination. No statistically significant differences in the mean G.I. scores or prevalence of gingivitis were found. There was a statistically significant increase in the extent of gingivitis in group 2 but not in any of the other groups (Table 47). The control group was made up of two nursery schools, Stanwell (69 children) and Westfield

Table 46

Changes in the extent of gingivitis in each study group between the examinations

group	mean no. of affected sites Ex.1	Ex.2	Ex.3	% reduction between examinations Ex.1-2 %	sig	Ex.2-3 %	sig
control	4.06	4.65	3.69	-14.0	n.s.	21.0	n.s.
brushing	4.62	4.28	2.47	7.0	n.s.	42.0	$p<0.05$
brushing & visits	5.00	2.50	2.88	50.0	$p<0.01$	-13.0	n.s.
visits	5.01	2.58	2.21	48.0	$p<0.001$	14.0	n.s.

Figure 29. Extent of gingivitis for each group at each examination

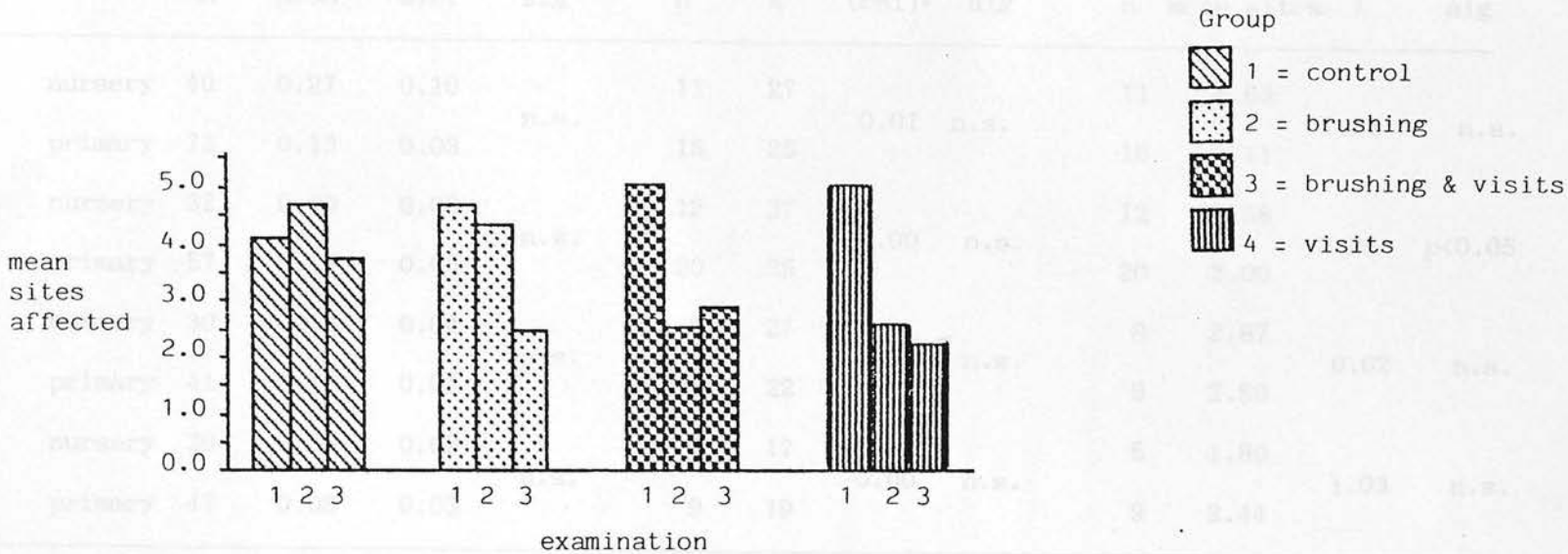


Table 47

A comparison of the mean Gingival Index (G.I.) scores, the prevalence and extent of gingivitis between the nursery and primary school children at the final examination.

group		mean G.I.				prevalence				extent				
		n	mean	s.e.	sig	n	%	$(chi)^2$	sig	n	mean sites	t	sig
control	nursery	40	0.27	0.10	n.s.	11	27	0.01	n.s.	11	4.63	1.21	n.s.
	primary	72	0.13	0.03		18	25			18	3.11		
brushing	nursery	32	0.09	0.02	n.s.	12	37	0.00	n.s.	12	1.58	2.25	$p<0.05$
	primary	57	0.19	0.05		20	35			20	3.00		
brushing + visits	nursery	30	0.14	0.04	n.s.	8	27	0.03	n.s.	8	2.87	0.02	n.s.
	primary	41	0.11	0.04		9	22			9	2.89		
visits	nursery	30	0.05	0.02	n.s.	5	17	0.00	n.s.	5	1.80	1.03	n.s.
	primary	47	0.08	0.03		9	19			9	2.44		

Court (43 children). Both nurseries were similar with respect to social structure and were situated in similar city areas. The reasons for the improvement of gingivitis in this group remain obscure.

5.9.2. Toothbrushing group

a. Mean G.I. Scores (Table 44 & Figure 27)

The mean G.I. score of group 2 decreased slightly between the examinations. The score at the baseline examination was 0.26; 0.23 at the second and 0.16 at the final examination. There was no statistically significant difference in the mean G.I. scores between the first and second, or the second and third examinations.

b. Prevalence (Table 45 & Figure 28)

The prevalence of gingivitis in group 2 was 32.6% at the first examination, 28.1% at the second and 36% at the final examination. There were no statistically significant differences in the prevalence of gingivitis between any of the examinations.

c. Extent (Table 46 & Figure 29)

The extent of gingivitis in the brushing group decreased from 4.62 mean affected sites at the baseline examination to 4.28 mean sites at the second examination. This difference was not statistically significant. At the final examination the extent of gingivitis had decreased to 2.47, an improvement of 42% when compared with the second examination. This difference was statistically significant.

Summary

Although there was a trend towards an improvement in the mean G.I. values and the extent of gingivitis of the children in this group, the differences only reached statistical significance in the extent of gingivitis between the second and third examination.

During the summer holidays the mean G.I. scores decreased slightly but there was a small increase in the prevalence of gingivitis.

5.9.3. Toothbrushing and home visits groups

a. Mean G.I.Scores (Table 44 & Figure 27)

The mean G.I. score of group 3 at the first and second examination was 0.28 and 0.12 respectively. This reduction of 0.16 units reflected an improvement of 57% which was statistically significant. The mean G.I. scores were identical at the second and third examinations.

b. Prevalence (Table 45 & Figure 28)

The prevalence of gingivitis decreased during the study in Group 3. The proportion of children with gingivitis was 32.4% at the first examination, 28.2% at the second and 23.9% at the final examination. There were no statistically significant differences in the prevalence of gingivitis between the examinations.

c. Extent (Table 46 & Figure 29)

The mean number of affected sites was 5.0 at the first examination, 2.50 at the second and 2.88 at the third. The difference between the first and second examination was 2.5 affected sites, a reduction

of 50% which was statistically significant. There was a slight increase between the second and third examination but the difference was not statistically significant.

Summary

There was a decrease in the mean G.I. scores, the prevalence and the extent of gingivitis in this group of children during the study.

The mean G.I. scores had significantly decreased by the second examination and the improvement was held at the final examination. The reductions in the prevalence of gingivitis between the examinations were not statistically significant. The extent of gingivitis had fallen significantly by the second examination. There was a small deterioration after the summer holiday but the extent of gingivitis at the final examination was still significantly reduced. The improvement in gingival health in this group was maintained during the summer vacation.

5.9.4. Home visits group

a. Mean G.I.scores (Table 44 & Figure 27)

The mean G.I. score of the children in group 4 decreased between the first and second examination, and between the second and third examination. The scores were 0.30, 0.09 and 0.07. This was a decrease of 0.21 units between examination 1 and 2 (70%), and 0.02 units between examinations 2 and 3 (22%). The difference in the mean G.I. score at the second examination was statistically significant when compared with the baseline value. There was a slight decrease in mean G.I. Score at the final examination but the

difference compared with the second examination was not statistically significant.

b. Prevalence (Table 45 & Figure 28)

The prevalence of gingivitis in Group 4 was 33.8% at the first examination and 22.1% at examination 2. This difference was not statistically significant. At the third examination the proportion of children with gingivitis was 18.2%. There was not a statistically significant difference between the second and third examinations.

c. Extent (Table 46 & Figure 29)

The extent of gingivitis was significantly reduced from 5.01 to 2.58 between the baseline and second examination. The reduction was 2.4 units (48%). The extent of gingivitis at the final examination was 2.21, a small reduction since the second examination but the difference between the examinations was not statistically significant.

Summary

There was a decrease in mean G.I. scores in the prevalence and extent of gingivitis in the children in Group 4. The mean G.I. score was significantly reduced by the second examination. This improvement was maintained during the summer holiday. A similar decrease was observed in both the prevalence and extent of gingivitis and again was maintained during the summer vacation.

5.10. DISTRIBUTION OF GINGIVITIS

To look for changes in the distribution of gingivitis in the mouth a mean G.I. score per tooth and a mean G.I. score for each tooth surface was calculated. It must be emphasised that the prevalence and extent of gingivitis was low and the mean scores considered in this analysis are very small.

5.10.1. Mean G.I. score per tooth (Tables 48-55, Figures 30-33)

In general there was more gingivitis in the mandible than the maxilla, no difference between left and right hand side of the mouth and more gingivitis in relation to molar than incisor teeth. At the second examination there was a significant increase in mean G.I. scores in the control group in relation to maxillary molar teeth compared with the baseline examination (Figure 34).

There were no significant changes in mean G.I. scores in relation to either molar or incisor teeth in the children in group 2 between the first and second examinations. In group 3 statistically signficant improvements in mean G.I. scores were observed between the first and second examination in relation to the maxillary left molar and both mandibular molar teeth.

Significant improvements in mean G.I. scores were also found in relation to mandibular molar teeth in group 4 between the baseline and second examination.

At the final examination mean G.I. scores in the control group in

relation to all maxillary and mandibular teeth had improved significantly since the second examination. The greatest improvements were on molar teeth (Figure 35).

Mean G.I. scores per tooth were slightly reduced in group 2 at the third examination compared with the second, but the difference only reached statistical signficance in the maxillary right molar.

In group 3 and 4 there were no statistically significant differences in mean G.I. scores per tooth between the second and third examination.

5.10.2. **Mean G.I. score per tooth surface** (Tables 56-63, Figures 36-39).

In the maxilla the greatest amount of gingivitis was found in relationship to buccal tooth surfaces and in relation to lingual sites in the mandible. Mesial and distal gingivitis was almost identical in both jaws. The least amount of gingivitis was found in relation to lingual tooth surfaces of upper teeth.

Mean G.I. scores in relation to maxillary buccal and distal tooth surfaces increased significantly between the first and second examinations in the control group (Figure 40).

There were no significant changes in mean G.I. scores in relation to any tooth surfaces in group 2 between the baseline and second examination. In group 3 there were significant improvements in mean G.I. scores in relation to maxillary, buccal and mandibular, mesial

and distal tooth surfaces between the first and second examinations. An identical finding was observed in mandibular teeth in group 4 between these two examinations but there were no significant changes in relation to individual tooth surfaces in the maxilla. At the final examination mean G.I. scores in the control group in relation to maxillary buccal and distal surfaces had improved, deteriorated in maxillary distal surfaces and improved in mandibular lingual, mesial and distal surfaces compared with the second examination (Figure 41). Improvements in mean G.I. in relation to maxillary, buccal, mesial and distal surfaces were found in group 2 between the second and third examinations.

In groups 3 and 4 there were no statistically significant differences in mean G.I. scores in relation to any tooth surfaces between the last two examinations.

5.11. GENERAL SUMMARY FOR GINGIVITIS

The results for gingivitis in this study are difficult to interpret and the picture is complicated by the fact that gingival inflammation decreased in the control group during the study. It should however, be emphasised that throughout the study levels of gingivitis in all of the children were very low.

Mean G.I. scores in every study group had decreased by the final examination but were only significantly lower than the control group in group 4, the home visits group.

There were no marked changes in the prevalence of gingivitis during this study in any of the groups.

The extent of gingivitis was only significantly lower than the control group at the last examination in group 4. However within the control group the extent of gingivitis remained essentially unchanged during the study but there were significant improvements within the three experimental groups at the last examination.

The degree of gingival inflammation of all of the children throughout this investigation was mild.

Overall, greater reductions in gingivitis were seen in groups 3 & 4 - the groups that had been visited at home by the hygienist. These reductions were maintained during the summer holiday when the preventive programme had been suspended.

There were some unexplained changes in the distribution of gingivitis in relation to individual teeth and surfaces in the control group during the study; a deterioration in relation to maxillary molar teeth and surfaces between examinations 1 and 2 followed by an improvement between examinations 2 and 3.

There were no marked changes in the distribution of gingivitis in group 2 during the study when the preventive programme was in operation, but improvements were found in both groups 3 and 4, the home visits groups, which were maintained when the programme had finished. In all children more gingivitis was found in the mandible than the maxilla, no difference between the left and right hand side of the mouth and more gingivitis in relation to molar than incisor teeth. Most gingivitis was found in relation to mandibular, lingual and maxillary buccal tooth surfaces.

Table 48

A comparison of the mean Gingival Index (G.I.) score of the maxillary right second deciduous molar (55) between each examination for each group.

Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig
E/ or 55	Control	1	0.03	0.11	2.68	p<0.01
		2	0.10	0.02		
		2	0.10	0.02	2.57	p<0.05
		3	0.02	0.01		
	Brushing	1	0.06	0.02	1.73	n.s.
		2	0.11	0.03		
		2	0.11	0.03	3.30	p<0.01
		3	0.02	0.01		
	Brushing & visits	1	0.07	0.03	1.78	n.s.
		2	0.02	0.01		
		2	0.02	0.01	0.00	n.s.
		3	0.02	0.01		
	Visits	1	0.04	0.02	1.79	n.s.
		2	0.01	0.005		
		2	0.01	0.005	0.57	n.s.
		3	0.003	0.003		

Table 49

A comparison of the mean Gingival Index (G.I). score for the maxillary right second deciduous incisor (52) between each examination for each group.

Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig
B/ of 52	Control	1	0.01	0.01	0.20	n.s.
		2	0.01	0.01		
		2	0.01	0.01	1.91	n.s.
		3	0.00	0.00		
	Brushing	1	0.01	0.01	1.00	n.s.
		2	0.00	0.00		
		2	no gingivitis			
		3	" "			
	Brushing & visits	1	0.003	0.004	0.63	n.s.
		2	0.01	0.01		
		2	0.01	0.01	1.00	n.s.
		3	0.00	0.00		
	Visits	1	no gingivitis			
		2	" "			
		3	" "			

Table 50

A comparison of the mean Gingival Index (G.I.) score for the maxillary left second deciduous molar (65) between each examination for each group.

Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig
/E or 65	Control	1	0.03	0.01	2.12	p<0.05
		2	0.07	0.02		
		2	0.07	0.02	2.89	p<0.01
		3	0.01	0.01		
	Brushing	1	0.06	0.02	0.35	n.s.
		2	0.05	0.02		
		2	0.05	0.02	0.76	n.s.
		3	0.03	0.02		
	Brushing & visits	1	0.04	0.01	2.44	p<0.01
		2	0.003	0.004		
		2	0.003	0.004	1.00	n.s.
		3	0.001	0.001		
	Visits	1	0.04	0.02	1.84	n.s.
		2	0.003	0.003		
		2	0.003	0.003	0.00	n.s.
		3	0.003	0.003		

Table 51

A comparison of the mean Gingival Index (G.I.) score for the mandibular right second deciduous molar (85) between each examination for each group.

Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig
E/ or 85	Control	1	0.19	0.03	0.21	n.s.
		2	0.20	0.03		
		2	0.20	0.03	2.76	p<0.01
		3	0.12	0.03		
	Brushing	1	0.11	0.02	1.80	n.s.
		2	0.06	0.02		
		2	0.06	0.02	0.82	n.s.
		3	0.08	0.02		
	Brushing & visits	1	0.14	0.03	2.38	p<0.05
		2	0.07	0.02		
		2	0.07	0.02	0.47	n.s.
		3	0.08	0.02		
	Visits	1	0.18	0.04	3.16	p<0.01
		2	0.06	0.10		
		2	0.06	0.10	0.36	n.s.
		3	0.05	0.01		

Table 52

A comparison of the mean Gingival Index (G.I.) score for the mandibular left second deciduous incisor (72) between each examination for each group.

Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig
/B or 72	Control	1	no gingivitis			
		2	" "			
		3	" "			
	Brushing	1	0.02	0.01	0.38	n.s.
		2	0.01	0.01		
		2	0.01	0.01	1.27	n.s.
		3	0.00	0.00		
	Brushing & visits	1	0.003	0.004	1.00	n.s.
		2	0.000	0.000		
		2	no gingivitis			
		3	" "			
	Visits	1	0.02	0.01	0.00	n.s.
		2	0.02	0.01		
		2	0.02	0.01	1.40	n.s.
		3	0.00	0.00		

Table 53

A comparison of the mean Gingival Index (G.I.) score for the mandibular left second deciduous molar (75) between each examination for each group.

Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig
/E or 75	Control	1	0.19	0.03	0.20	n.s.
		2	0.18	0.03		
		2	0.18	0.03	2.32	p<0.05
		3	0.11	0.02		
	Brushing	1	0.13	0.03	1.27	n.s.
		2	0.09	0.02		
		2	0.09	0.02	0.26	n.s.
		3	0.10	0.02		
	Brushing & visits	1	0.15	0.03	2.44	p<0.05
		2	0.07	0.02		
		2	0.07	0.02	0.52	n.s.
		3	0.06	0.02		
	Visits	1	0.17	0.04	3.08	p<0.01
		2	0.06	0.01		
		2	0.06	0.01	0.84	n.s.
		3	0.04	0.01		

Table 54

A comparison of the mean Gingival Index (G.I.) score for all maxillary teeth between each examination for each group.

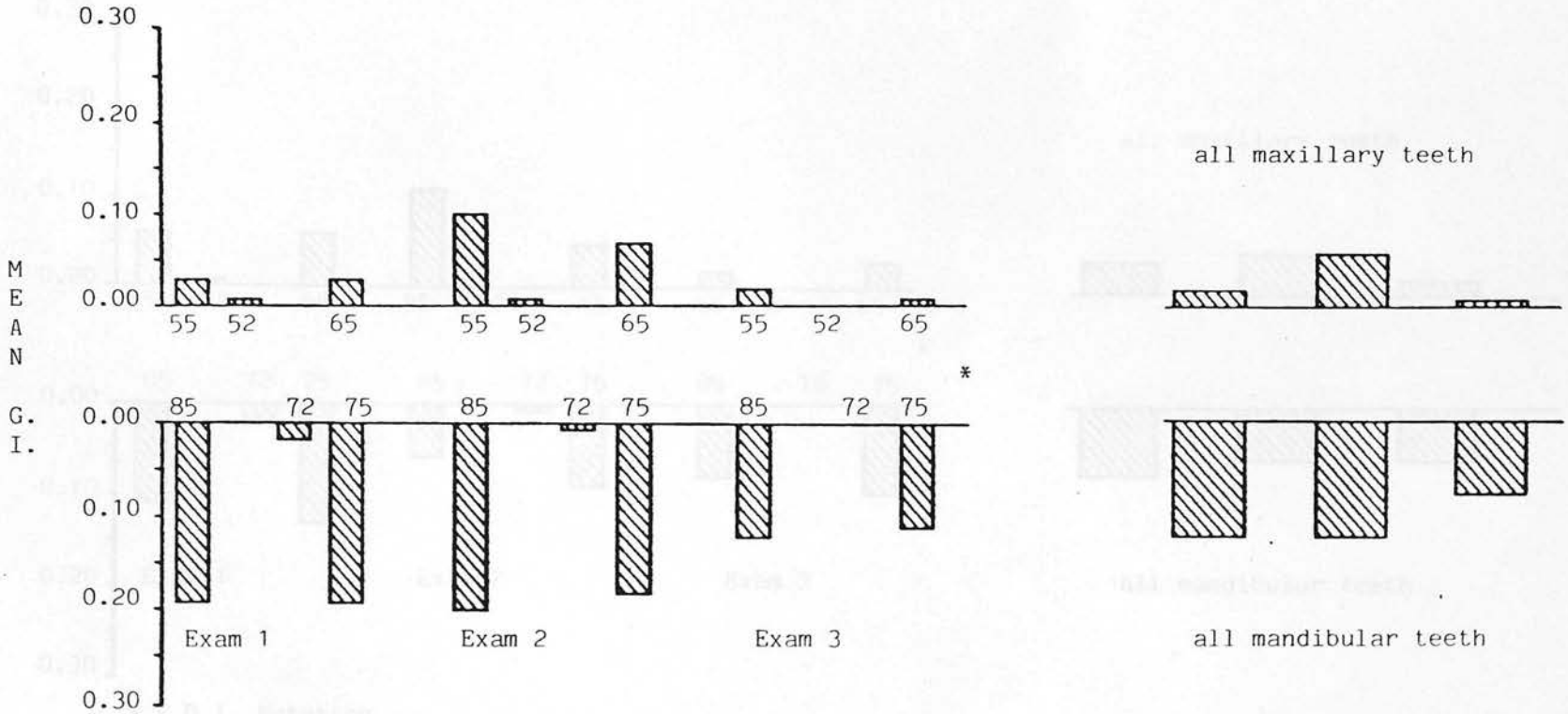
Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig
All upper	Control	1	0.02	0.01	2.40	p<0.01
		2	0.06	0.01		
		2	0.06	0.01	3.06	p<0.01
		3	0.01	0.01		
	Brushing	1	0.04	0.01	0.73	n.s.
		2	0.05	0.01		
		2	0.05	0.01	3.01	p<0.01
		3	0.02	0.01		
	Brushing & visits	1	0.04	0.01	1.95	n.s.
		2	0.01	0.01		
		2	0.01	0.01	0.18	n.s.
		3	0.01	0.01		
	Visits	1	0.03	0.01	1.84	n.s.
		2	0.003	0.002		
		2	0.003	0.002	0.38	n.s.
		3	0.002	0.002		

Table 55

A comparison of the mean Gingival Index (G.I.) score for all mandibular teeth between each examination for each group.

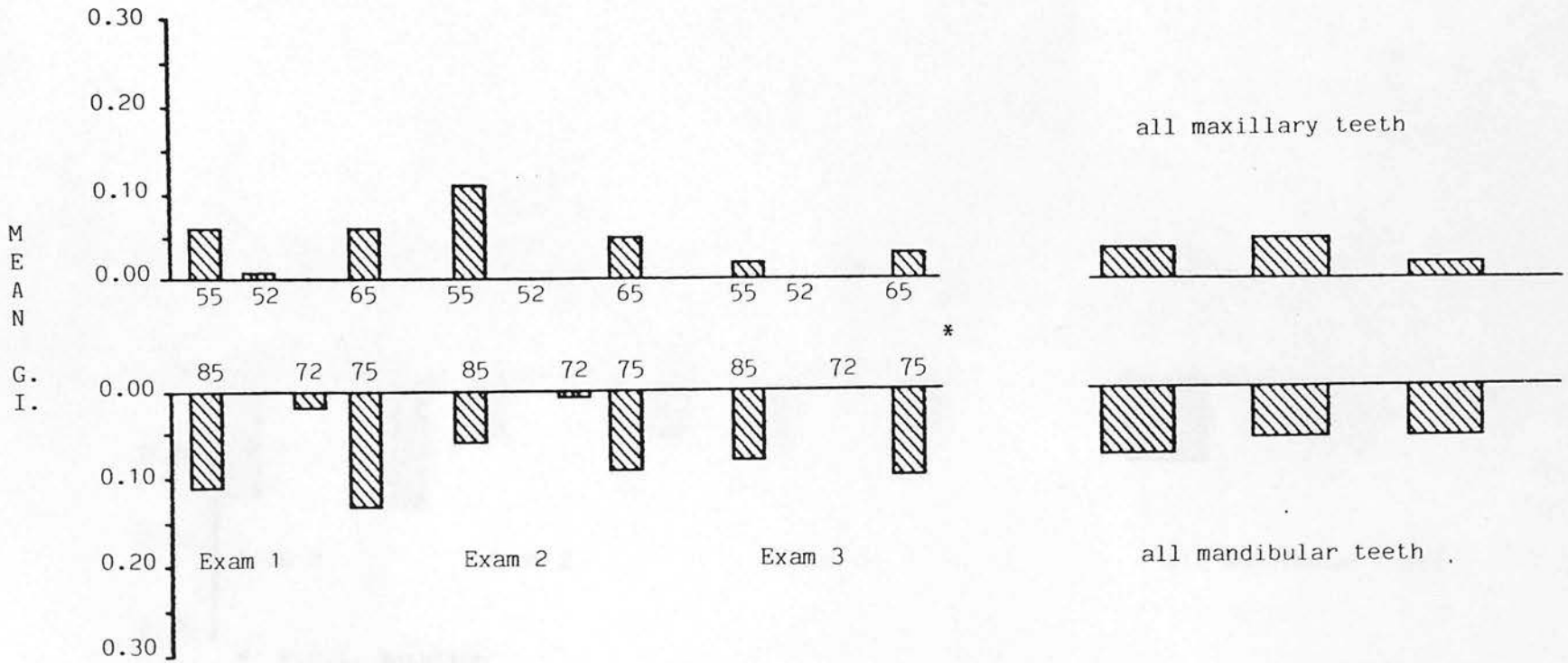
Tooth	Group	Examination number	Mean tooth Score	s.e.	t	sig
All lower	Control	1	0.13	0.02	0.00	n.s.
		2	0.13	0.02		
		2	0.13	0.02	2.73	p<0.01
		3	0.08	0.02		
	Brushing	1	0.08	0.02	1.67	n.s.
		2	0.06	0.02		
		2	0.06	0.01	0.23	n.s.
		3	0.06	0.01		
	Brushing & visits	1	0.10	0.02	2.54	p<0.05
		2	0.05	0.01		
		2	0.05	0.01	0.00	n.s.
		3	0.05	0.01		
	Visits	1	0.12	0.03	2.90	p<0.01
		2	0.04	0.01		
		2	0.04	0.01	0.99	n.s.
		3	0.03	0.01		

Figure 30. CONTROL GROUP - Mean G.I. scores per tooth



* F.D.I. Notation

Figure 31. BRUSHING GROUP - Mean G.I. scores per tooth



* F.D.I. Notation

Figure 32. BRUSHING & HOME VISITS GROUP - Mean G.I. scores per tooth

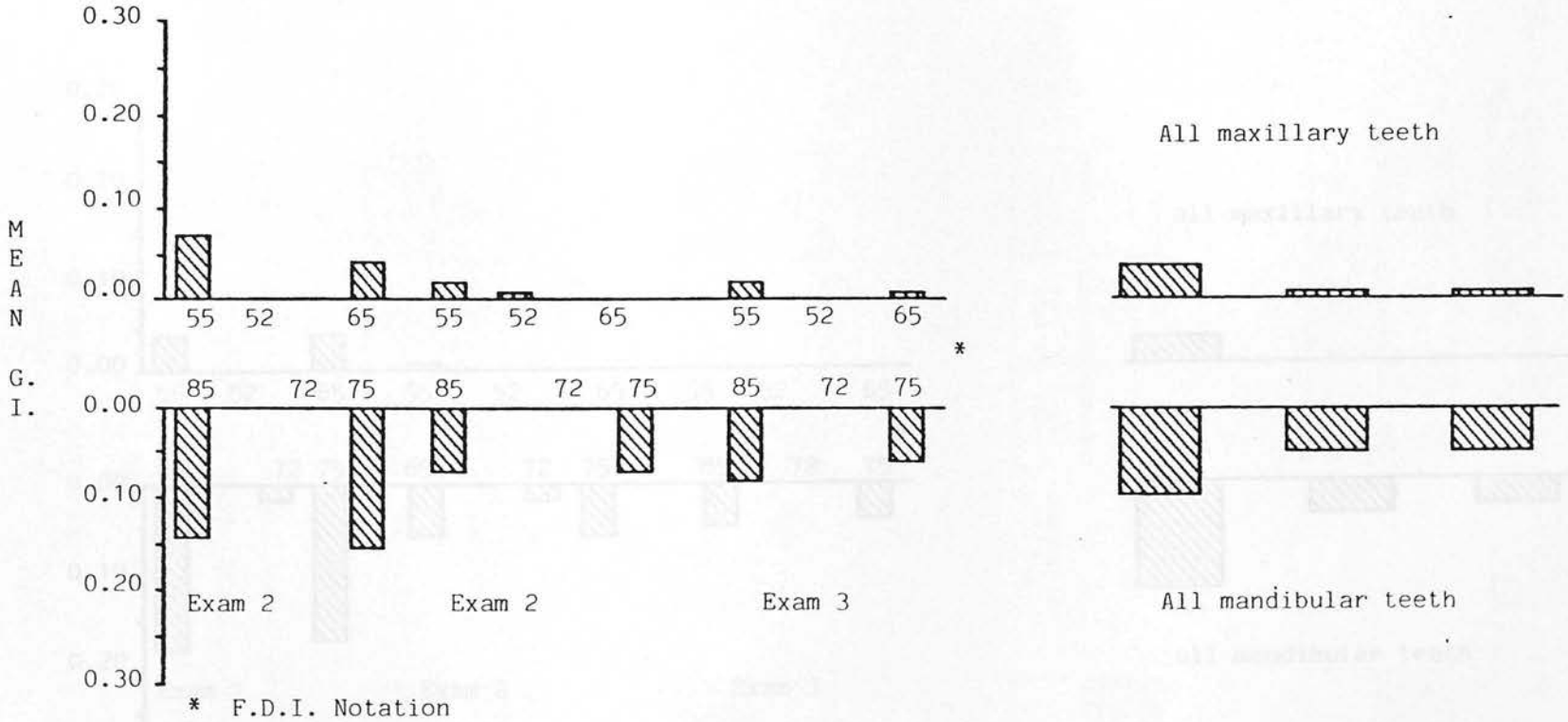


Figure 33. HOME VISITS GROUP - Mean G.I. scores per tooth

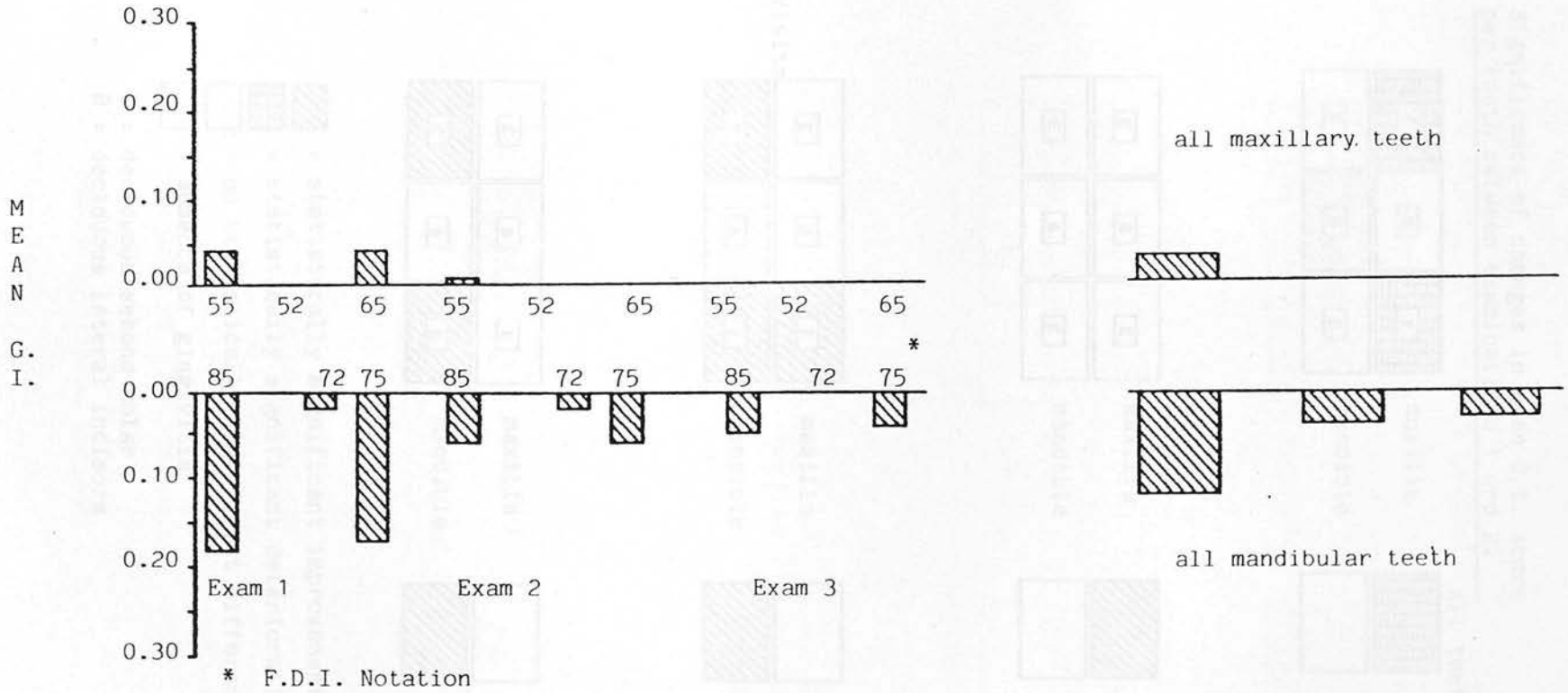


Figure 34. Significance of changes in mean G.I. score per tooth between examinations 1 and 2.

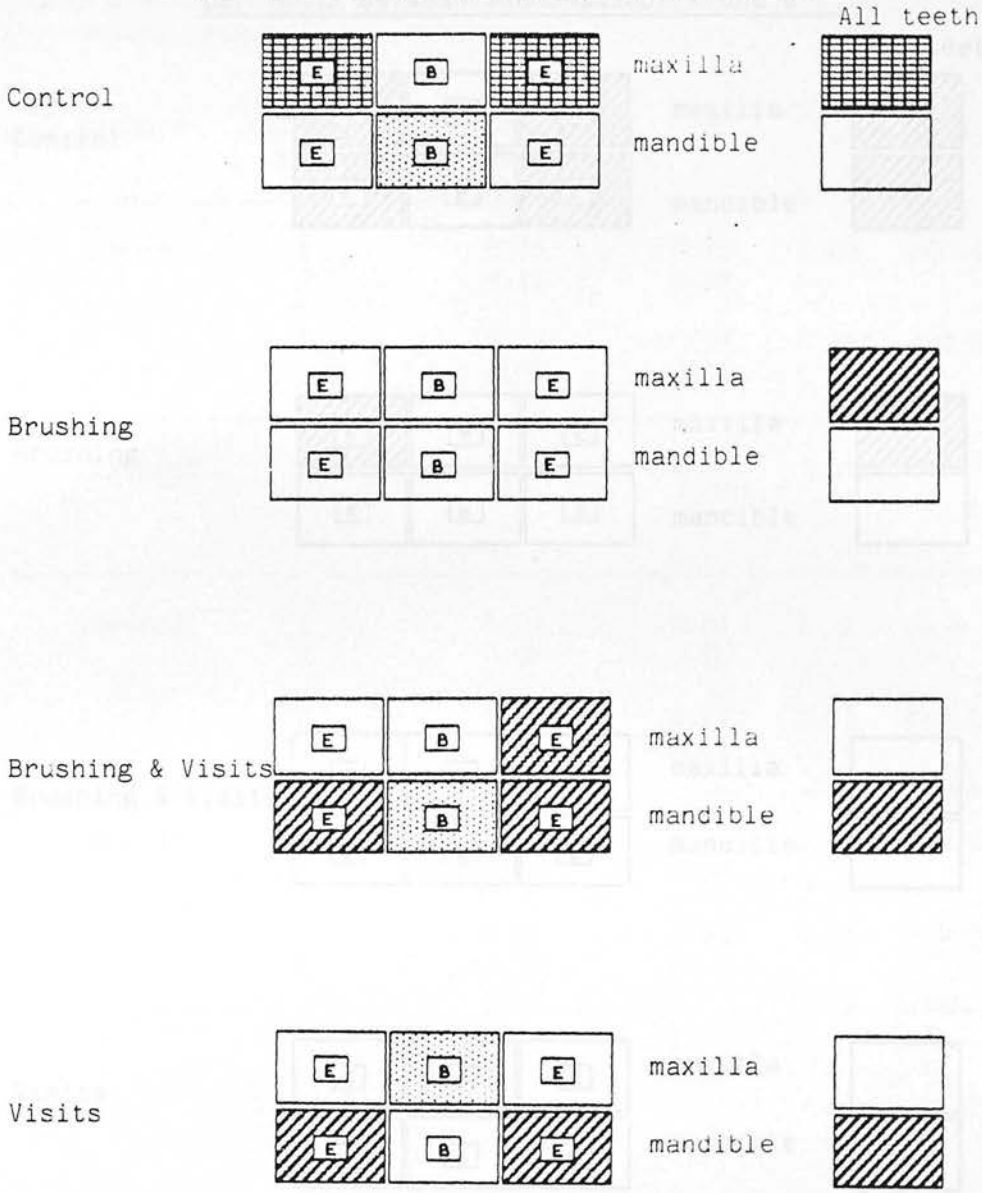


Figure 35. Significance of changes in mean G.I. score per tooth between examinations 2 and 3

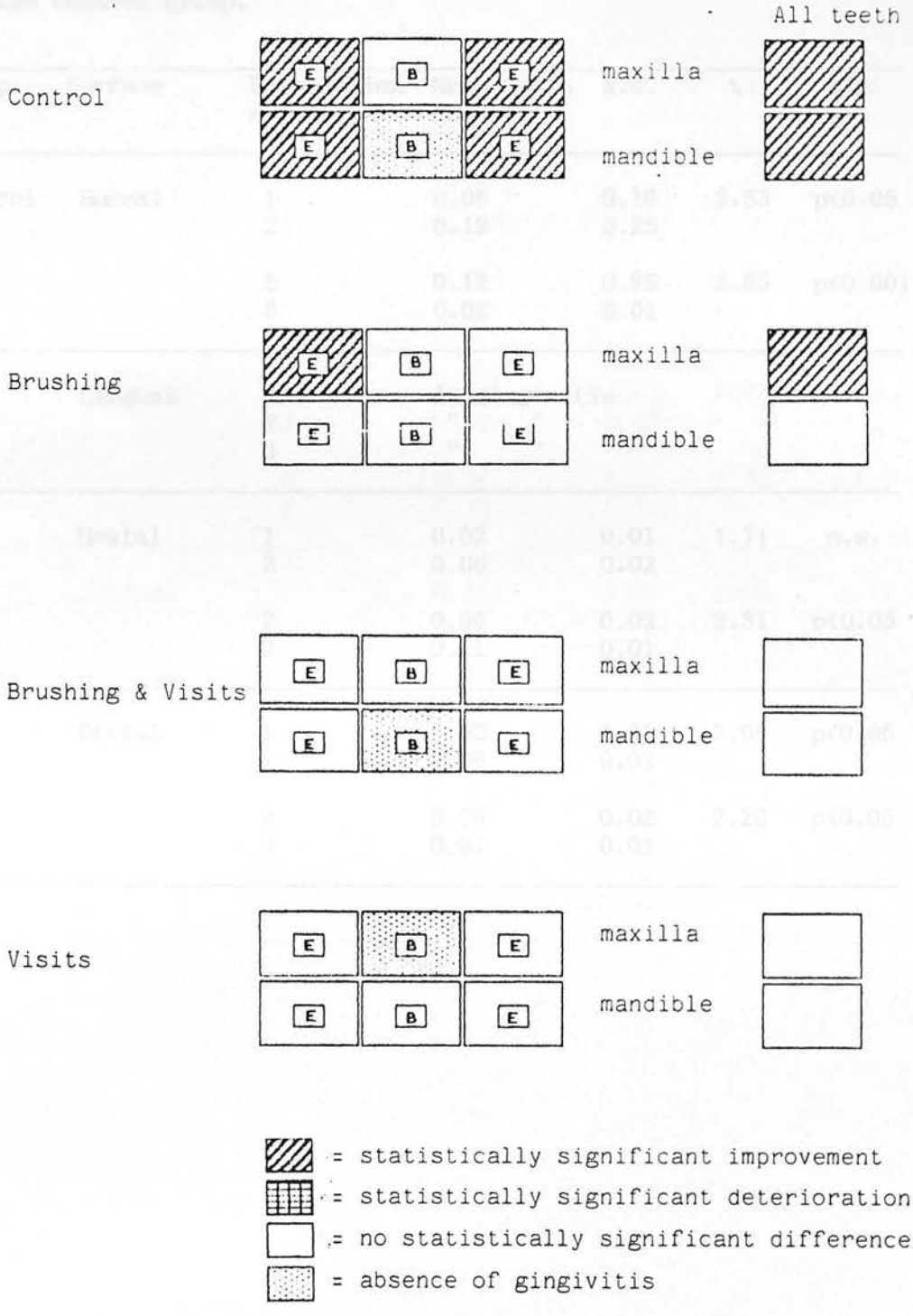


Table 56

A comparison of the mean Gingival Index (G.I.) scores in relation to individual maxillary tooth surfaces between each examination for the control group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig
Control	Buccal	1	0.05	0.16	2.53	p<0.05
		2	0.12	0.25		
		2	0.12	0.25	3.85	p<0.001
		3	0.02	0.01		
	Lingual	1	no gingivitis			
		2	" "			
		3	" "			
	Mesial	1	0.02	0.01	1.71	n.s.
		2	0.06	0.02		
		2	0.06	0.02	2.31	p<0.05
		3	0.11	0.01		
	Distal	1	0.02	0.01	2.05	p<0.05
		2	0.06	0.02		
		2	0.06	0.02	2.26	p<0.05
		3	0.01	0.01		

Table 57

A comparison of the mean Gingival Index (G.I.) scores in relation to individual mandibular tooth surfaces between each examination for the control group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig
Control	Buccal	1	0.00	0.00	1.00	n.s.
		2	0.003	0.003		
		2	0.003	0.003	1.14	n.s.
		3	0.01	0.01		
	Lingual	1	0.25	0.03	0.16	n.s.
		2	0.24	0.03		
		2	0.24	0.03	2.53	$p<0.05$
		3	0.16	0.03		
	Mesial	1	0.13	0.02	0.00	n.s.
		2	0.13	0.02		
		2	0.13	0.02	2.37	$p<0.05$
		3	0.07	0.02		
	Distal	1	0.13	0.02	0.11	n.s.
		2	0.13	0.02		
		2	0.13	0.02	2.59	$p<0.05$
		3	0.06	0.02		

Table 58

A comparison of the mean Gingival Index (G.I.) scores in relation to individual maxillary tooth surfaces between each examination for the brushing group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig
Brushing	Buccal	1	0.07	0.02	0.74	n.s.
		2	0.09	0.02		
		2	0.09	0.02	3.33	p<0.01
		3	0.02	0.01		
	Lingual	1	0.01	0.01	1.35	n.s.
		2	0.00	0.00		
		2	0.00	0.00	1.00	n.s.
		3	0.004	0.004		
	Mesial	1	0.04	0.01	0.90	n.s.
		2	0.06	0.02		
		2	0.06	0.02	2.38	p<0.05
		3	0.02	0.01		
	Distal	1	0.05	0.02	1.03	n.s.
		2	0.07	0.02		
		2	0.07	0.02	2.64	p<0.01
		3	0.02	0.01		

Table 59

A comparison of the mean Gingival Index (G.I.) scores in relation to individual mandibular tooth surfaces between each examination for the brushing group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig.
Brushing	Buccal	1	0.02	0.01	1.35	n.s.
		2	0.01	0.005		
		2	0.01	0.005	0.58	n.s.
		3	0.004	0.004		
	Lingual	1	0.17	0.03	1.10	n.s.
		2	0.13	0.03		
		2	0.13	0.03	1.31	n.s.
		3	0.18	0.03		
	Mesial	1	0.08	0.02	1.42	n.s.
		2	0.05	0.02		
		2	0.05	0.02	1.52	n.s.
		3	0.03	0.01		
	Distal	1	0.08	0.02	1.45	n.s.
		2	0.04	0.02		
		2	0.04	0.02	1.27	n.s.
		3	0.03	0.01		

Table 60

A comparison of the mean Gingival Index (G.I.) scores in relation to individual maxillary tooth surfaces between each examination for the brushing and visits group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig.
Brushing & visits	Buccal	1	0.10	0.03	2.50	p<0.05
		2	0.02	0.01		
		2	0.02	0.01	0.69	n.s.
		3	0.04	0.02		
	Lingual	1	no gingivitis			
		2	" "			
		3	" "			
	Mesial	1	0.02	0.01	0.90	n.s.
		2	0.01	0.01		
		2	0.01	0.01	1.42	n.s.
		3	0.00	0.00		
	Distal	1	0.03	0.02	1.00	n.s.
		2	0.01	0.01		
		2	0.01	0.01	1.42	n.s.
		3	0.00	0.00		

Table 61

A comparison of the mean Gingival Index (G.I.) scores in relation to individual mandibular tooth surfaces between each examination for the brushing & visits group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig.
Brushing & visits	Buccal	1	0.005	0.005	1.00	n.s.
		2	0.000	0.000		
		2	0.00	0.00	1.35	n.s.
		3	0.01	0.01		
	Lingual	1	0.17	0.03	0.38	n.s.
		2	0.15	0.03		
		2	0.15	0.03	1.04	n.s.
		3	0.12	0.03		
	Mesial	1	0.12	0.03	3.12	$p<0.01$
		2	0.02	0.01		
		2	0.02	0.01	0.47	n.s.
		3	0.03	0.01		
	Distal	1	0.11	0.03	3.13	$p<0.01$
		2	0.02	0.01		
		2	0.02	0.01	0.47	n.s.
		3	0.03	0.01		

Table 62

A comparison of the mean Gingival Index (G.I.) scores in relation to individual maxillary tooth surfaces between each examination for the visits group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig.
Visits	Buccal	1	0.04	0.02	1.47	n.s.
		2	0.01	0.01		
		2	0.01	0.01	0.81	n.s.
		3	0.004	0.004		
	Lingual	1	0.01	0.01	1.35	n.s.
		2	0.00	0.00		
		2	0.00	0.00		
		3	0.00	0.00		
	Mesial	1	0.03	0.01	1.76	n.s.
		2	0.00	0.00		
		2	0.00	0.00		
		3	0.00	0.00		
	Distal	1	0.03	0.01	1.76	n.s.
		2	0.00	0.00		
		2	0.00	0.00	1.00	n.s.
		3	0.004	0.004		

Table 63

A comparison of the mean Gingival Index (G.I.) scores in relation to individual mandibular tooth surfaces between each examination for the visits group.

Group	Surface	Examination number	Mean tooth Score	s.e.	t	sig.
Visits	Buccal	1	0.02	0.01	1.27	n.s.
		2	0.004	0.004		
		2	0.004	0.004	1.00	n.s.
		3	0.00	0.00		
	Lingual	1	0.19	0.04	1.34	n.s.
		2	0.14	0.03		
		2	0.14	0.03	0.96	n.s.
		3	0.10	0.03		
	Mesial	1	0.14	0.03	3.60	$p<0.001$
		2	0.02	0.01		
		2	0.02	0.01	0.70	n.s.
		3	0.01	0.01		
	Distal	1	0.13	0.03	3.48	$p<0.001$
		2	0.02	0.01		
		2	0.02	0.01	0.33	n.s.
		3	0.01	0.01		

Figure 36. CONTROL GROUP - Mean G.I. surface scores

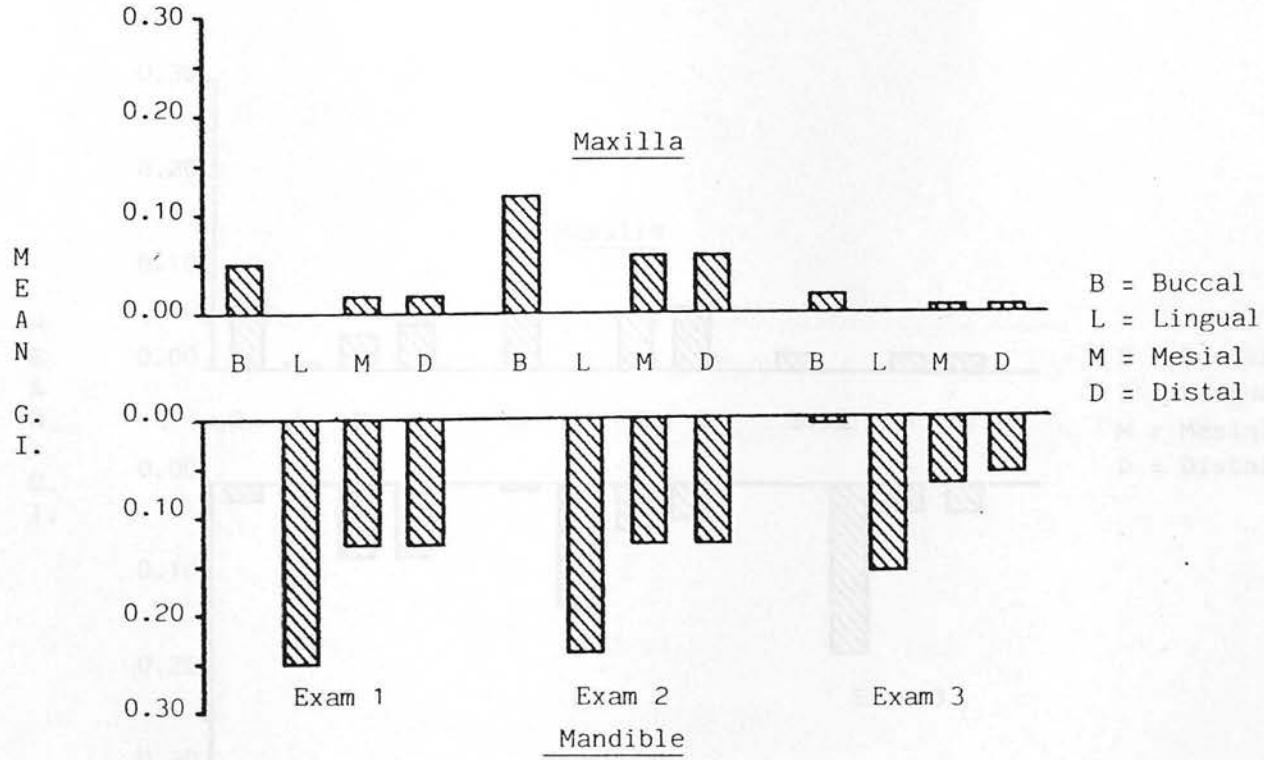


Figure 37. BRUSHING GROUP - Mean G.I. surface scores

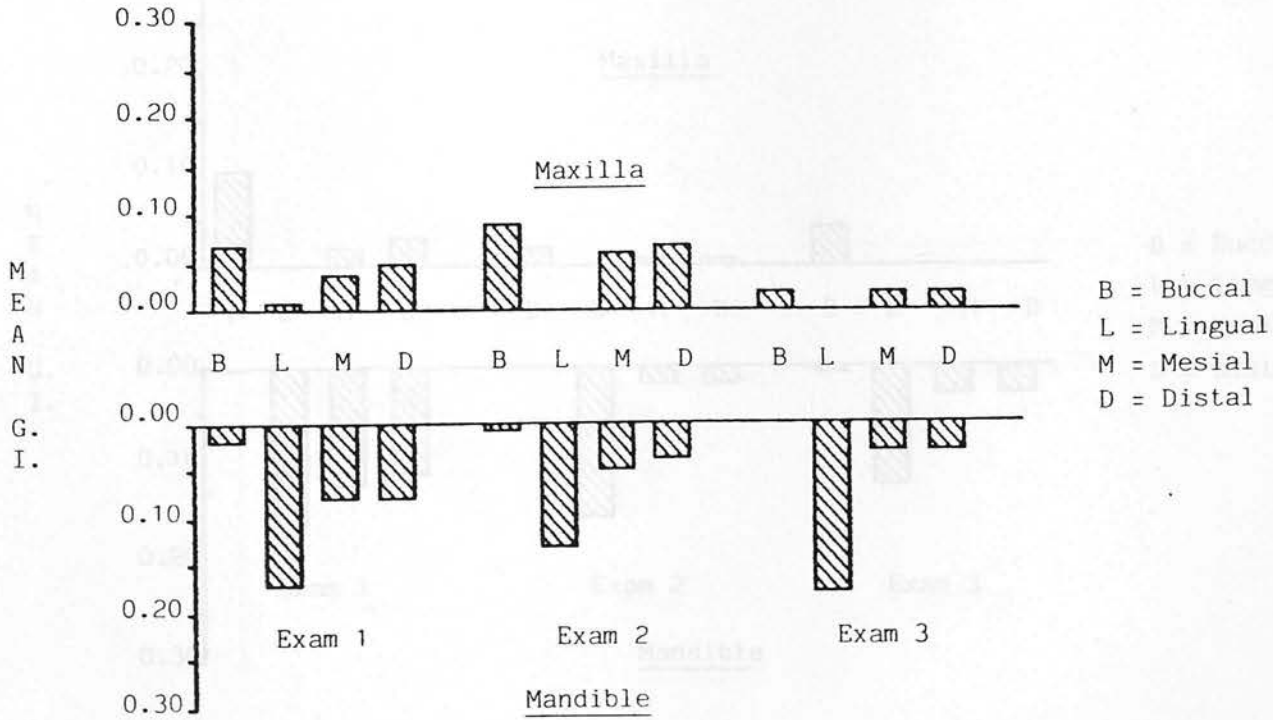


Figure 38. BRUSHING & HOME VISITS GROUP. Mean G.I. surface scores

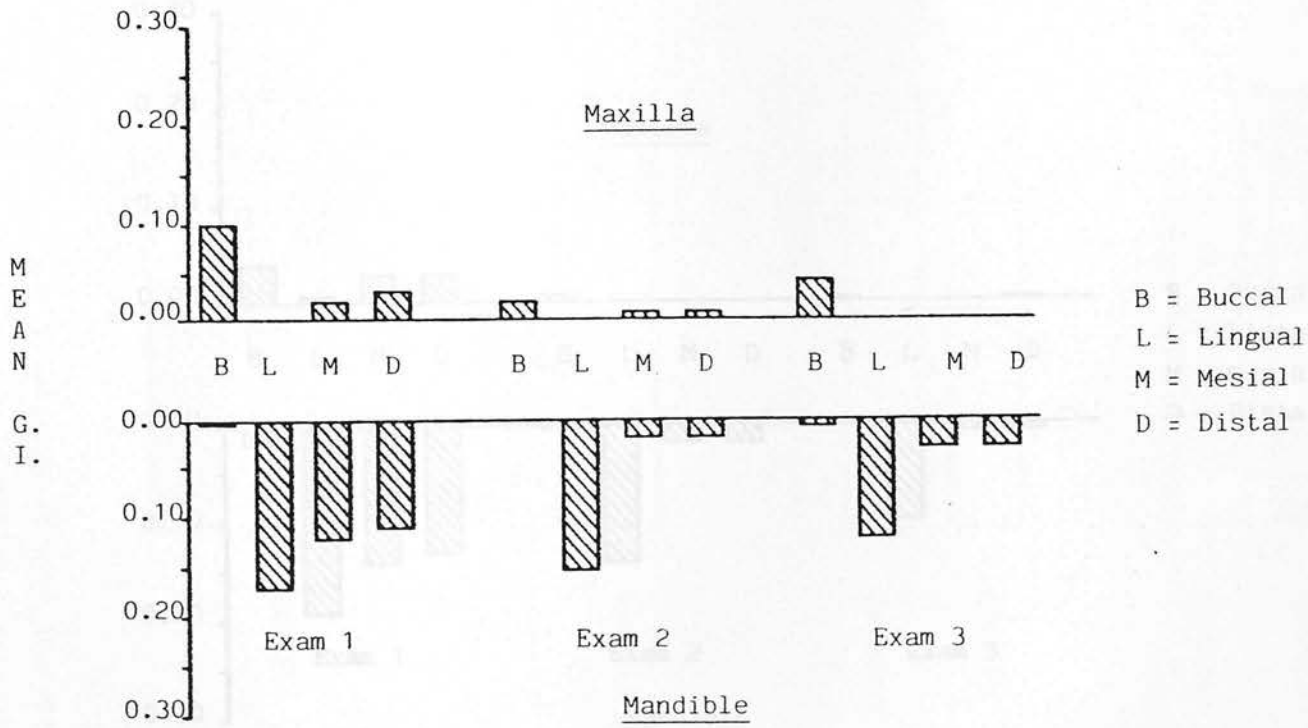


Figure 39. HOME VISITS GROUP - Mean G.I. surface scores

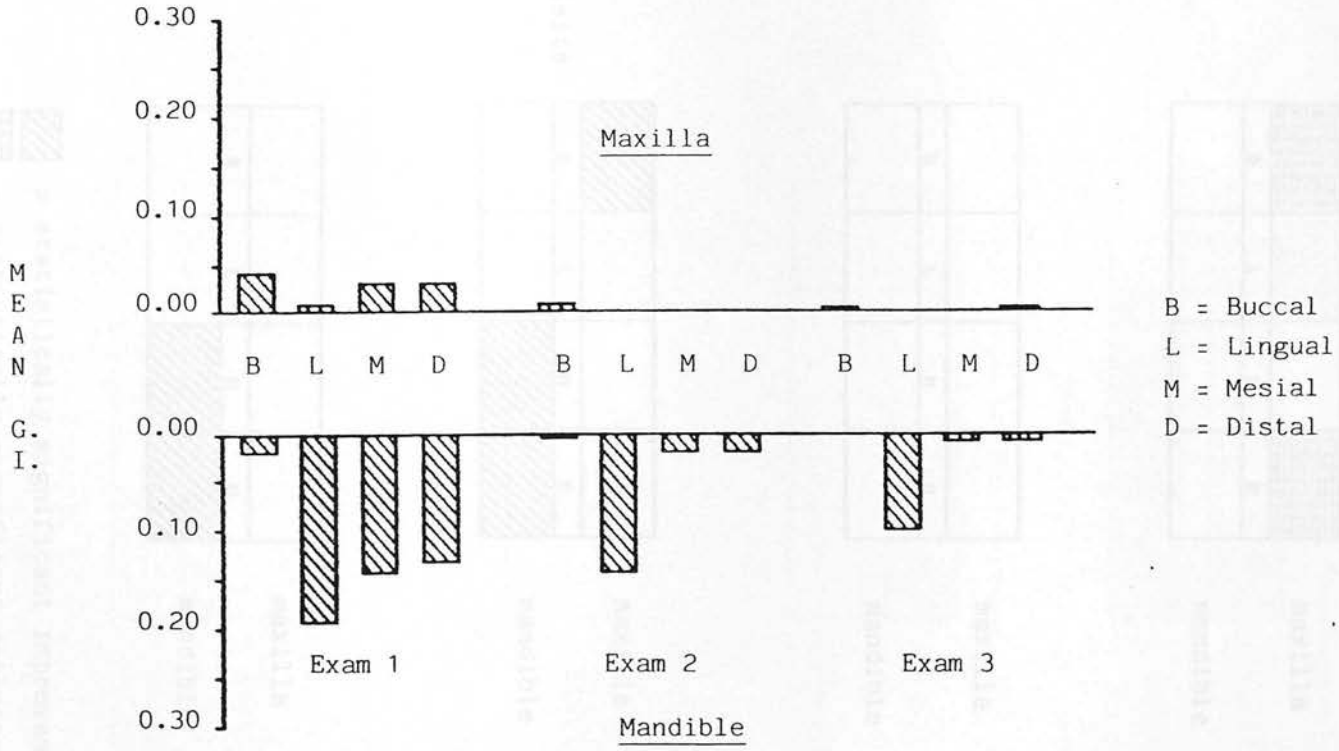


Figure 40. Signficance of changes in mean G.I. surface scores between examinations 1 and 2

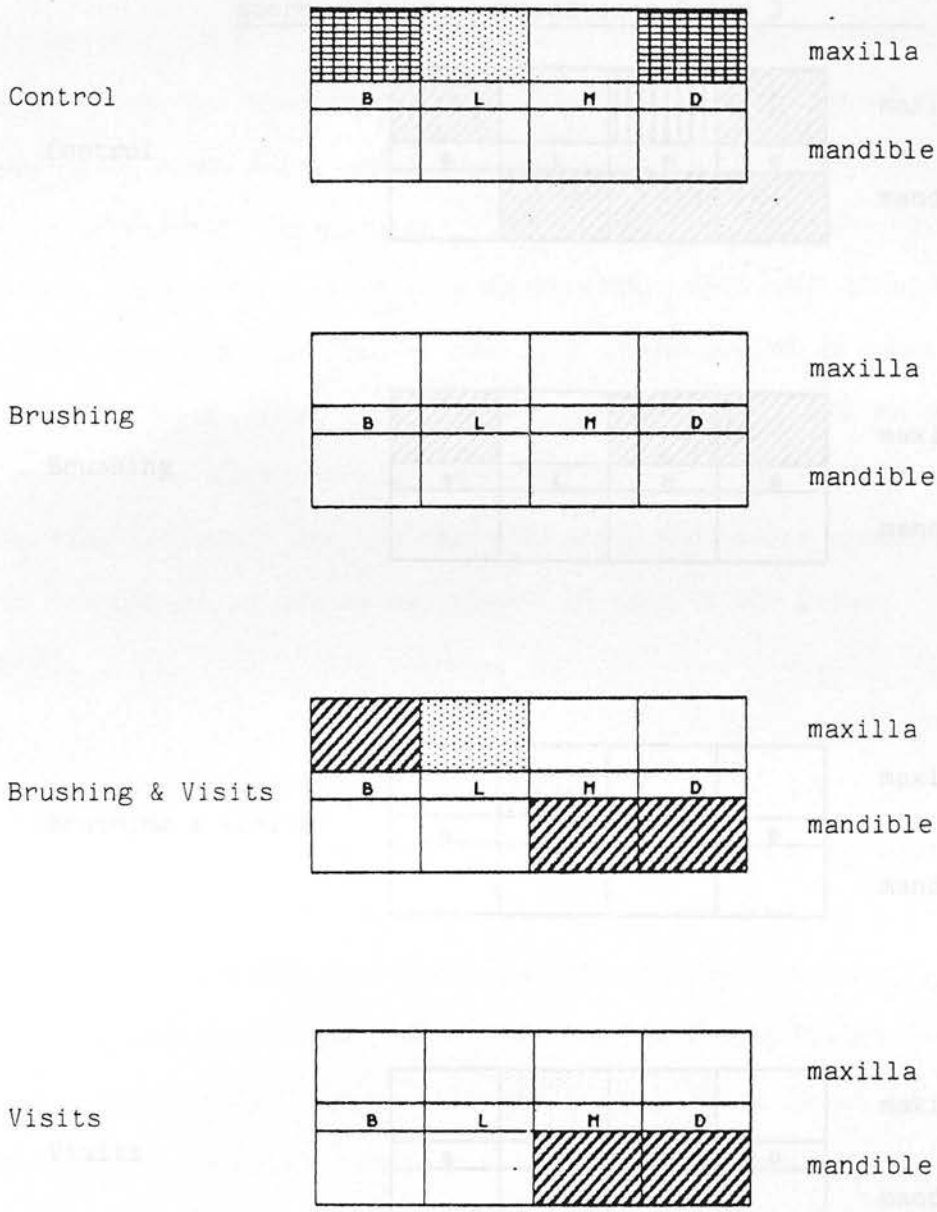
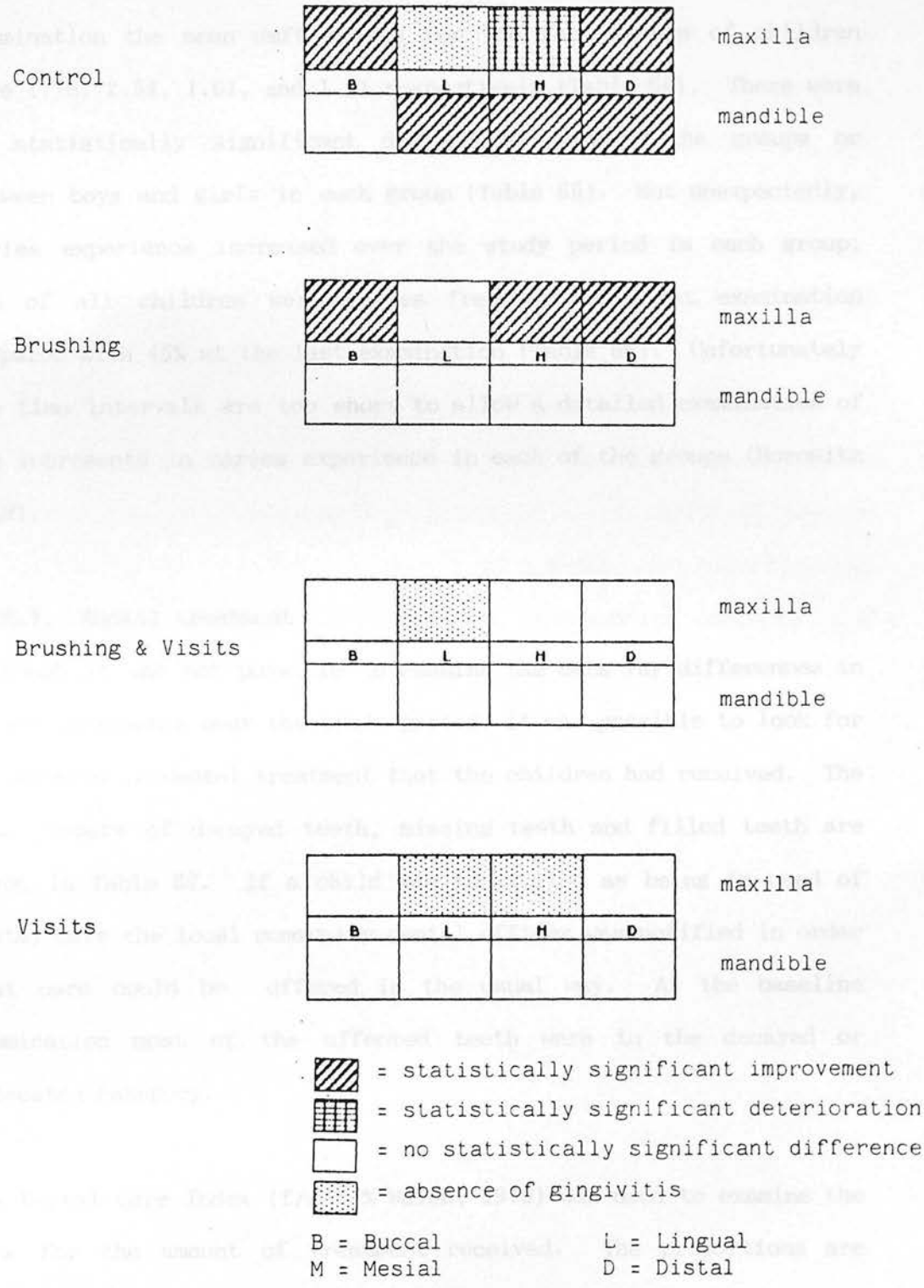


Figure 41. Significance of changes in mean G.I. surface scores between examinations 2 and 3



5.12. DENTAL CARIES

Children in groups 2 and 3 brushed their teeth daily at school for approximately 5 months using a fluoride toothpaste. At the baseline examination the mean dmft values for the four groups of children were 1.75, 2.54, 1.61, and 1.61 respectively (Table 64). There were no statistically significant differences between the groups or between boys and girls in each group (Table 65). Not unexpectedly, caries experience increased over the study period in each group; 60% of all children were caries free at the first examination compared with 45% at the last examination (Table 66). Unfortunately the time intervals are too short to allow a detailed examination of the increments in caries experience in each of the groups (Horowitz 1968).

5.12.1. Dental treatment

Although it was not possible to examine the data for differences in caries increments over the study period, it was possible to look for differences in dental treatment that the children had received. The mean numbers of decayed teeth, missing teeth and filled teeth are given in Table 67. If a child was identified as being in need of dental care the local community dental officer was notified in order that care could be offered in the usual way. At the baseline examination most of the affected teeth were in the decayed or untreated category.

The Dental Care Index (f/dmf % Walsh, 1970) was used to examine the data for the amount of treatment received. The proportions are

given in Table 68. Both the control group and experimental groups showed evidence of an uptake of dental care between the baseline and final examination. There was a trend towards a greater uptake of dental treatment in the combined experimental groups than in the control group, but the difference did not reach statistical significance (Table 69). A statistically significant difference was observed in the care index of the experimental groups between the first and final examinations (Table 70) but this was of little clinical significance. This is illustrated in the Pie Charts, Figures 42,43 and 44. At the final examination decayed untreated teeth still predominated.

Extracted teeth are also an indication of having received dental treatment and the mean number of extracted teeth increased between the baseline and the final examination. There were significantly more extracted teeth in group 2 at every examination compared with the control group but not at any examination in groups 3 and 4.

Table 64

Mean dmft values and standard error of the mean for each group at each examination.

Group	Number	dmft Baseline Examination Mean	s.e.	Second Examination Mean	s.e.	Third Examination Mean	s.e.
1	112	1.75	(0.29)	2.49	(0.34)	2.84	(0.35)
2	89	2.54	(0.41)	3.17	(0.43)	3.47	(0.45)
3	71	1.61	(0.21)	2.48	(0.42)	2.79	(0.44)
4	77	1.61	(0.36)	1.89	(0.04)	2.08	(0.39)

Table 65

Mean dmft values and standard error of the mean for boys and girls at each examination.

Group	Sex	Number	mean dmft Baseline Examination Mean	s.e.	Second Examination Mean	s.e.	Third Examination mean	s.e.
Control								
	boys	48	2.25	(0.52)	3.23	(0.61)	3.54	(0.66)
	girls	64	1.37	(0.31)	1.94	(0.38)	2.31	(0.37)
Brushing								
	boys	40	2.90	(0.62)	3.70	(0.65)	4.17	(0.69)
	girls	49	2.24	(0.54)	2.73	(0.58)	2.89	(0.57)
Brushing and Home visits								
	boys	35	1.37	(0.55)	2.37	(0.63)	2.74	(0.69)
	girls	36	1.83	(0.54)	2.58	(0.57)	2.83	(0.58)
Home visits								
	boys	36	1.97	(0.60)	2.17	(0.58)	2.25	(0.56)
	girls	41	1.29	(0.44)	1.66	(0.53)	1.83	(0.54)

Table 66

Numbers and proportions of children caries free (dmft = 0) for each group at each examination.

Examination	Group	Number in group	Caries free Number	%	Total %
Baseline	Control	112	66	60	
	Brushing	89	43	48	
	Brushing + visits	71	45	63	
	Visits	77	54	70	60
Second	Control	112	57	51	
	Brushing	89	35	39	
	Brushing + visits	71	35	49	
	Visits	77	47	61	50
Third	Control	112	46	41	
	Brushing	89	34	38	
	Brushing + visits	71	33	46	
	Visits	77	43	56	45

Table 67

Mean numbers of decayed, missing and filled teeth for each group at each examination.

Group	Examination								
	Baseline			Second			Third		
	d	m	f	d	m	f	d	m	f
Control	1.45	0.15	0.15	1.90	0.31	0.28	1.96	0.50	0.37
Brushing	1.88	0.49	0.17	1.88	0.80	0.54	1.90	1.04	0.59
Brushing + Home visits	1.31	0.17	0.13	1.88	0.27	0.32	2.00	0.42	0.37
Home visits	1.32	0.13	0.16	1.05	0.40	0.44	1.12	0.48	0.48

Table 68

Care Index (CI%) for each group at each examination.

Group	Numbers	CI% baseline exam. %	second exam. %	third exam. %
Control	112	8.6	11.2	13.0
Brushing	89	6.6	17.0	17.0
Brushing + home visits	71	8.1	12.9	13.3
Home visits	77	9.9	23.2	24.0

Care Index = ft/dmft%

Table 69

The Care Index (ft/dmft %) in the control group and combined experimental groups at the baseline and final examination

Examination	Number of Children	Group	Care Index %
Baseline	112	Control	8.6
	237	All experimental	7.7
Final	112	Control	13.0
	237	All experimental	17.4

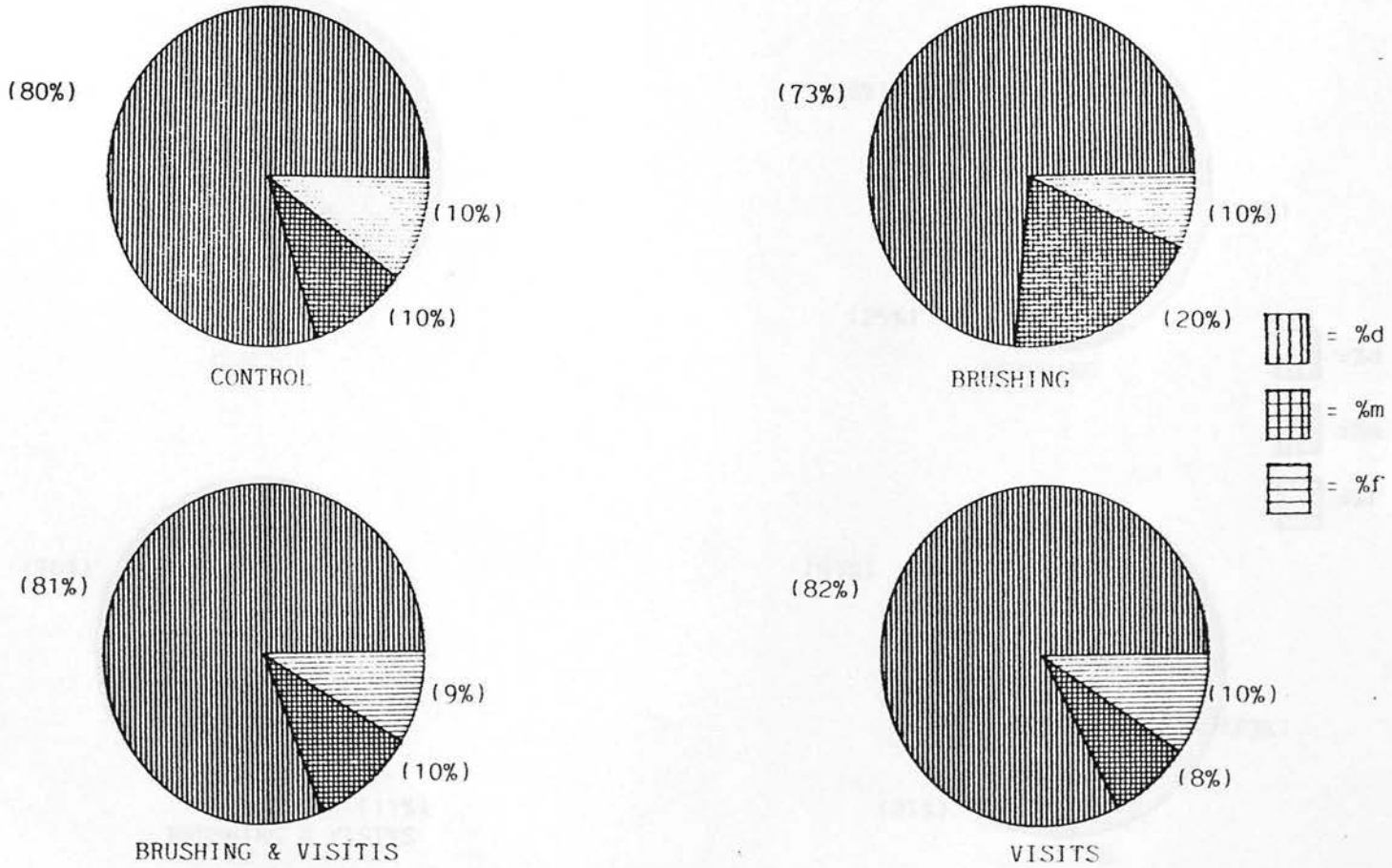
Table 70

Care Index of the control group and all experimental groups - a. comparison between the baseline and final examination

Examination	Number	Group	Filled teeth	Decayed and missing teeth
Baseline	112	(a) Control	17	179
	237	(b) All experimental	37	429
Final	112	(c) Control	42	276
	237	(d) All experimental	116	557

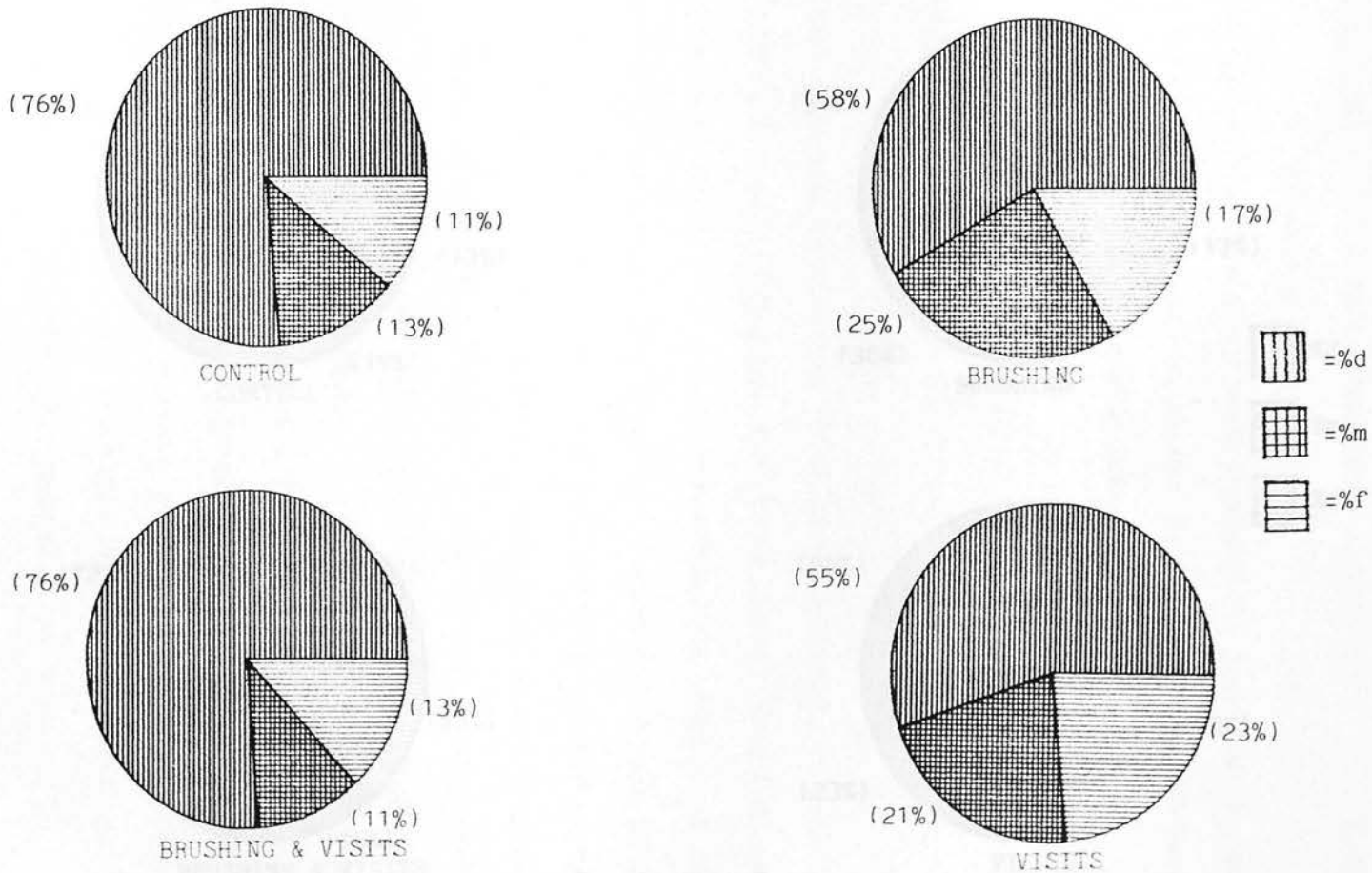
a. versus b. $(chi)^2 = 0.10$ n.s.
a. versus c. $(chi)^2 = 2.61$ n.s.
b. versus d. $(chi)^2 = 20.46$ $p<0.001$

Figure 42. The distribution of decayed, missing and filled teeth at the baseline examination



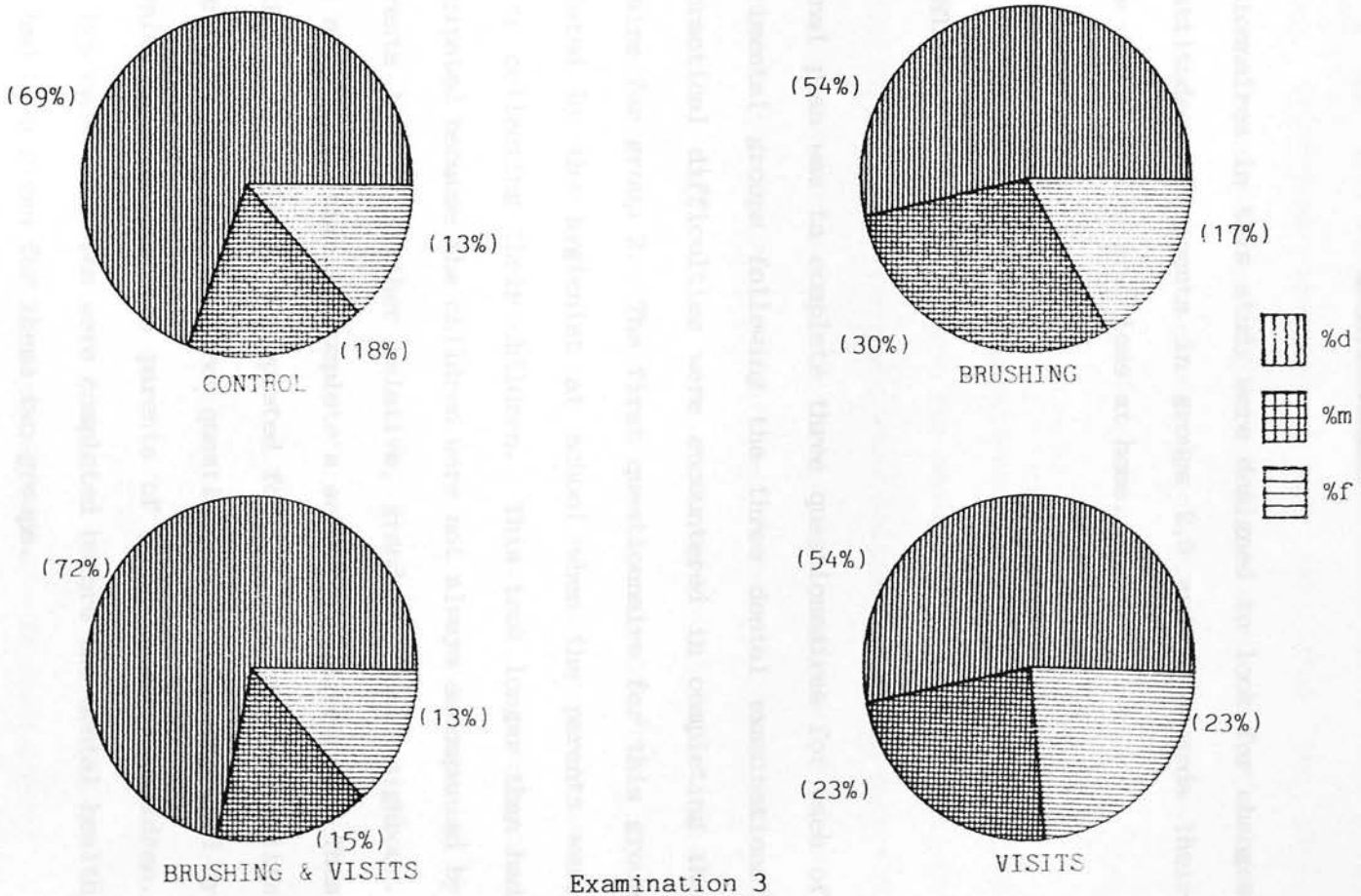
Examination 1

Figure 43. The distribution of decayed, missing and filled teeth at the second examination



Examination 2

Figure 44. The distribution of decayed, missing and filled teeth at the final examination



Examination 3

CHAPTER 6

QUESTIONNAIRES

The questionnaires in this study were designed to look for changes in the attitudes of parents in groups 2,3 and 4 towards their children's dental health practices at home.

6.1. METHOD

The original plan was to complete three questionnaires for each of the experimental groups following the three dental examinations. However practical difficulties were encountered in completing the questionnaire for group 2. The first questionnaire for this group was completed by the hygienist at school when the parents were bringing or collecting their children. This took longer than had been anticipated because the children were not always accompanied by their parents but by another relative, grandparent or neighbour. There was not enough time to complete a second questionnaire. Thus two questionnaires only were completed for group 2, at the baseline and at the final examination. Three questionnaires were completed by the hygienist at home for the parents of group 3 and 4 children. The first two questionnaires were completed before the dental health education had been given for these two groups.

6.2. RESULTS

6.2.1. Numbers of questionnaires completed

A total of 293 questionnaires were completed after the first examination, 180 after the second and 206 after the final examination. The numbers of children seen at each examination and the numbers and proportions for whom a questionnaire was completed in each group are given in Table 71.

The relatively small number of questionnaires completed in group 2 at the last examination reflects the small number of children who had remained at nursery after the summer holiday. By then over 60% of the original group had moved to a large number of different primary schools and it was not practical to contact the parents of these children to complete the last questionnaire at home. In any case the circumstances would not have been comparable to the situation at the beginning of the trial. Finally no arrangements had been made, when the trial was being organised, to visit these parents at home.

Data for all questionnaires completed in each study group is presented including those children for whom it was not possible to complete the related dental examination.

6.2.2. Toothbrushing practices at home

At the beginning and end of the study all parents in each group claimed that their children were brushing their teeth at home. (Only one child at the second questionnaire in group 2 claimed not

Table 71

Numbers of children seen at each examination and the numbers and proportions for whom a questionnaire was completed.

Group	Examination 1			Examination 2			Examination 3		
	No. examined	No. completed questionnaire	(%)	No. examined	No. completed questionnaire	%	No. examined	No. completed questionnaire	(%)
control	145	-	-	133	-	-	117	-	-
brushing	134	110	(81)	102	-	-	99	34	(35)
brushing and visits	130	88	(68)	107	87	(81)	104	85	(82)
visits	149	95	(64)	120	93	(77)	115	87	(76)

to be brushing at home.) For all of the children in this part of the study the most popular toothbrushing times were after breakfast and before going to bed (Table 72).

Twenty parents at the first questionnaire, 11 parents at the second questionnaire and 10 parents at the last questionnaire claimed that their children brushed their teeth more than three times a day. To simplify presentation these responses have been included in the "three times daily" brushing group. Similarly, 18 parents at questionnaire 1, and 2 parents at questionnaires 2 and 3 claimed that their children brushed less than once a day and these were included in the "once a day" brushing group.

In the first questionnaire 55% of parents in group 2 said their children brushed their teeth three times a day or more, 35% said twice a day and 9% once a day. By the second questionnaire only 9% claimed to brush three times a day or more, 62% twice a day, and 29% once a day. These changes in toothbrushing frequency were statistically significant (Table 73).

Stated frequency of toothbrushing in groups 3 and 4 were similar in both sets of questionnaires with over 40% of children brushing their teeth twice a day on all occasions. There was a slight shift to less children brushing three times a day or more, and fewer children brushing once a day or less. These changes in toothbrushing frequency were statistically significant in group 4, the home visits group, but not in group 3.

Table 72

When does your child brush his/her teeth?

	brushing				brushing and visits						visits					
	Q1 n=110		Q2 n=34		Q1 n=88		Q2 n=87		Q3 n=85		Q1 n=95		Q2 n=97		Q3 n=87	
Time of brushing	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
before breakfast	4	(4)	-	-	5	(6)	3	(3)	-	-	7	(7)	9	(9)	1	(1)
after breakfast	84	(76)	27	(79)	55	(62)	65	(75)	69	(81)	66	(69)	68	(70)	74	(85)
midday	85	(77)	3	(9)	21	(24)	22	(25)	17	(20)	18	(19)	20	(21)	19	(22)
after evening meal	8	(7)	2	(6)	12	(14)	10	(11)	4	(5)	12	(13)	16	(16)	9	(10)
before bed	98	(89)	29	(81)	83	(94)	75	(86)	80	(94)	79	(83)	75	(77)	84	(96)
other	1	(0.9)	-	-	7	(8)	6	(7)	3	(3)	4	(4)	9	(9)	-	-

Table 73

How often does your child brush his/her teeth

	brushing				brushing and visits						visits					
	Q1 n=110		Q2 n=34		Q1 n=88		Q2 n=87		Q3 n=85		Q1 n=95		Q2 n=97		Q3 n=87	
brushing frequency	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
>3 times/day) 3 times/day)	61	(55)	3	(9)	19	(21)	18	(21)	14	(16)	20	(21)	18	(18)	18	(21)
2 times/day	39	(35)	21	(62)	44	(50)	47	(54)	54	(63)	42	(44)	52	(54)	59	(68)
1 time/day) <1 time/day)	10	(9)	10	(29)	25	(28)	22	(25)	16	(19)	33	(35)	22	(23)	10	(11)

Group 2 - brushing	$(chi)^2 = 24.74$	$p<0.001$
Group 3 - brushing + visits	$(chi)^2 = 3.85$	n.s.
Group 4 - visits	$(chi)^2 = 14.94$	$p<0.01$

The parents of children in the study groups were asked if they had ever been given advice on how to care for their child's teeth. 58% of parents in group 2, 47% in group 3 and 53% in group 4 said that they had been given some advice. In over 70% of cases this advice had been given by a dentist (Table 74).

6.2.3. Effect of the dental health education programme on the parents.

The effect of the dental health programme on the parents was measured by looking at parental involvement with toothbrushing at home. There were however some problems associated with group 2 - the brushing only group. Because of the difficulties mentioned earlier only two questionnaires were completed for this group, one at the beginning and one at the end of the study. Thus, from the point of view of timing, questionnaire number 2 in the brushing group is equivalent to questionnaire 3 in the other two experimental groups. The only comparison that can therefore be made for group 2 is between questionnaires 1 and 3 in this part of the analysis.

A second problem was that by the last questionnaire there had been considerable losses of the participants in group 2, largely because the majority of the children had moved to primary school where it was not practical to contact their parents.

110 questionnaires were completed for group 2 at the beginning compared with only 31 at the end of the study. However, no statistically significant differences in the responses of the parents at the first questionniare were found between these 31

Table 74

Who gave professional advice (for those given advice) in groups 2,3 & 4.

	brushing		brushing & visits		visits		Total	
No. given advice	n=64 (58%)		n=41 (47%)		n=45 (53%)		n=150	
	n	%	n	%	n	%	n	%
dentist	52	(81)	35	(85)	32	(71)	119	(79)
doctor	-	-	2	(5)	-	-	2	(1)
health visitor	2	(3)	3	(7)	4	(9)	9	(6)
dental hygienist	29	(45)	2	(5)	5	(11)	36	(24)
other			4	(10)	15	(33)	19	(13)

parents and the 79 who were eventually lost from this part of the study.

The questionnaire data for group 2 parents presented below is only for the 31 parents who completed the first and last questionnaire. It was also not possible to interview a small number of parents in groups 3 and 4 (three and eight questionnaires respectively) but these were accepted as being too small to make any appreciable difference.

Group 2

At the first questionnaire 55% of parents in group 2 claimed that their children brushed their teeth by themselves compared with 74% at the second questionnaire (Table 75). This difference was not statistically significant. None of the parents in group 2 claimed to have changed from not helping to helping their children with toothbrushing. Indeed there was a trend towards leaving the children to brush their teeth by themselves.

Group 3

Only 39% of parents in group 3 claimed they helped with their children's toothbrushing at the first questionnaire. This increased significantly to 56% on the second occasion. There was also a slight increase to 59% at the third questionnaire which was not statistically significant, indicating that there was no relapse in parental involvement with toothbrushing during the summer holiday beween questionnaire 2 and 3.

Table 75

Who brushes your child's teeth?

	brushing				brushing and visits						visits					
	Q1		Q2		Q1		Q2		Q3		Q1		Q2		Q3	
	n = 31		n = 31		n = 88		n = 87		n = 85		n = 95		n = 93		n = 87	
Who brushes?	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Child	17	(55)	23	(74)	54	(61)	33	(38)	35	(41)	45	(47)	29	(31)	31	(36)
Parent) Parent and child) Other)	14	(45)	8	(26)	34	(39)	54	(56)	50	(59)	50	(53)	64	(69)	56	(64)

Q = Questionnaires

Group 2 - brushing group Q1 with Q2 $(chi)^2 = 2.54$ n.s.

Group 3 - brushing + visits Q1 with Q2 $(chi)^2 = 9.61$ $p<0.01$
Q2 with Q3 $(chi)^2 = 0.19$ n.s.

Group 4 - visits Q1 with Q2 $(chi)^2 = 5.16$ $p<0.05$
Q2 with Q3 $(chi)^2 = 0.40$ n.s.

Group 4

About half of group 4 parents (53%) were already helping their children with toothbrushing at the first questionnaire. This figure increased significantly to 69% at the second questionnaire and fell slightly to 64% at the last questionnaire - thus indicating a slight relapse during the summer holiday with fewer parents helping with toothbrushing than at the second questionnaire. These changes between questionnaire 2 and 3 however, were not statistically significant.

When the data for groups 3 and 4 was combined (Table 76) statistically significantly more parents were helping with toothbrushing at questionnaires two and three. There was no statistically significant relapse during the summer holiday.

6.2.4. Relating parents responses to the dental health of their children.

Young children cannot be expected to have the necessary skill and muscle co-ordination to carry out efficient toothbrushing. It is for this reason that parents are encouraged to assist with toothbrushing. It also impresses on the child the value the parent places on toothbrushing. It would be reasonable to expect different attitudes towards helping with toothbrushing to be reflected in the children's oral cleanliness and gingivitis, where the children who received help had the healthier mouths. If parents claim to change from allowing their children to brush alone to helping them with toothbrushing it is reasonable to look for improvements in the dental health of their children.

Table 76

Who brushes your child's teeth - combined data for groups 3 and 4

	Groups 3 and 4					
	Q1		Q2		Q3	
	n=183	%	n=180	%	n=172	%
child	99	(54)	62	(34)	66	(38)
parent						
parent + child	84	(46)	118	(65)	106	(62)
other						

Q = questionnaire

Q1 with Q2 $(chi)^2 = 14.02$ $p<0.001$
Q1 with Q3 $(chi)^2 = 8.81$ $p<0.01$
Q2 with Q3 $(chi)^2 = 0.59$ n.s.

None of the parents of the children in group 2 claimed at the last questionnaire to have changed their attitudes towards helping their children with toothbrushing but more importantly, all of these children were being helped at school. The results presented are therefore for the following subgroups of children from groups 3 and 4 only.

a. Children who brushed by themselves at each questionnaire
b. Children whose parents helped with toothbrushing at each questionnaire

All of these children had been examined at the relevant dental examinations. The numbers of children in these subgroups are given in Table 77. The results given are for school groups 3 and 4 combined.

a. Children who brushed by themselves at each questionnaire.

(Tables 78 and 79).

The oral hygiene of the 30 children who always brushed their teeth by themselves improved significantly by the second questionnaire. There was a small deterioration between the second and third questionnaire but the difference was not statistically significant. The mean P.I. scores were 2.20, 0.68 and 0.82 at the first, second and third questionnaires respectively. Similarly the number of children with good, fair and poor oral hygiene status improved significantly between questionnaire 1 and 2. Six children (20%) had good oral hygiene at questionnaire 1 compared with 21 children (70%) at questionnaire 2. The corresponding figures for poor oral hygiene

Table 77

Who brushed your child's teeth - the numbers of children and parents in each group at each questionnaire.

Subgroup	Who brushed child's teeth questionnaire 1	questionnaire 2	questionnaire 3	Group 3 n	Group 4 n	Total n
i.	child -	child -	child -	19	11	30
ii.	child & parent	child & parent	child & parent	24	29	53

Table 78

Oral hygiene of children who brushed their teeth by themselves at each questionnaire.

Who brushed child's teeth	Questionnaire No.				
	n = 30	MEAN P.I.			
		mean	s.e.	t.	sig.
child	1	2.20	0.33	4.65	p<0.001
child	2	0.68	0.12		
child	2	0.68	0.12	0.71	n.s.
child	3	0.82	0.18		
		good	fair	poor	$(chi)^2$	sig
child	1	6	11	13	19.09	p<0.001
child	2	21	8	1		
child	2	21	8	1	0.70	n.s.
child	3	18	11	1		

Table 79

Gingivitis in children who brushed their teeth by themselves at each questionnaire.

Who brushed child's teeth	Questionnaire No.					
	n = 30		MEAN G.I.			
			mean	s.e.	t	sig.
child	1		0.46	0.15	2.34	p<0.05
child	2		0.10	0.04		
child	2		0.10	0.04	1.14	n.s.
child	3		0.15	0.04		
	n = 30		PREVALENCE			
			present	absent	(chi)²	sig
child	1		11	19	0.71	n.s.
child	2		7	23		
child	2		7	23	0.33	n.s.
child	3		10	20		
			EXTENT			
		n	mean	s.e.	t	sig.
child	1	11	2.66	0.90	2.25	p<0.05
child	2	7	0.63	0.26		
child	2	7	0.63	0.26	1.14	n.s.
child	3	10	0.90	0.27		

are 13 children (43%) at questionnaire 1 and 1 child (3%) at questionnaire 2.

The numbers of children with good, fair and poor oral hygiene at the last questionnaire were similar to those at the second questionnaire.

The gingival health of these children had also improved by the second questionnaire. The mean G.I. score of 0.46 had fallen to 0.10 at the second questionnaire. This difference was statistically significant. There was a slight deterioration at the last questionnaire to a mean G.I. score of 0.15 but the difference was not statistically significant. There was no significant improvement in the prevalence of gingivitis between the questionnaires but there was an improvement in the extent. The mean number of affected sites at the first questionnaire was 2.66, 0.63 at the second and 0.90 at the third. The reduction in mean sites affected at the second questionnaire was statistically significant. The slight increase in the extent of gingivitis between the second and third questionnaires was not statistically significant.

b. Children whose parents helped them with toothbrushing at each questionnaire. (Tables 80 and 81)

The mean P.I. scores of 53 children who were always helped with toothbrushing, improved significantly between the first and second questionnaire. There was a small increase in mean plaque scores between questionnaires 2 and 3 but the difference was not statistically significant. Twenty eight children (53%) had good

Table 80

Oral hygiene of children whose parents helped them with toothbrushing at each questionnaire.

Who brushed child's teeth	Questionnaire No.	n = 53		MEAN P.I.	
		mean	s.e.	t	sig.
child & parent	1	1.13	0.18	3.6	$p<0.001$
child & parent	2	0.51	0.09		
child & parent	2	0.51	0.09	1.54	n.s.
child & parent	3	0.68	0.11		

		good	fair	poor	$(chi)^2$	sig.
child & parent	1	28	19	6	6.25	$p<0.05$
child & parent	2	40	11	2		
child & parent	2	40	11	2	1.78	n.s.
child & parent	3	35	13	5		

Table 81

Gingivitis in children whose parents helped them with toothbrushing at each questionnaire.

Who brushed child's teeth	Questionnaire No.					
		n = 53		MEAN G.I.		
			mean	s.e.	t	sig.
child & parent	1		0.17	0.05	1.46	n.s.
child & parent	2		0.09	0.02		
child & parent	2		0.09	0.02	1.03	n.s.
child & parent	3		0.06	0.02		
		n = 53		PREVALENCE		
			present	absent	(chi)²	sig.
child & parent	1		11	42	0.21	n.s.
child & parent	2		14	39		
child & parent	2		14	39	1.43	n.s.
child & parent	3		8	45		
				EXTENT		
		n	mean	s.e.	t	sig.
child & parent	1	11	1.02	0.31	1.46	n.s.
child & parent	2	14	0.55	0.14		
child & parent	2	14	0.55	0.14	1.03	n.s.
child & parent	3	8	0.38	0.13		

oral hygiene and 6 children (11%) had poor oral hygiene at the first questionnaire. At the second questionnaire 40 children (75%) had good oral hygiene and only 2 children (4%) had poor oral hygiene. These changes were statistically significant. Changes in good, fair and poor oral hygiene were not statistically significant between questionnaire 2 and 3.

The mean G.I. scores in this subgroup were very low at each questionnaire. The values were 0.17, 0.09 and 0.06 at each of the three questionnaires respectively. No statistically significant differences existed between the three questionnaires. There were no significant changes in the prevalence of gingivitis between the questionnaires. The mean number of affected sites was 1.02 at the first questionnaire, 0.55 at the second and 0.38 at the third questionnaire.

The dental health of the children in groups 3 and 4 improved during the study regardless of whether their parents were helping or not helping with toothbrushing. In consequence it was not possible to demonstrate significant improvements in dental health when the parents claimed to have changed from not helping to helping.

However when the mean P.I. scores, mean G.I. scores, the prevalence and extent of gingivitis in these two subgroups were looked at collectively it could be seen that in every case these values were slightly lower in the children whose parents helped them with toothbrushing.

This was examined further and a comparison was made between the 30 children who always brushed their teeth by themselves with the 53 children whose parents always helped them with toothbrushing at each questionnaire (Tables 82 and 83).

The mean P.I. scores of the 30 and 53 children at the first questionnaire were 2.20 and 1.13 respectively. The difference between these two mean values was statistically significant. Of the 30 children, 6 (20%) had good oral hygiene and 13 (68%) had poor oral hygiene, and of the 53 children, 28 (53%) had good oral hygiene and 6 (11%) had poor oral hygiene. These differences were statistically significant. The mean P.I. scores of the 53 children were also lower than the 30 children at the second and third questionnaires but the differences were not statistically significant. At each questionnaire the mean G.I. scores and extent of gingivitis were also lower in the 53 children but the differences between them and the 30 children were not statistically significant.

There was no difference in the prevalence of gingivitis between the 53 and 30 children at the first and final examination. Prevalence of gingivitis was slightly higher (26% versus 23%) in the 53 children at the second examination but the difference compared with the 30 children was not statistically significant.

Table 82

A comparison of the oral hygiene of 30 children who brushed their teeth by themselves with 53 children whose parents assisted them at each questionnaire.

Who brushed child's teeth	Questionnaire Number					
			MEAN P.I.			
		n	mean	s.e.	t	sig.
child	1	30	2.20	0.30	3.14	p<0.01
child & parent		53	1.13	0.18		
child	2	30	0.68	0.12	1.09	n.s.
child & parent		53	0.51	0.10		
child	3	30	0.82	0.18	0.68	n.s.
child & parent		53	0.68	0.11		

		n	good	fair	poor	$(chi)^2$	sig.
child	1	30	6	19	13	13.62	p<0.01
child & parent		53	28	19	6		
child	2	30	21	8	1	0.38	n.s.
child & parent		53	40	11	2		
child	3	30	18	11	1	2.07	n.s.
child & parent		53	35	13	5		

Table 83

A comparison of the gingival health of 30 children who brushed their teeth by themselves with 53 children whose parents assisted them at each questionnaire.

Who brushed child's teeth	Questionnaire Number					
				MEAN G.I.		
		n	mean	s.e.	t	sig.
child	1	30	0.46	0.15	1.82	n.s.
child & parent		53	0.17	0.05		
child	2	30	0.10	0.04	0.30	n.s.
child & parent		53	0.09	0.02		
child	3	30	0.15	0.04	1.73	n.s.
child & parent		53	0.06	0.02		
				PREVALENCE		
		n	present	absent	(chi)²	sig.
child	1	30	11	19		
child & parent		53	11	42	1.74	n.s.
child	2	30	7	23	0.002	n.s.
child & parent		53	14	39		
child	3	30	10	20	2.75	n.s.
child & parent		53	8	45		
				EXTENT		
		n	mean	s.e.	t	sig.
child	1	11	2.66	0.90	1.73	n.s.
child & parent		11	1.02	0.31		
child	2	7	0.63	0.26	0.33	n.s.
child & parent		14	0.55	0.14		
child	3	10	0.90	0.27	1.73	n.s.
child & parent		8	0.38	0.13		

6.3. SUMMARY

The majority of parents in the three experimental groups claimed that their children brushed their teeth at least twice a day. The most popular times for toothbrushing were after breakfast and before going to bed. Only about half of the parents in this part of the study claimed to have been given any advice on how to care for their children's teeth but in most cases the advice had been given by a dentist.

Questionnaires were used to look for changes in attitudes of parents to dental health practices at home, in particular of parents changing from allowing their children to brush their teeth by themselves, to helping them with toothbrushing. No changes in attitudes were noted in parents of group 2 children. This showed that the programme had had no effect on the behaviour of these parents at home. An identical trend was observed in the earlier Edinburgh nursery school study (Sutcliffe et al 1984). Supervised daily toothbrushing at school resulted in improved levels of oral cleanliness in the children but there was a deterioration during the summer holiday and it was postulated that the school programme had had no effect on the behaviour of the parents at home. A similar finding was reported by Alice Horowitz in her study with adolescents in 1980.

The dental health education given to parents in groups 3 and 4 was effective in changing their attitudes towards toothbrushing practices at home resulting in more parents helping their children

with toothbrushing at the end of the study.

There was also a trend showing that children whose parents always helped them with toothbrushing had the cleanest mouths and the least amount of gingivitis.

CHAPTER 7

COST OF THE PREVENTIVE PROGRAMMES

The question now to be asked is did each of the dental health education programmes achieve their stated aims.

The clinical aims were to improve oral cleanliness and gingivitis in nursery school children and to prevent a relapse over the summer vacation after the preventive programmes had ceased. Oral hygiene improved in the three experimental groups whilst the preventive programme was running but relapsed in group 2 - the toothbrushing only group - during the summer vacation. The plaque removal programme for this group was therefore considered to be unsuccessful. Although the extent of gingivitis (mean number of affected sites) was significantly reduced for this group at the final examination, the toothbrushing only programme at school was not as effective at improving gingivitis as the programme for groups 3 and 4.

In groups 3 and 4 - the home visits groups - both oral cleanliness and gingivitis improved during the active programme and were maintained when the programme had finished. These programmes were therefore considered to be successful. It now remains to determine the cost of the three programmes.

Effort effectiveness can be expressed as a number of units of

effectiveness per unit of effort (Hollis 1979). In this study the input (or unit effort) is the man hours taken up by each preventive programme. The output (units of effectiveness) is the improvement in the Plaque and Gingival Index scores.

The study was in two parts, the first between the baseline and second examination when the preventive programmes were carried out and the second part between the second and final examination after the preventive programmes had been suspended. The measures of effort effectiveness have been made between the baseline and second examinations. The 57 children whose parents refused the home visit have been included in this part of the analysis because, even though they would not take part in all of the programme, they consumed some of the effort devoted to this community programme. Reluctance to comply with any preventive programme is of some considerable importance in evaluating the effectiveness of the programmes. Excluding the refusers could lead to over estimating the cost of the programme and potentially overestimating its clinical effectiveness. The children in group 3 whose parents refused the home visit were participating in the toothbrushing programme at school.

7.1. INPUT (MAN HOURS)

The input was the number of contact hours spent by the hygienist teaching and supervising toothbrushing in the schools in groups 2 and 3 and giving dental health education to parents at home in groups 3 and 4.

The hygienist recorded in a diary the hours spent teaching and supervising toothbrushing at nursery school and the hours spent visiting parents at home. Travelling time was also recorded. Toothbrushing for group 2 and 3 at nursery consumed a total of 179 hours and the total time for home visiting (plus unsuccessful calls) for groups 3 and 4 was 343 hours. The total travelling time to the nursery schools for toothbrushing was 48 hours and to the areas for home visiting was 80 hours. To assist future comparisons the data is presented separately including and excluding travelling time (Table 84).

The calculations for the hours spent teaching and supervising toothbrushing, the home visiting and travelling time for each experimental group are given in Appendix 6a. The mean time spent per child has been derived from the final size of each study group at the second examination which was when the preventive programmes were about to finish.

Teaching and supervising toothbrushing at school took 84 hours or 0.82 hours/child in group 2. Toothbrushing at school plus home visits took 264 hours or 2.46 hours/child in group 3 and home visits took 174 hours or 1.45 hours/child in group 4. The mean hours per child including travelling time were 1.14 in group 2, 2.92 group 3 and 1.83 in group 4.

Oral cleanliness had deteriorated by 27% and gingivitis had increased by 30% in the control group by the second examination. It is possible that the three experimental groups could also have

Table 84

Time consumed by the hygienist for each preventive programme.

Group		Teaching & supervising toothbrushing		Dental health education	
		Toothbrushing	Travelling	Home visits	Travelling
	n	hours	hours	hours	hours
2	102	84	33	-	-
3	107	95	15	169	34
4	120	-	-	174	46

deteriorated without the dental health education. To allow for this the baseline values for mean P.I. and mean G.I. for each group have been adjusted by 27% and 30% respectively. These adjusted results for effort effectiveness are presented together with the results calculated from the true baseline values in Tables 85 & 86.

7.2. COST OF IMPROVEMENTS

7.2.1. Oral Hygiene

The mean Plaque Index value of the control group at the second examination was 2.10. The corresponding values for groups 2,3 and 4 were 0.74, 0.54 and 0.73 respectively. There was therefore an improvement of 1.36 units in group 2, 1.56 in group 3 and 1.37 units in group 4. The improvements calculated from the adjusted baseline values were 1.74, 1.49 and 1.25 respectively.

The calculations for the cost of preventing one Plaque Index unit of plaque accumulation (i.e. the cost of improvement) at examination 2 are given in Appendix 6b and summarised in Table 85. At examination 2 the cost of preventing one Plaque Index unit excluding travelling time of plaque accumulating was 0.60 hours in group 2, 1.57 hours in group 3 and 1.06 hours in group 4. The corresponding values including travelling time were 0.84, 1.87 and 1.33. The cost using the adjusted baseline values was 0.47, 1.65 and 1.16 excluding travelling time and 0.65, 1.95 and 1.46 including travelling for group 2,3 and 4 respectively. Therefore the cost of the improvement in plaque index values when the preventive programme was still in

Table 85

Cost of preventing one Plaque Index (P.I.) unit of plaque accumulation at examination 2 for each experimental group.

Group	True Baseline		Adjusted Baseline	
	excluding travel	including travel	excluding travel	including travel
	hours	hours	hours	hours
Brushing	0.60	0.84	0.47	0.65
Brushing + visit	1.57	1.87	1.65	1.95
Visits	1.06	1.33	1.16	1.46

Table 86

Cost of preventing one Gingival Index (G.I.) unit of gingival inflammation at examination 2 for each experimental group

Group	True Baseline		Adjusted Baseline	
	excluding travel	including travel	excluding travel	including travel
	hours	hours	hours	hours
Brushing	5.12	7.12	7.45	10.36
Brushing + visit	9.11	10.81	10.25	12.17
Visits	4.83	6.10	3.72	4.69

operation was lowest in the brushing group 2 and the programme for group 3 (excluding travelling time) cost approximately 30% more than for group 4. A similar picture was observed when the adjusted baseline values were used.

At the final examination after the preventive programme had been suspended, the oral hygiene scores of the children in group 2 had deteriorated significantly, but had been maintained in groups 3 and 4.

7.2.2. Gingivitis

The mean Gingivitis Index value of the control group at the second examination was 0.39. The corresponding values for groups 2,3 and 4 were 0.23, 0.12 and 0.09 respectively. There was therefore an improvement of 0.16 units in group 2, 0.27 units in group 3 and 0.30 units in group 4. The improvements calculated from the adjusted baseline values were 0.11, 0.24 and 0.30 units respectively. The calculations for the cost of preventing one Gingivitis Index unit of gingivitis (i.e. the cost of improvement) at examination 2 are given in Appendix 6c and summarised in Table 86 using both true and adjusted baseline values.

At examination 2 the cost of preventing one Gingivitis Index unit of gingival inflammation excluding travelling time was 5.12 hours in group 2, 9.11 hours in group 3 and 4.83 hours in group 4. The corresponding values including travelling time were 7.12, 10.81 and 6.10. The cost using the adjusted baseline values was 7.45, 10.25 and 3.72 hours excluding travelling time and 10.36, 12.17 and 4.69

hours including travelling time for group 2,3 and 4 respectively. Thus the cost of the improvement in Gingivitis Index values was highest in group 3 and lowest in group 4 at the second examination.

At the final examination the improvements in gingivitis found at the second examination were observed in each of the experimental groups.

7.3. SUMMARY

Toothbrushing at school was the most economical programme but oral cleanliness relapsed after the programme had been withdrawn and left only a small residual improvement in gingivitis. Toothbrushing at school plus home visits was more effective but also the most expensive programme. Home visiting was more effective than school brushing but more expensive, although not as expensive as school brushing plus home visiting. Adding school brushing to home visiting did not materially improve the clinical outcome. The home visiting attracted less support from the parents than the school brushing programmes. Thus school based programmes appeared to have been more acceptable to the parents than home based programmes.

Adjusting the baseline values of the experimental groups to accommodate the changes in oral cleanliness and gingivitis in the control group between the first and second examinations, did not significantly contribute to the results.

CHAPTER 8

DISCUSSION

During this study a dental health education programme which lasted one academic year was completed for three groups of nursery school children in areas of urban deprivation. The programme was designed to evaluate and compare school and home based dental health education.

8.1. NUMBERS OF CHILDREN AND LOSSES FROM THE STUDY

Five hundred and fifty eight children initially participated in the study but only 349 completed the programme, a loss of 209 children or 37% (Table 12).

Unlike primary school, attendance at nursery is voluntary and one quarter of the losses were due to children being absent from one or more dental examination and some children (26% of the losses) had moved away from the area. In addition, at the final examination, over 60% of children had moved to over 50 different primary schools (Table 87). Although it was possible to visit 43 of these schools it was impractical to visit them all and as a result 28 children (13%) were lost in the move from nursery to primary school. This was an unexpected finding as it did not occur in the earlier Edinburgh nursery school study and it should be taken into account

Table 87

Proportion of children who had moved to primary school at the final examination

Group	number in group at final examination	number at school	proportion at school %
control	112	70	62
brushing	89	57	64
brushing & visit	71	41	58
visits	77	47	61

in the organisation of any future studies that cover the pre-school/primary school period. There is no formal 'handover' from nursery to primary school and nursery school children are not automatically all transferred to the nearest primary school. In fact the nursery schools were not always aware of the primary school that their former children had transferred to.

Compliance with home visits was a problem with some families and over 30% of parents in the home visits groups refused the visit but allowed their children to participate in the programme at school. The reasons for refusing the home visit were not always given. Some parents resented the intrusion into their home and other parents commented that they had already been given dental health education by their dentist. This was also an unexpected finding and one that has important implications for home based dental health education. There is no point in such a dental health education programme if the parents dislike it or do not see the value of it. At the beginning of the study a letter was sent to all parents seeking permission for their children to participate in the programme (Appendix 2). Baseline examinations were then carried out and the children were allocated to the study group. Although their parents were given no choice of preventive programme, letters describing the school toothbrushing and home visiting were sent to the parents concerned, requesting their co-operation (Appendix 2). All parents allowed their child to take part in the toothbrushing at school but home visiting was not acceptable to all of the families in the study. Unlike health visiting, home visiting to provide dental health education is uncommon and some parents were not prepared for it.

Mothers in the United Kingdom are visited by a Health Visitor after the birth of their baby. At this time they are probably more receptive to health education. In the Hillingdon study, (Winter et al, 1981) 420 parents were successfully interviewed at home, within two to four weeks of their child's birth, by a dental health educator and only 5 parents refused to cooperate.

A similar finding to that in the present study has recently been reported by Rossow et al 1990. The Norwegian authors stated that the main reason for a major drop out of participants from their study of the patterns of sugar consumption in early childhood, was the low response rate to home visiting.

Better motivated parents such as those with handicapped or disabled children, would perhaps find such an approach more acceptable. Discounting these losses from the home visits group, the remaining losses from each study group were balanced.

8.2. TOOTHBRUSHING AT SCHOOL

In 1977, in a pilot study of supervised daily toothbrushing with 30 nursery school children, which lasted 2 months, Sutcliffe and co-workers showed that it was possible to successfully teach toothbrushing, mainly under the supervision of the school staff with limited help from dental personnel. A similar finding was observed in a longer investigation (Sutcliffe et al 1984) and children who had brushed their teeth for up to 2 years at nursery school still

had significantly cleaner mouths one year later at primary school.

Based on these earlier experiences with toothbrushing programmes in Edinburgh nursery schools, a brushing programme lasting 6 months was thought to be long enough for the purposes of this investigation.

The toothbrushing programme was well accepted by the school staff, the children and their parents. No fundamental problems were encountered with the cleaning and disinfecting of the toothbrushes, or the dispensing of toothpaste but there were some difficulties associated with the rinsing mugs. In addition to being used for rinsing, the mugs acted as a convenient storage receptacle for each child's toothbrush. Although the children recognised their own mug they sometimes preferred a mug with a different picture on it. This led to problems of identification and it was decided to discard the rinsing mugs. The problem was solved by storing the toothbrushes in racks or trays according to the wishes of the school staff.

8.3. EXAMINER BIAS

It was acknowledged from the outset that the examinations would not be blind. Transporting the children to a single examination point would have permitted a blind examination and was considered but discarded because of the practical difficulties that this would have caused with such young children. Another alternative would have been to increase the size of the team and employ another assistant to organise the study but this is not easily compatible with the

aims of a PhD thesis. In the event, careful analysis of the data has demonstrated no obvious examiner bias.

The examiner knew to which study group each school belonged as she had initially allocated the schools. Random allocation was not possible for the reasons given earlier in the plan of the investigation. The allocation of the schools to the study groups was made after the baseline examination and this examination was therefore blind. The purpose of the second examination was to check that the programme was running effectively but this examination was not blind. The atmosphere in nursery classrooms is very informal as the children are so young. Managing and carrying out dental examinations in very young children requires a lot of concentration and patience and it is arguable that the examiner was usually too busy to be biased. Children were often reluctant to be examined and the examiner, recorder and school staff went to great lengths to coax and encourage children to participate.

However at the final examination over 60% of children had moved to a large number of different primary schools. At the primary schools when the children were examined, the examiner had no knowledge of the children's group. Indeed, it later became clear that children from more than one study group were present in some primary schools. This was therefore a blind examination for some children. If, in each group, the status of the children seen at nursery school was identical to that of the children at primary school, then this would indicate a lack of bias on the part of the examiner. A total of 8 separate assessments of plaque and gingivitis for the four study

groups were made at the final examination. In seven of these assessments the indices were statistically identical. The one non-identical assessment was the plaque index in the control group which is discussed later (Table 88 & 89).

Thus the first examination was blind and the final examination was mainly blind. In addition, at the first examination, before the health education began, a logical relationship was found between questionnaire data and clinical data. Children whose parents always helped them with toothbrushing had significantly cleaner mouths than children who always brushed by themselves. There was no bias in the collection of the questionnaire data. Finally, the consistency of diagnosis was investigated at each examination and the results presented are satisfactory. Overall, these results are interpreted to mean that there was no important bias during the examinations.

8.4. CONSISTENCY OF DIAGNOSIS

Approximately 10% of the children in the study underwent duplicate dental examinations for oral cleanliness, gingivitis and dental caries.

At the present time there are no generally approved methods of measuring examiner variability (Bulman & Osborne 1989) but research workers are becoming increasingly aware of its importance. Proportion agreement between the first and duplicate examinations and 't' tests on mean scores have been used and results reported in

Table 88

A comparison of the mean Plaque Index (P.I.) values between the nursery and primary school children at the final examination.

group	school	number	mean P.I.	s.e.	t	sig
control	nursery	40	1.61	0.21	2.50	$p<0.05$
	primary	72	0.99	0.14		
brushing	nursery	32	1.42	0.19	0.39	n.s.
	primary	57	1.53	0.17		
brushing + visits	nursery	30	0.72	0.14	0.25	n.s.
	primary	41	0.76	0.11		
visits	nursery	30	0.90	0.24	1.03	n.s.
	primary	47	0.66	0.13		

Table 89

A comparison of the mean Gingival Index (G.I.) values between the nursery and primary school children at the final examination.

group		n	mean G.I. mean	mean G.I. s.e.	sig
control	nursery	40	0.27	0.10	n.s.
	primary	72	0.13	0.03	
brushing	nursery	32	0.09	0.02	n.s.
	primary	57	0.19	0.05	
brushing + visits	nursery	30	0.14	0.04	n.s.
	primary	41	0.11	0.04	
visits	nursery	30	0.05	0.02	n.s.
	primary	47	0.08	0.03	

the literature. Reliability coefficients have been recommended by Rugg-Gunn & Holloway (1974) and more recently Bulman & Osborne (1989) have recommended the use of Dice's Coincidence Index and Cohen's Kappa statistic.

These statistics have been calculated to establish the intra-examiner reliability in the present study. Higher values for examiner consistency were achieved for gingivitis and dental caries than for oral cleanliness. It is difficult to reproduce mean plaque index scores to a sufficient degree of accuracy because the examination involves removing some of the plaque. The results, which were compared where possible with those of other workers, show that the examiner was able to diagnose plaque accumulations, gingivitis and dental caries to an acceptable level of reproducibility.

The Kappa statistic is probably the most reliable statistic for assessing overall examiner agreement (Bulman & Osborne 1989). It is interpreted as the proportion of available agreement that is obtained once chance agreement has been taken into account (Nuttall & Paul 1985). In addition to being calculated to test the reliability of the presence or absence of a disease such as dental caries, the Kappa statistic can be modified to fit circumstances such as in the present study where the severity of disease (i.e. gingivitis and oral cleanliness) has been recorded (Bulman & Osborne 1989). It is a convenient statistic to use and, based upon the results in the present study, the author believes it to be the statistic of choice at the present time for the measurement of

intra-examiner variablility.

8.5. ORAL HYGIENE

Oral cleanliness and gingivitis were recorded using the mean Plaque Index (Silness & Loe 1964) and the mean Gingival Index (Loe & Silness 1963). There are theoretical objections to using mean values of arbitrarily weighted scores and in an attempt to overcome these objections, the information for oral cleanliness was re-expressed as good, fair and poor, and for gingivitis the prevalence, extent and degree. In the event, this further investigation did not significantly contribute to the interpretation of the results. This was because the arbitrary weighted plaque accumulations and gingival inflammation scores could range over 4 points from 0-3. In fact the range of scores actually recorded was very limited and 84% of plaque accumulations and 97% of inflammed gingivae were scored as 1. Thus the arbitrary weightings of 2 and 3 were hardly ever used (Tables 90 and 43). Mean Plaque Index and Gingival Index scores would probably have been adequate for this age group.

There were unexpected changes in the oral hygiene of the children in the control group during the study which had deteriorated by the second examination and improved by the third. It is not understood why these changes occurred.

If the children had known that the dentist was going to visit their school it could be argued that they had made a special effort to

Table 90

Scores of plaque accumulation by groups at each examination.

examination	group	total sites affected	score 1		score 2		score 3	
			n	%	n	%	n	%
Baseline	Control	999	898	90	101	10	-	-
	Brushing	853	726	85	83	10	44	5
	Brushing & visits	539	409	76	122	23	8	1
	Visits	653	590	90	63	10	-	-
Second	Control	1094	829	76	231	21	34	3
	Brushing	359	332	92	27	7	-	-
	Brushing & visits	222	216	97	6	3	-	-
	Visits	320	308	96	12	4	-	-
Third	Control	605	459	76	142	23	4	1
	Brushing	613	468	76	145	24	-	-
	Brushing & visits	273	247	90	26	9	-	-
	Visits	277	223	80	54	19	-	-

clean their teeth and their teeth were therefore cleaner than normal at the baseline examination. After the first examination the children in the control group were not visited again until the second examination. Neither the children nor their parents received any dental health education. It is possible that their oral cleanliness just reverted back to their pre-examination or normal level as observed at examination 2. However, the children were unlikely to have known about the impending dental visit before the final examination for the following reasons. At the final examination over 60% of the children had moved from nursery to a large number of different primary schools (Table 87). There were frequently only small numbers of children to be examined at any one school. It was the policy in these cases to check that the children were in school before the examination and thus avoid wasted journeys because of absenteeism. Arrangements made to visit these schools were usually made by telephone on the morning of the examination. When larger groups of children were examined at primary school it was observed that they had usually been allocated to a differing number of primary I classes. Although the children recognised the dental personnel, their school teachers were not familiar with the study and did not appear to have told the children beforehand about the dental examination.

The move from the informal atmosphere at nursery school to the more formal environment at primary school is an important event for young children and their parents. Most of the children who had moved to primary school looked very neat and tidy at the beginning of the school year. When the oral hygiene data for the nursery school and

primary school children was analysed separately it was observed that the children who had moved to primary school in the control group had significantly cleaner mouths than the children who had remained at nursery (Table 88). This difference did not occur in the experimental groups and the reasons for the improvement in the oral hygiene of the control group remain obscure.

A similar improvement in the oral hygiene of the control group was reported by Anaise & Zilkah in 1976 and by Ashley & Sainsbury in 1981. Both sets of authors have suggested that this was perhaps due to a "spillover" effect. The dental examination alone might have been sufficient to lead to improved oral hygiene practices at home, but would not account for the deterioration in oral cleanliness seen at the second examination.

The oral hygiene of the children in group 2 who brushed their teeth daily at school, improved during the study but there was a statistically significant relapse after the second examination during the summer holiday. This finding is identical to that of the earlier Edinburgh nursery school study implying a failure to influence toothbrushing behaviour at home. If the mean Plaque Index scores are selected and summarised to one decimal place (Table 91), it can be seen that with regard to plaque accumulations, both groups 3 and 4 benefited from the programme and did not experience the relapse demonstrated by group 2 during the summer holiday. The dental health education had influenced the parents attitudes to dental health at home as significantly more parents in groups 3 and 4 were helping their children with toothbrushing by the second

Table 91

Mean Plaque Index (P.I.) values summarised to one decimal place.

Group	active health education		no health education
	Baseline Examination	Second Examination	Final Examination
Control	1.7	2.1	1.2
Brushing	2.0	0.7	1.5
Brushing & visits	1.6	0.5	0.7
Visits	1.6	0.7	0.7

examination. The additional toothbrushing in group 3 children did not appear to have any more benefit than the dental health education alone.

Since the changes in the oral hygiene of the control group were unexpected it is perhaps reasonable to consider group 2 - the school brushing only group - as another control group for groups 3 and 4. School brushing is the conventional method of delivering dental health education i.e. accepted best practice, which is the usual basis for a control group in a clinical trial. In this context children in groups 3 and 4, benefited more from the programme than the children in group 2.

8.5.1. Plaque accumulations on individual teeth and surfaces.

There were some interesting changes in plaque accumulations on individual teeth and surfaces in the control group during the study.

The children in group 2 were able to significantly clean all teeth and surfaces during the study when the preventive programme was operating but this was not so after the programme had finished.

In groups 3 and 4 significant improvements in plaque accumulations were found on all teeth examined and also on most tooth surfaces (except for maxillary lingual surfaces in group 4) when the preventive programme was running and there were no significant deteriorations in plaque accumulations on molar teeth during the summer holiday. At this time all surface improvements had been maintained with the exception of maxillary buccal surfaces in both

of these home visits groups.

Plaque accumulations were greater in the maxilla than in the mandible. This finding is in contrast to that of Mackler & Crawford who reported greater accumulations of plaque in the mandible, in a small study of plaque development and gingivitis in the primary dentition in 13 children aged 3-6 years (Mackler & Crawford 1973).

The children in the present study were able to clean mandibular teeth more effectively than maxillary teeth. This is perhaps because they found the twisting action of the hand necessary to gain access to the upper teeth more difficult. Incisor teeth were cleaner than molar teeth probably because access was easier. A similar finding was reported in the earlier nursery school study (Sutcliffe et al 1984). Tsamsouris and co-workers also found that supervised toothbrushing in kindergarten children resulted in more effective plaque removal from the mandible than the maxilla and from anterior rather than posterior teeth (Tsamsouris et al 1979). Greater accumulations of plaque on the right hand side of the mouth is a feature of right-handed populations and has been commented on before (Dunning 1979).

8.6. GINGIVITIS

The expected clinical outcome of regular efficient plaque removal is reduced levels of gingivitis. This would appear to apply with more certainty to older rather than younger children. It has been

commented that the gingival tissue in young children seem to respond differently to plaque accumulations. Thus Spencer et al (1983) reported a weaker relationship between plaque accumulations and gingivitis in 5 and 6 year olds than in adults and suggested that reductions in plaque accumulations in relation to the primary dentition may not be associated with reductions in gingival inflammation. Similarly Matsson & Goldberg (1985) have shown that at the same level of plaque accumulation the gingival reaction in children aged 4 to 6 years was lower than in older children and young adults.

Although the levels of gingivitis of the children in this study were low some changes in gingival health were recorded during the study period.

The standard of gingival health of the control group improved over the study period. This has been investigated but the reasons for the improvement are unclear. The children who brushed their teeth daily at school showed some improvements in their gingival health but there was a slight deterioration in the prevalence of gingivitis during the summer holiday. The toothbrushing programme at school had had little effect on the gingival condition of the children in this group. If the mean Gingival Index only is selected and summarised to one decimal place, it can be seen that the mean values are very low but, as with plaque, groups 3 and 4 were the ones to benefit most from the preventive programme (Table 92). These improvements were maintained during the summer vacation.

Table 92

Mean Gingival Index (G.I.) values summarised to one decimal place.

Group	Active health education Baseline Examination	Second Examination	No health education Final Examination
Control	0.3	0.4	0.2
Brushing	0.3	0.2	0.2
Brushing & visits	0.3	0.1	0.1
Visits	0.3	0.1	0.1

8.6.1. Gingivitis in relation to individual teeth and surfaces

When gingivitis was present it was usually localised to the lingual aspect of the lower deciduous molars and the buccal aspect of the upper maxillary molar. There was more gingivitis in the mandible than in the maxilla and more in relation to molar than incisor teeth. An identical finding has been reported by Schroder and Granath (1983) in a study of dietary habits and oral hygiene as predictors of caries in 3 year old children in Sweden. The improvements observed during the present study were greatest in relation to maxillary buccal surfaces and mandibular, mesial and distal surfaces.

8.7. CARIES EXPERIENCE AND DENTAL TREATMENT.

The study was too short to have any measurable effect on the caries experience of the children. The health education had little effect on the uptake of dental care. At the final examination, in children with some decay experience, untreated teeth predominated. This was disappointing but not entirely unexpected as young children in the United Kingdom generally receive low levels of dental care. In a recent survey of Scottish five year olds, over 50% of children had some decay experience and decayed, untreated teeth predominated over missing and filled teeth (Pitts & Davis 1989). The mean dmft of the children in this study at the final examination was slightly higher than the Lothian Region's 5 year olds' mean dmft, the values being 2.81 and 2.48 respectively. The mean age of the Lothian children was 5.22 years, compared with 4.71 for the nursery school children.

Similar difficulties in providing care for this young age group were experienced in an earlier preventive dental health programme for nursery school children in Edinburgh (unpublished report 1982) when an attempt was made to provide care from caravan surgeries at school. For a number of reasons this proved to be only moderately successful. Difficulties arose when moving the caravan from school to school and some schools were unwilling to have the caravan in the school playground for fear of vandalism. There was only a moderate uptake of care at the final examination and as in the present study, decayed, untreated teeth still predominated.

It may be concluded that general encouragement to attend for dental care along with the other dental health education messages was of little value in this study. A special programme with the sole aim of encouraging parents to take young children for regular dental care would perhaps be more successful. It is unfortunate that some parents still believe that children are not entitled to dental care until they go to primary school.

The classical approach of a dental examination and referral was clearly unsuitable for the majority of these children. It will be interesting to see if long term Capitation (Holloway et al 1990, Lennon et al 1990)), which has implications for the family, will make any difference to the uptake of dental care by pre-school children in the future. However the pilot study has not shown any evidence of a greater uptake of care by school aged children.

8.8. QUESTIONNAIRES

There were no difficulties in completing the questionnaires at home for parents of children in groups 3 and 4 but some were experienced in group 2 at nursery school. This took rather longer than had been expected because the parents did not always accompany their child to school. A solution to this problem could be to contact parents at home by appointment.

The majority of parents in the three experimental groups claimed that their children brushed their teeth at least twice a day. The high proportion claiming to brush more than three times a day (at the first questionnaire in group 2) is thought to reflect an eagerness to please the hygienist. By the second questionnaire only 9% claimed to brush more than three times a day, 62% stated that they brushed twice a day, and 10% once a day.

The most popular times for toothbrushing were after breakfast and before going to bed. These are the times that dentists usually recommend as being the most appropriate for children to brush their teeth. Only about half of the parents in this part of the study claimed to have been given any advice on how to care for their children's teeth but in most cases the advice had been given by a dentist.

The questionnaires were also used to look for changes in attitudes of parents towards dental health practices at home, in particular of parents changing from not helping to helping with toothbrushing.

None of the parents in group 2 claimed to have changed from not helping to helping with toothbrushing at the final examination. It is possible that these parents thought that the toothbrushing at school had been sufficient and that there was no need for further instruction and supervision at home during the summer holidays. Changes in attitudes were only observed in the parents in groups 3 and 4 and there was a trend showing that children whose parents always helped them with toothbrushing had cleaner mouths and lower levels of gingivitis than children who always brushed by themselves. This was particularly noticeable at the first examination before the health education began.

Children in group 3 were shown how to brush their teeth at school and their parents were given verbal instruction at home. Parents of children in group 4 were given verbal instruction only, there was no practical demonstration with the child and no dentist was involved. Nevertheless, as in group 3, these parents and children were able to maintain the improvements in oral cleanliness and gingivitis during the summer vacation.

8.9. COMPARISONS WITH OTHER DENTAL HEALTH EDUCATION PROGRAMMES

As virtually all children go to school, the classroom is considered the most appropriate setting in which to present dental health education. There are many reports of school based dental health education programmes published in the literature.

The studies vary greatly in their design, content and approach. Craft et al (1981) evaluated a 3 week teacher mediated dental health education curriculum package with 1092, 13-14 year old adolescents. The package was designed to emphasise self-care, and combined a scientifically accurate message with educational and behavioural science concepts. Examination of a random sample of children revealed significant improvements in oral hygiene status along with gains in knowledge and positive changes in attitudes. Significant improvements were still found 6 months later after reinforcement programmes.

Craft et al (1984) repeated this programme on a smaller scale with 216 adolescents in Central Scotland. The authors reported that although the results allowed some satisfaction in that there were significant improvements in oral hygiene along with considerable gains in knowledge and attitudes, they did not wish to comment on the clinical importance of the changes. They found that the programme was not acceptable to all of the school teachers. Some teachers considered it to be too voluminous and repetitive and others cast doubt on its effectiveness.

The same programme was again evaluated by Arnold & Doyle (1984) in Lancashire with 114, 13-14 year old children and in addition, an estimate of the financial cost was made. This study failed to detect any improvements in oral hygiene and the cost of the programme was high. The authors reported that as the questionnaire was not suitable for all children, the programme's relevance should be determined before it is used. They recommended that the

programme should be directed at children whose dental health knowledge was limited and thus make better use of financial resources.

Supervised toothbrushing programmes at school is another approach. One of the problems associated with such programmes is that unless there is regular follow-up and reinforcement of the dental health education, relapse is common. Horowitz et al (1980) in a study of the effectiveness of a 2 year supervised daily brushing and flossing regime with initially aged 10-13 year olds, noted that the benefits accrued during the school term initially, disappeared during the summer holiday. In another paper (Horowitz 1980) she stated that only modest benefits can be realistically expected from school based programmes intended to control plaque by mechanical methods and suggested that although oral hygiene regimens should not be dropped in schools, they should not be the major focus of a school based programme.

When dental personnel are involved in professional tooth cleaning programmes, authors have reported more lasting benefits. Axelsson and Lindhe (1974) measured the effect of an intensive preventive programme in children aged 7-14 years. The test group received fortnightly oral hygiene instruction, motivation and topical fluoride applications. After two years the experimental group had very low plaque levels and negligible amounts of gingivitis when compared with a control group.

Whereas other studies (Poulsen et al 1976, Hamp et al 1978 and

Ashley & Sainsbury 1981) have reported similar reductions in plaque and gingivitis as Axelsson & Lindhe (1974), not all workers were able to repeat these results.

Badersten et al 1975 carried out professional tooth cleaning, including oral hygiene instruction and fluoride mouthrinsing at monthly intervals, on 10-12 year old chidren. After one year, frequency of gingivitis was signficantly lower but not reduced as much as in Axelsson's & Lindhe's study. This was attributed to the monthly, rather than fortnightly, prophylaxis and lack of parental support within a low socio-economic group.

School based health education cannot be completely condemned and in a review of school based dental health education programmes Flanders (1987) has recommended that they should be continued to be developed even though the evidence for their effectiveness is equivocal, because children are not only fast learners, anxious to acquire new skills, but they are also at risk of developing dental health problems.

Most of the reported school based programmes have been designed for primary school children and adolescents. In recent years there has been some emphasis on giving dental health education to chidren and their parents (Cohen 1980, Leatherman 1982, and Levy 1984). Pre-school and young primary school children are likely to benefit more from such an approach than adolescents as they are more dependent on their parents. Telford & Murray's approach to toothbrushing of "get the stain off" would appear to be more appropriate for older

children. In this investigation, children aged 9-17 attending for routine dental care showed marked improvements in gingival health and oral cleanliness 3 months after a single lesson of oral hygiene instruction involving disclosure and self-removal of plaque (Telford & Murray 1974). In the present study, health education counselling at home, away from the clinical situation and avoiding the use of a dentist, was an effective method of improving oral hygiene and gingivitis in nursery school children, and was more successful than a short term toothbrushing programme at school.

8.10. COST EFFECTIVENESS

This study has been costed by calculating the mean input in hours (including and excluding travelling time) spent by the hygienists teaching and supervising toothbrushing at school and giving dental health education at home and relating this to improvements in oral hygiene and preventing gingivitis in the children.

Daily supervised toothbrushing at nursery school was the least expensive programme. It resulted in improved standards of oral hygiene during the school term but had no effect on toothbrushing behaviour at home. However the children only brushed their teeth at school for about 6 months and this may not have been long enough. Children in the earlier nursery school study (Sutcliffe et al 1984) who brushed their teeth for up to two years at nursery school still had significantly cleaner mouths than the control group one year later at primary school.

The most expensive programme in the present study was in group 3 where school toothbrushing was combined with home visiting to give dental health education. This programme was effective in improving and maintaining oral cleanliness, but when compared with group 4, the home visits only group, it was found that the toothbrushing at school gave no additional benefit.

Home visiting cost about twice as much as school toothbrushing but was effective over the short period of the study.

Since toothbrushing at school was the cheapest programme and has been shown to be effective if operated for a lengthier period than in the present study, it is postulated that a longer programme of school toothbrushing would cost the same or be less expensive than the home visits programme. This would be a subject for further research.

8.11 CONCLUSION

The importance of giving professional advice on toothbrushing to children and their parents is becoming more widely recognised. In this study, dental health education given to parents and their children living in areas of urban deprivation was effective in improving and maintaining their standards of oral cleanliness and gingivitis. Combining dental health education for parents at home with conventional toothbrushing programmes at school did not result in any additional benefit. This programme can therefore not be

recommended. Toothbrushing only at school resulted in an improvement in oral cleanliness and gingivitis in the children during the school term but there was a relapse during the long summer vacation, indicating that the programme had failed to influence the parents in their toothbrushing practices for their children at home. A longer period of toothbrushing might have had more lasting benefit. Children whose parents always assisted them with toothbrushing had cleaner mouths and less gingivitis than children who always brushed their teeth by themselves. Parents should therefore continue to be advised to regularly help young children with toothbrushing.

Home visits to provide dental health education is uncommon and in this study it was not acceptable to between 32% and 35% of parents. Such an approach would be too costly for all children, but more motivated parents such as those of children with certain special needs, would possibly benefit from this form of dental health education.

8.12. RECOMMENDATIONS FOR FURTHER RESEARCH

8.12.1. The children who participated in this study are now 7 - 8 years old and will still be at primary school. It would be interesting to examine these children to determine if there has been any measurable longterm benefit from the dental health education programme.

8.12.2. Compare a programme of home visiting similar to that in the present study with a longer toothbrushing programme at nursery school.

8.12.3. Preschool children continue to receive low levels of dental treatment. A specific investigation is needed on the effectiveness of a dental health education programme with the single aim of encouraging parents to take young children for regular dental care.

8.12.4. A pilot study to determine if home visiting to provide dental health education would be acceptable to parents of children with special needs.

APPENDIX 1

LETTERS OF APPROVAL

LOTHIAN REGIONAL COUNCIL

EDUCATION

Director W. D. C. Semple,
40 Torphichen Street,
Edinburgh EH3 8JJ

Please note our new
Telephone Number is:
031-229 9166

Our reference PE/JM/PA

Your reference

Date 17th June 1985

Miss J. A. Rayner,
Lecturer,
Department of Preventive Denistry,
17, Teviot Place,
EDINBURGH, EH1 2QZ

Dear Miss Rayner,

I refer to your letter of 13th May, 1985 regarding the proposed dental health education programme for Edinburgh Nursery School children.

The programme seems excellent and there is no problem about approving the study as such. In order however, to ensure acceptability to the Authority I would propose the following approach to the liaison with the homes concerned. Rather than the school releasing the names and addresses to the Board, your Department might prepare a circular letter which can be issued to all parents of the nursery pupils, inviting them to volunteer to be visited.

Please let me know if this is acceptable and if I can be of further assistance.

Yours sincerely,

J. L. Morrison
Assistant Director

If telephoning please ask for

All communications to be addressed to the Director

Dean of Dental Studies:
PROFESSOR J.C. SOUTHAM
Secretary to the School of Dental Surgery:
MR. D.M. GILLANDERS

SCHOOL OF DENTAL SURGERY,
CHAMBERS STREET,
EDINBURGH
EH1 1JA
Telephone: 031 225 9511

Miss Janet Rayner,
Lecturer,
Department of Preventive Dentistry,
17 Teviot Place,
Edinburgh.

Dear Miss Rayner,

As Chairman of the Lothian Area Dental Ethical Committee, I approve your proposed study of Edinburgh Nursery School children and hope that this decision will be homologated at the next meeting of the Committee which I hope will be held towards the end of July.

Yours sincerely,

Professor J.C. Southam,
Chairman,
Lothian Area Dental Ethical Committee

JCS/mrm

APPENDIX 2

LETTERS TO PARENTS

Telephone 031-667 1011
Ext

Department of Preventive Dentistry
1 Surgeons' Square
High School Yards
EDINBURGH EH1 1LZ

Date

Dear Parent/Guardian

DENTAL HEALTH SURVEY OF NURSERY SCHOOL CHILDREN

This letter is to ask if you are willing to have your child's teeth examined at Nursery School and later at Primary School. The purpose of the examination is to provide more information about the dental health of very young children in Edinburgh. It is intended to hold the first examination this term, the second examination at the end of the summer term 1986, and the last examination in the autumn term of 1986. The examinations are being held in co-operation with the Community Dental Service and have the support of the Education Authorities. If we find that your child needs care, you will be told about this. No dental treatment will be carried out.

The dental examination is a very simple one which does not frighten young children and no children are ever examined if they express any unwillingness. A number of Edinburgh Nursery Schools have already co-operated with us and I hope that you will be willing to help too.

If I can provide you with any additional information about the Survey, please do not hesitate to get in touch with me.

Yours sincerely,

Janet A.Rayner
Lecturer in Preventive and Children's Dentistry.

I am/am not willing to allow my child to take part in the Dental Health Survey of Nursery and Primary School Children.

Signature .....
(Parent/Guardian)

Telephone: 031-667 1011
Ext

University of Edinburgh

Department of Preventive Dentistry
1 Surgeons' Square
High School Yards
EDINBURGH EH1 1LZ

Date

Dear Parent or Guardian of .....

Thank you for allowing your child to take part in the dental survey at nursery school.

One way to prevent future dental disease is to encourage young children to brush their teeth regularly. It is proposed to begin a toothbrushing programme at nursery school under the supervision of a dental hygienist and the school staff. Would you be willing for your child to take part in a toothbrushing programme? Of course this will be in addition to any toothbrushing which you encourage your child to do at home.

If you would like your child to take part, please would you complete the form below and return it to the nursery school. All information will be handled with the strictest confidence.

Thank you again for your help with this survey.

Yours sincerely,

Janet A.Rayner
Lecturer in Preventive and Children's Dentistry

I would like/would not like my child to take part in the toothbrushing programme at nursery school.

Signature..... Address.....
(Parent/Guardian) .....
.....
Tel. No. .....

Telephone: 031-667 1011
Ext.

Department of Preventive Dentistry
1 Surgeons' Square
High School Yards
EDINBURGH EH1 1LZ

Date

Dear Parent or Guardian of .....

Thank you for allowing your child to take part in the dental survey at nursery school. It is very important that we should try to prevent future dental disease. One way to do this is for dental personnel to give dental health education to children and their parents. Would you as a parent be willing for a dental hygienist to visit you at home at a convenient time to talk to you about dental health education and answer any questions you might like to ask about your child's teeth.

If you are willing please would you complete the form below and return it to the nursery school. All information will be handled with the strictest confidence.

Thank you once again for your help with this survey.

Yours sincerely,

Janet A.Rayner
Lecturer in Preventive and Children's Dentistry

I would like/would not like a dental hygienist to visit me at home.

Signature .....
(Parent/Guardian)

Address.....
.....
.....
Tel. No. .....

APPENDIX 3

QUESTIONNAIRES

DENTAL HEALTH EDUCATION FOR NURSERY SCHOOL CHILDREN

NAME OF CHILD _____ Ser.No. _____

NAME OF PARENT/GUARDIAN _____ School No. _____

ADDRESS _____ Quad No. _____

_____

Date of Interview _____

"Hello Mrs..... I am Mrs. Fiona Kennedy, the dental hygienist assisting Miss Janet Rayner in the nursery school dental survey. I understand that Miss Rayner has written to you and that you have very kindly agreed to let me ask you some questions about your child's teeth and also to tell you the best way of looking after them.

Would it be it be convenient for me to see you now ____

0 - No, 1 - Yes, 2 - Further appointment ____

Your child's name is .....

He/she attends ..... nursery school

1 - Albany	2 - Balgreen	3 - Burdiehouse	____
4 - Greengables	5 - Inchview	6 - Silverknowes	
7 - Stanwell	8 - Westfield Ct.	9 - High School Yards	____
10 - Grassmarket			

Does he/she attend nursery ____

1 - A.M. 2 - P.M. 3 - Fulltime ____

I would now like to ask you some questions about toothbrushing:

1) Does your child brush his/her teeth at home (or have them brushed?) ____

0 - No, 1 - Yes ____

2) Who usually brushes your child's teeth?

1 - child ____
2 - parent
3 - parent & child ____
4 - other.....
(write in)

3) How often does he/she brush his/her teeth, or have them brushed?

1 - more than 3 times daily
2 - 3 times daily
3 - 2 times daily
4 - once a day
5 - less than once a day

4) At what time of day does your child brush his/her teeth or have them brushed?

a - before breakfast

b - after breakfast 0 - No 1 - Yes

c - Midday

d - after evening meal

e - before bedtime

f - any other times ..... (write in)

5) Has anyone ever told you or your child how to care for your child's teeth?

0 - No, 1 - Yes

6) Who gave you this advice?

a - dentist

b - doctor 0 - No 1 - Yes

c - health visitor

d - dental hygienist

e - other

7) Questionnaire no.

(For groups 3 and 4 only go on to Dental Health Education)

DENTAL HEALTH EDUCATION FOR NURSERY SCHOOL CHILDREN

1) Does your child brush his/her teeth at home
(or have them brushed?)

0 - No, 1 - Yes

2) Who usually brushes your child's teeth?

1 - child
2 - parent
3 - parent & child
4 - other.....
(write in)

3) How often does he/she brush his/her teeth, or have them brushed?

1 - more than 3 times daily
2 - 3 times daily
3 - 2 times daily
4 - once a day
5 - less than once a day

4) At what time of day does your child brush his/her teeth or have them brushed?

a - before breakfast
b - after breakfast
c - Midday
d - after evening meal
e - before bedtime
f - any other times .....
(write in)

0 - No
1 - Yes

5) Questionnaire no.

(For group 3 and 4 only, go on to Dental Health Education)

DENTAL HEALTH EDUCATION FOR NURSERY SCHOOL CHILDREN

1) Does your child brush his/her teeth at home
(or have them brushed?)

0 - No, 1 - Yes

2) Who usually brushes your child's teeth?

1 - child
2 - parent
3 - parent & child
4 - other.....
(write in)

3) How often does he/she brush his/her teeth, or have them brushed?

1 - more than 3 times daily
2 - 3 times daily
3 - 2 times daily
4 - once a day
5 - less than once a day

4) At what time of day does your child brush his/her teeth or have them brushed?

a - before breakfast

b - after breakfast 0 - No
1 - Yes

c - Midday

d - after evening meal

e - before bedtime

f - any other times .....
(write in)

5) Questionnaire no.

This is my last visit to you. I hope the information I have given has been of value to you and that you will continue to take an interest in the dental health of your child. Thank you for agreeing to take part.

APPENDIX 4

EXAMINATION CHART

EXAMINATION CHART - Side 1

NAME .....

Serial [1] [2] [3] Date of Birth [4] [5] [6] [7] [8] [9] Date of Exam [10] [11] [12] [13] [14] [15]

School [16] [17] Sex (0) M (1) F [18] Exam No. [19]

Oral Hygiene

	E				B				E				
	B	L	M	D	B	L	M	D	B	L	M	D	
UR	20	21	22	23	24	25	26	27	28	29	30	31	UL
LR	32	33	34	35	36	37	38	39	40	41	42	43	LL
	B	L	M	D	B	L	M	D	B	L	M	D	
	E				B				E				

Gingivitis

	E				B				E				
	B	L	M	D	B	L	M	D	B	L	M	D	
UR	44	45	46	47	48	49	50	51	52	53	54	55	UL
LR	56	57	58	59	60	61	62	63	64	65	66	67	LL
	B	L	M	D	B	L	M	D	B	L	M	D	
	E				B				E				

APPENDIX 5

CALCULATIONS FOR THE CONSISTENCY OF DIAGNOSIS

Calculation of the statistical tests used for the consistency of diagnosis

A. Proportion agreement (percent reproducibility)

This method of calculation reproducibility suggested by Jackson (1966) can be illustrated using the following formula:

$$p = \frac{b}{(a + b)} \times 100$$

p = % reproducibility
a = number of sites/teeth with disagreement
b = number of sites/teeth with consistment agreement

Data for oral hygiene, gingivitis and dental caries was entered into a contingency table as shown in Table 93 and the value of p calculated as shown.

B. Dice's Coincidence Index

The index is calculated from the following formula using data entered into the contingency table (Table 93).

$$\text{sound (present)} = \frac{a}{(a+c) + (a+b)} \qquad \text{decayed (absent)} = \frac{d}{(b+d) + (c+d)}$$

The index was calulated for dental caries and gingivitis.

Table 93

A contingency table for the comparison of the diagnosis of caries experience by the same examiner on two separate occasions.

		First Evaluation		
		Sound	dmft	Total
Second Evaluation	Sound	a	b	a + b
	dmft	c	d	c + d
	Total	a + c	b + d	

a = sound at the first and second evaluation
b = decayed, missing or filled at the first evaluation and sound at the second evaluation
c = sound at the first evaluation and decayed, missing or filled at the second evaluation
d = decayed, missing or filled at both evaluations

$$P = \frac{a + d}{a + c + d + b} \times 100$$

C. Kappa Statistics

Unweighted Kappa

The Kappa statistic is calculated from the following formula:

$$K = \frac{po - pe}{1 - pe}$$

where po is the percentage agreement observed and pe is the percentage agreement expected. The coefficient K is the proportion of agreement after chance agreement is removed from consideration. The value of K can range from 1 (perfect agreement) to any negative value. Landis & Koch (1977) interpreted Kappa values so that researchers could interpret their meanings.

0.0 - 0.20	slight agreement
0.21 - 0.40	fair agreement
0.40 - 0.60	moderate agreement
0.61 - 0.80	substantial agreement
0.81+	perfect agreement.

Weighted Kappa

The weighting system applied for oral hygiene is as follows:

		examination 1		
		good	fair	poor
examination 2	good	1.0	0.5	0
	fair	0.5	1.0	0.5
	poor	0	0.5	1.0

C. Paired t tests

The duplicate data was also analysed using paired t tests on mean mouth scores for caries, gingivitis and oral hygiene.

D. Reliability Coefficient

$$\text{Reliability coefficient (r)} = \frac{\text{total variance - error variance}}{\text{total variance}}$$

(Rugg-Gunn & Holloway 1974)

In the present study error variance (Se) was calculated using Dahlberg's direct method (Dahlberg 1940) as recommended by Rugg-Gunn et al (1976).

$$Se = \frac{d^2}{2N}$$

where d = difference between routine and re-examination scores
N = number of subjects re-examined

APPENDIX 6

CALCULATIONS FOR THE COST OF THE PREVENTIVE PROGRAMME

a. Mean time spent per child in each preventive programme, including and excluding, travelling time.

Group	Number of children at second examination	Mean time/child excluding travelling time	Mean time/child including travelling time
	n	**hours/child**	**hours/child**
Brushing	102	$\frac{84}{102} = 0.82$	$\frac{84 + 33}{102} = 1.14$
Brushing & Visits	107	$\frac{95 + 169}{107} = 2.46$	$\frac{95 + 15 + 169 + 134}{107} = 2.92$
Home visits	120	$\frac{174}{120} = 1.45$	$\frac{174 + 46}{120} = 1.83$

b. The cost, excluding and including, travelling time of preventing one P.I. unit of plaque accumulation using actual and adjusted baseline values.

This was calculated using the following formula:

$$\text{cost of preventing one P.I. unit of plaque accumulation} = \frac{\text{the mean input in hours/child}}{\text{P.I. unit difference between the control and experimental group at the second examination.}}$$

Group	True Baseline		Adjusted Baseline	
	excluding travel	including travel	excluding travel	including travel
	hours	**hours**	**hours**	**hours**
Brushing	$\frac{0.82}{1.36} = 0.60$	$\frac{1.14}{1.36} = 0.84$	$\frac{0.82}{1.74} = 0.47$	$\frac{1.14}{1.74} = 0.65$
Brushing & visits	$\frac{2.46}{1.56} = 1.57$	$\frac{2.92}{1.56} = 1.87$	$\frac{2.46}{1.49} = 1.65$	$\frac{2.92}{1.49} = 1.95$
Visits	$\frac{1.45}{1.37} = 1.06$	$\frac{1.83}{1.37} = 1.33$	$\frac{1.45}{1.25} = 1.16$	$\frac{1.83}{1.25} = 1.46$

c. **The cost, excluding and including, travelling time of preventing one G.I.unit of gingival inflammation using actual and adjusted baseline values.**

This was calculated from the following formula:

$$\text{The cost of preventing one G.I. unit of gingival inflammation} = \frac{\text{the mean input in hours/child}}{\text{G.I. unit difference between the control and experimental groups at the second examination.}}$$

Group	True Baseline excluding travel	True Baseline including travel	Adjusted Baseline excluding travel	Adjusted Baseline including travel
	hours	**hours**	**hours**	**hours**
Brushing	$\frac{0.82}{0.16} = 5.12$	$\frac{1.14}{0.16} = 7.12$	$\frac{0.82}{0.11} = 7.45$	$\frac{1.14}{0.11} = 10.36$
Brushing & visits	$\frac{2.46}{0.27} = 9.11$	$\frac{2.92}{0.27} = 10.81$	$\frac{2.46}{0.24} = 10.25$	$\frac{2.92}{0.24} = 12.17$
Visits	$\frac{1.45}{0.30} = 4.83$	$\frac{1.83}{0.30} = 6.10$	$\frac{1.45}{0.30} = 4.83$	$\frac{1.83}{0.30} = 6.10$

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EXAMINATION CHART - Side 2