

# The dental caries status of Scottish adolescents reported to be regular attenders. Initial results from a primary dental care based research network.

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**Aim** To investigate the caries status of, and the delivery of care to, a group of regularly attending adolescent dental patients. To conduct research in primary dental care. A subsidiary aim was to compare the caries status of this sample to population samples.

**Setting** General dental practices across Scotland.

**Design** A 3-year cohort study.

**Subjects** 41 volunteer general dental practitioners and 616 adolescent patients (mean age = 12.1 years at baseline) defined by the practitioners as 'regular' attenders.

**Results** All practices remained in the study. 403 subjects were seen at both baseline and final examination and 329 were examined at all 4 annual examinations. The mean D<sub>3</sub>MFT (dentine caries threshold) was 1.8 at baseline and 3.9 at the final examination, three years later. Of the 541 subjects seen at baseline 62% had experienced either restored or unrestored dental caries. Thirty-four percent of all those examined at baseline had all the unrestored dental caries. The majority of the disease was to be found in the molar teeth, particularly the first permanent molars. The provision of sealants was relatively high with 85% of subjects having at least one sealed tooth by the final examination. Although disease levels were related to socio-economic status, the Care Index was not.

**Conclusions** The 'regularly attending' subjects had a better normative level of dental health than their peers in the Scottish population. However, wide variation was found. The project also demonstrated the feasibility of undertaking research in partnership with general dental practitioners.

The Strategies for Caries Control Study (SCCS), undertaken by the Dental Health Services Research Unit, University of Dundee in collaboration with general dental practitioners in Scotland, originated in the mid-1980s and its inception was a response to the major changes in the views of many dentists as to the most effective methods of treating caries.<sup>1</sup> These changes in care philosophy involved a move from a restorative to a preventive and minimal interventional approach. In part, these changes in approach had come about as a result of advances in the understanding of the carious process, recognition of the variation in diagnostic and treatment decisions and developments in dental materials. There was, at that time concern as to whether general dental practitioners (GDPs) had adopted these modern preventive orientated and minimally destructive approaches to the treatment and prevention of caries.<sup>1</sup>

The project was divided into two phases and data gathering commenced in 1987. SCCS Phase 1 consisted of a postal questionnaire which was sent to all primary care dentists in Scotland and an interview of 211 dentists (50.5% of those volunteering to be interviewed). The results of the questionnaire and interview studies have been published.<sup>2-4</sup>

The second phase of SCCS, of which this paper presents initial results, can be described as a pragmatic clinical study. It took the form of a three year cohort study, commencing in 1991, in volunteer dental practices across Scotland. These practitioners were working under a capitation system for the entire length of the project rather than a fee-for-item of service system.

The main aim of SCCS Phase 2 was to examine the delivery of caries control care to regularly attending adolescent patients. This paper will present the project's methodology, specifically it will demonstrate the successful development of a Primary Dental Care Based Research Network. Results relating to the normative dental caries status of regularly attending adolescent subjects of this Network will be presented. This will be related to attendance and the effect of social class on oral health. Further, the value of the practitioners' own interpretation of attendance behaviour will be discussed. This paper presents data for a United Kingdom (U.K.) sample at the D<sub>1</sub> caries into enamel and dentine diagnostic threshold.<sup>5,6</sup>

## Method

Ethical approval was obtained from the relevant committee and all practitioners and patients gave informed consent.

### Population to be studied: General Dental Practitioners

All the GDPs who participated in the interview component of the study (SCCS Phase 1) were invited to participate in Phase 2. Initial interest in participation was first determined by letter and was followed by an explanatory booklet describing the planned project. The GDPs who continued to indicate a willingness to participate were then visited by two researchers to explain the study protocol, including the implications for the GDPs themselves and their practices.

### Population to be studied: Patients

The dentists provided the patient sample by each supplying the names of 30 adolescent patients; the only criteria for patient selection was that the patient should be between 11–13 years old and, in the opinion of their general dental practitioner, a regular attender. A regular attender was defined as 'someone whom they believed would keep appointments', as the practitioner's opinion was considered to be a predictor of attendance behaviour. They were specifically asked not to select on other criteria, such as caries status. Each list was randomised and fifteen patients per list were invited to participate. If a patient refused, the next person on each list was invited to take part until each dentist's quota was completed.

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**Benchmark examination**

A standardised dental examination of each subject was undertaken annually by one trained and calibrated examiner (CD). The visit to each practice was co-ordinated with the practice and occurred over two consecutive days. In subsequent years these examinations were arranged to occur as near as possible on the anniversary of the initial visit. All subjects were invited to attend for their routine check-up from their GDP and the study examination. The subjects were first seen by their GDP and then by the study examiner.

The study examinations of each subject were conducted in a mobile dental surgery, which offered a number of advantages:

- Standardised examination conditions of dental surgery standard including: dental light (Daray 'Operating Light 2', Daray Lighting Ltd, Bedfordshire, UK); dental unit with a three-in-one syringe; and a prophylax handpiece.
- Optimal examination position, with the subject supine in a dental chair.
- Radiographs were taken at the first and fourth examinations, the mobile surgery provided a suitable site, and standardised equipment for this (65 Kv Phillips Oralex, Phillips Corporation, Eindhoven, Netherlands).
- It reduced inconvenience to the volunteer dental practices, by negating the need to use a surgery in the practice.

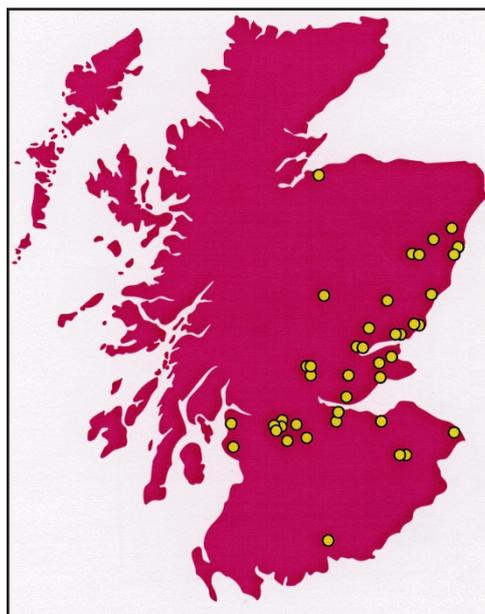
**Examination protocol**

Following their regular check-up by their GDP the subjects were examined in the mobile surgery. The teeth were cleaned and dried as necessary, and the oral condition was then recorded using the following criteria:

1. Caries at the D<sub>1</sub> diagnostic threshold (Table 1).<sup>5,6</sup>

**Table 1 The clinical caries diagnostic criteria used in the Strategies for Caries Control Study examinations (after Pitts and Fyffe, 1988).**

Code	Category	Criteria
0	Surface sound	A tooth is recorded as sound if it shows no evidence of treated or untreated clinical caries (slight staining is permitted).
1	Initial caries	No clinically detectable loss of substance. For pits and fissures there may be staining, discolouration, or rough spots in the enamel, but where rough spots can not be positively diagnosed. For smooth surfaces there may be white, opaque areas with loss of lustre. This code will be sub-divided:
1W	Enamel caries	White spot lesion
1B	Enamel caries	Brown spot lesion
2	Enamel caries	There is demonstrable loss of tooth surface in pits and fissures, or on smooth surfaces, but no undermined enamel. The texture of the material within the lesion may be chalky or crumbly, but there is no evidence that the lesion has penetrated the dentine.
3	Caries of dentine	There is the appearance of a carious lesion extending into dentine. This code will be sub-divided:
3P	Caries of dentine	A lesion in dentine, if cavitation present, less than 0.5 mm in diameter
3L	Caries of dentine	A lesion in dentine greater with cavitation greater than 0.5 mm in diameter.
4	Pulpal involvement	Deep cavity with probable pulpal involvement.



**Fig. 1 The location of the 41 practices**

2. Restoration quality<sup>7</sup>
3. Pit and fissure sealant quality.<sup>8</sup>
4. Gingival health, as a proxy for oral hygiene.<sup>9</sup>

In the second year the presence of enamel opacities was recorded, this was conducted prior to tooth cleaning.<sup>10</sup>

At the baseline and final examination, right and left bitewing radiographs were exposed (0.2s; 65 Kv; Kodak, Ektaspeed, Super Polysoft, E.P.22) with rectangular collimation and Rinn film holders and aiming device (Rinn XCP, Rinn Corporation, Illinois, USA). If the subject could not tolerate the holder a paper tab was used to hold the film in place. All films were developed using an automatic processor (Velopex Intra-X, Medivance Instruments Limited, London, UK). Double film packets (EP 22) were used and therefore it was possible to give each subject's GDP a copy of the film.

The radiographic films were randomised and read, by one examiner (CD), at the end of the first and fourth years. The viewing and coding of the radiographs was conducted under standardised and optimum conditions.<sup>11</sup> The radiographic codes and criteria used were those proposed by Pitts (1984) originally for approximal surfaces.<sup>12</sup>

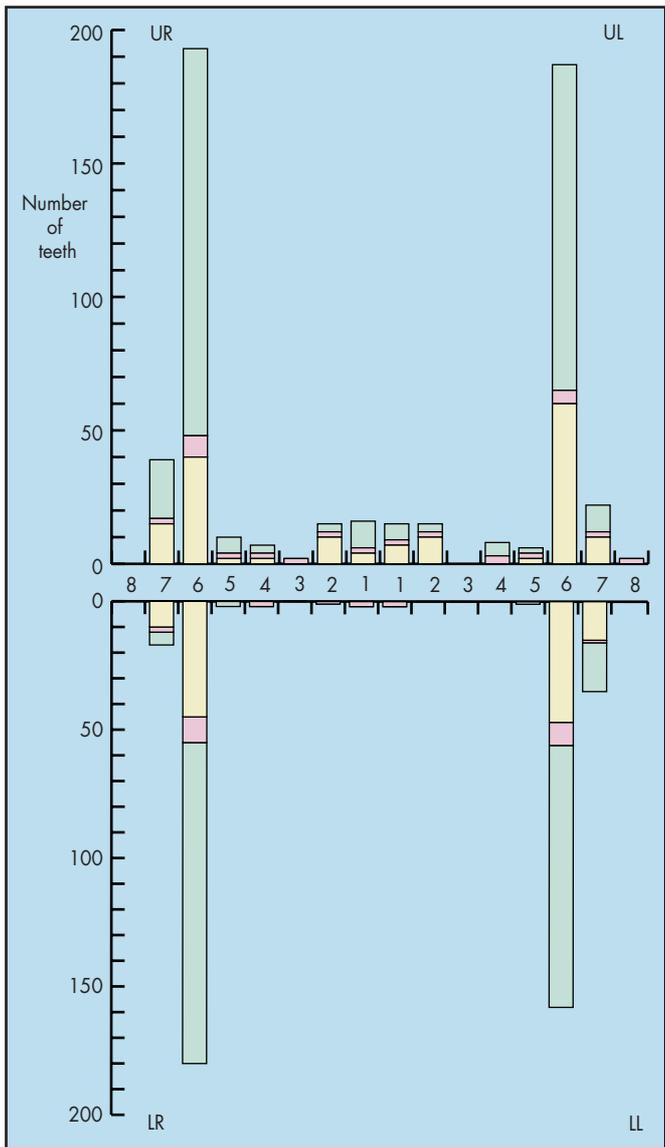
The clinical examination for the diagnosis of caries and assessment of restoration quality was entirely visual. The criteria for coding dentinal caries divides lesion severity into cavities greater or less than 0.5mm in diameter. A CPITN probe was available to assist with this judgement but teeth were not probed to establish caries status.

**Reproducibility**

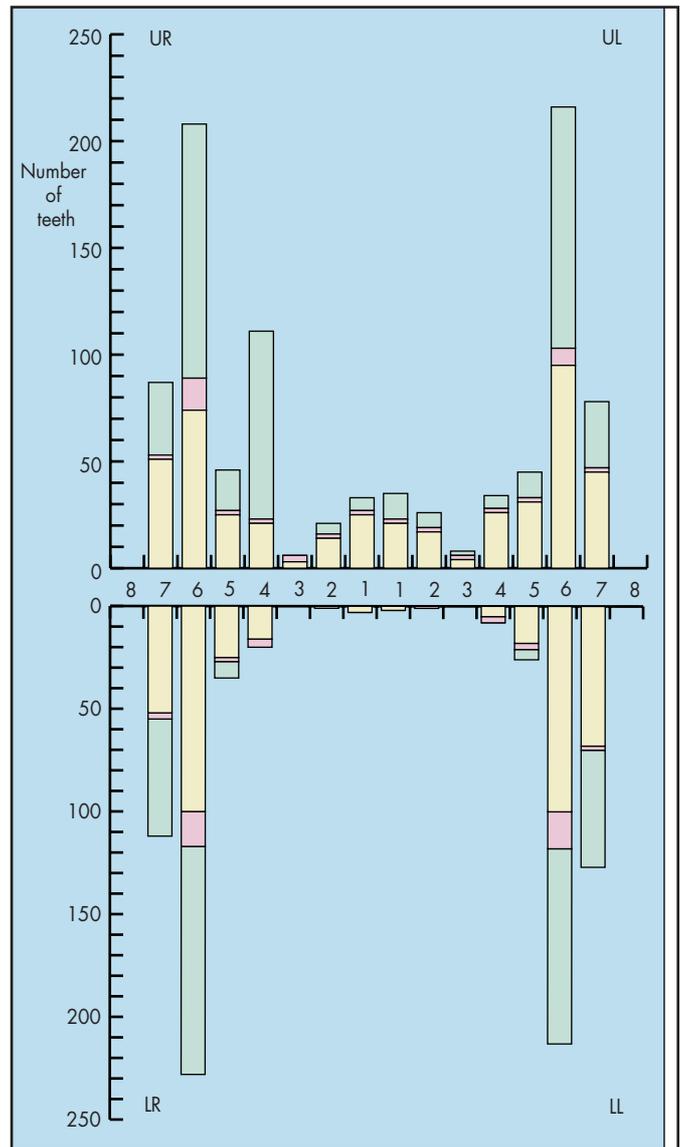
Towards the end of each set of annual examinations the study examiner conducted a reproducibility exercise on an age-matched sample of 15 subjects from a local secondary school under identical conditions to those of the main study. In the final year, to ensure an adequate sample, seven patients from one of the study dentists also agreed to be re-examined, maintaining a reproducibility sample of 15 subjects. All of these subjects were examined twice. These two examinations were conducted at least a week apart. A random sample of the radiographs were read twice to assess repeatability; this exercise was blind. At no time did the study examiner and the volunteer practitioners confer.

**General Dental Practitioner and patient data gathering**

The GDPs were asked to record each subject's oral condition in as much detail as possible at the time of the annual benchmark examination. They were also asked to record all care provided over the



**Fig. 2** Number of decayed, missing and filled teeth ( $D_3MFT$ ) at the baseline examination, by tooth (Clinical visual examination data only), for all subjects seen at this examination ( $n=541$ ). Green, filled; Red, missing; Yellow, decayed.



**Fig. 3** Number of decayed, missing and filled teeth ( $D_3MFT$ ) at the final examination, by tooth (Clinical visual examination data only), for all subjects seen at this examination ( $n=432$ ). Green, filled; Red, missing; Yellow, decayed.

course of the following year. The patients and their parents were asked to complete a questionnaire to determine their views on the importance of oral health and dental care. Initial results of these data have been presented and after further analysis these data will be presented in subsequent papers.<sup>13</sup>

## Results

### General Dental Practitioner sample

Forty-one GDPs from 38 practices volunteered to participate in the

project. The majority of the participants were male practice principals, who had graduated from a Scottish University. The location of the practices are presented in Figure 1. All practices remained in the study throughout the project. However, one GDP withdrew due to ill health after the second year and his colleagues in the practice kindly continued with the provision of the data.

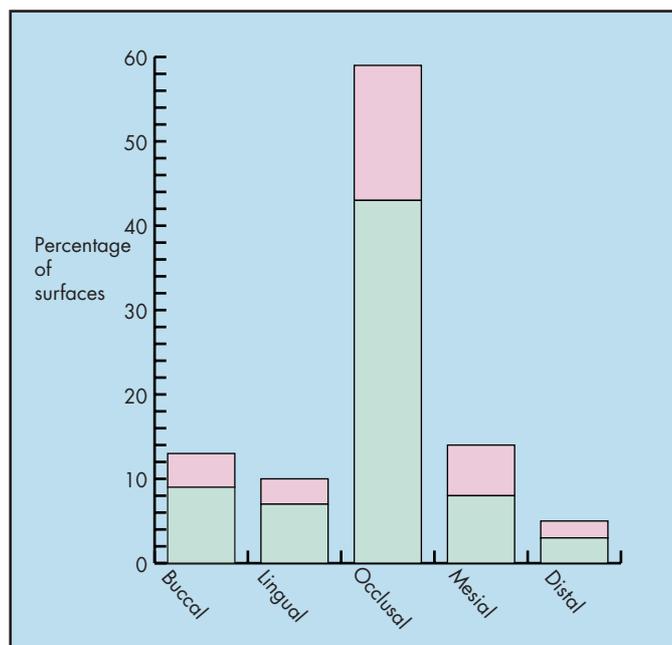
The mean interval between the baseline and year 1 visit; year 1 and year 2 visits; and year 2 and final visit were 373 (s.d. 22.9) days; 364 (s.d. 37.1) days; and 364 (s.d. 36.7) days respectively.

**Table 2** Baseline and final tooth and surface caries experience, radiographic data excluded.

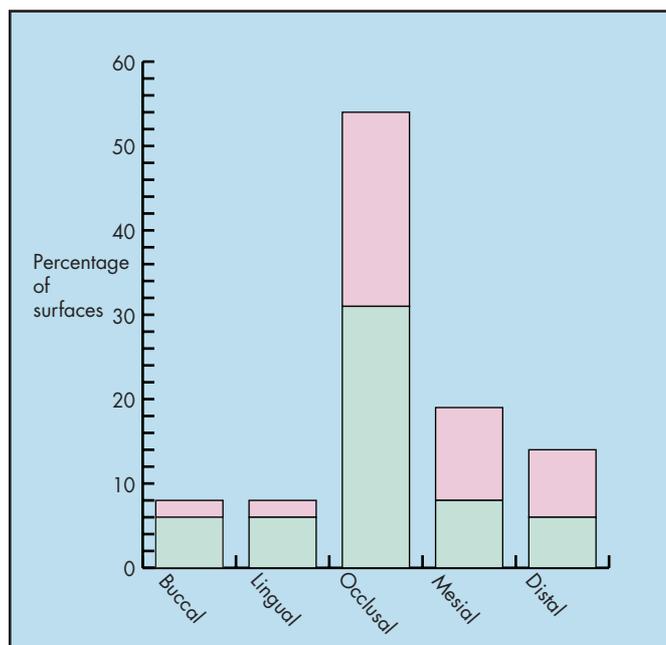
	Baseline ( $n=541$ )		Final ( $n=432$ )	
	Mean	Range	Mean	Range
$D_3T$	0.58	0-6	2.04	0-19
$D_1T$	6.01	0-25	11.05	0-28
MT	0.05	0-4	0.12	0-1
FT	1.14	0-10	1.74	0-11
$D_3S$	0.67	0-9	2.40	0-32
$D_1S$	9.90	0-61	22.52	0-93
FS	1.70	0-19	3.11	0-24
$D_3FS$	2.36	0-24	5.50	0-42
$D_3MFT$	1.78	0-15	3.90	0-20

**Table 3** Baseline and final tooth and surface caries experience, radiographic data included. Only subjects who were radiographed included.

	Baseline ( $n=525$ )		Final examination ( $n=397$ )	
	Mean	Range	Mean	Range
$D_3T$	2.10	0-15	4.85	0-20
$D_1T$	7.90	0-27	13.25	0-28
$D_3S$	2.50	0-27	5.98	0-39
$D_1S$	14.27	0-77	28.08	0-96
$D_3FS$	3.75	0-32	8.36	0-45
$D_3MFT$	2.86	0-16	6.02	0-21



**Fig. 4** Distribution of caries experience by surface (D<sub>3</sub>FS) at the baseline examination (Clinical visual examination only). For all subjects seen at this examination (n = 541). Red, D<sub>3</sub> decay; Green, filled.



**Fig. 5** Distribution of caries experience by surface (D<sub>3</sub>FS) at the final examination (Clinical visual examination only) For all subjects seen at this examination (n = 432). Green, filled; Red, D<sub>3</sub> decay.

**Patient sample**

Six hundred and sixteen patients volunteered to participate in the project. This is the number of patients the project aimed to recruit (15 patients per practitioner). The mean age of the sample at baseline was 12.1 years (s.d.= 0.9). Approximately half the sample were male and half female (females=310: males=306). Three hundred and twenty nine (53.2% of those consenting) subjects attended for all visits and 403 (65.4%) subjects were seen at both the baseline and final examination. Only 34 (5.5%) subjects were not seen at any examination.

The overall mean D<sub>3</sub>MFT was 1.8 at baseline and 3.9 by the final examination (Tables 2 and 3). Figure 2 shows the distribution of caries experience (D<sub>3</sub>MFT) by tooth for the baseline examination. Likewise, Figure 3 shows the equivalent distribution for the final examination.

Figures 4 and 5 display the distribution of decay experience (D<sub>3</sub>FS) by surface at baseline and final examinations respectively. The majority of the caries experience, both restored and unrestored, was found in the occlusal surfaces at both examinations, 58% at baseline and 53% at the final examination.

Sixty two percent of the subjects examined at baseline had experienced decay at the caries into dentine threshold (D<sub>3</sub>MFT>0), this had increased to 79% by year 3. There was an uneven distribution of the disease at baseline, a minority of the subjects (34%) having all the unrestored dental caries.

At baseline 78.6% of subjects had one or more sealed surfaces (mean number per subject = 3.34: range = 0-16). At the final examination 85% of subjects had at least one sealed surface (mean number per subject = 4.11: range = 0-16).

The majority of the caries experience (D<sub>3</sub>MFT) was found in the permanent molars at baseline (87.5%) and at year 3 (76.4%). The bulk of the unrestored dental decay was also present in these teeth at both examinations. At baseline, second permanent molar teeth accounted for a fifth of the carious teeth (60/316) and first permanent molar teeth accounted for three fifths (198/316) of the carious teeth. By the final examination second molar teeth accounted for a quarter (229/882) of lesions and first molars two fifths (372/882).

The Care Index (FT/D<sub>3</sub>MFT) was 0.64 at baseline and 0.45 by the final examination.<sup>14</sup>

Socio-economic status as determined by the Carstairs Score and its associated Deprivation Category (DEPCAT) is based on census data available by postcode of residence. Table 5 presents (DEPCAT score) caries experience by DEPCAT (1=high socio-economic status) at the baseline and final examinations and likewise for the Care Index in Figure 6.<sup>15</sup>

The incorporation of data from the radiographic examination increased the D<sub>3</sub>MFT from 1.8 to 2.9 and 3.9 to 6.0, at the initial and final examinations, respectively (Table 2 and 3).

**Reproducibility**

The results of the baseline and final clinical reproducibility exercises are presented in Table 4.

**Discussion**

The GDPs used in this study were volunteers, rather than a random sample. Volunteers are by definition different to a random sample and differences between volunteers and non-volunteers have been demonstrated in dentistry.<sup>16</sup> Due to the terms of the GDPs' NHS contract and the need for a high level of co-operation over the period of this longitudinal study, the only suitable option was to recruit volunteer GDPs. To place these GDPs in context the practice profiles of 39 GDPs, who consented, were accessed through the Scottish Dental Practice Division. Practice profiles are standard summaries of practitioners' prescribing and fee income patterns, comparing the individual practitioner with Health Board and National means. No differences between the SCCS sample and their colleagues in the GDS in Scotland as a whole were identified.

The dentists were asked to select the patients on the basis of attendance only. The significance of the patients being 'regular' attenders was that it offered the full opportunity for each GDP to provide care as they deemed appropriate, although it is recognised that individual patients will have different abilities to comply with care advised. The 1993 survey of Children's Dental Health in the United Kingdom reported 66% of 12 year olds claiming to regularly attend the dentist, defined as someone who had attended in the previous 6 months for a 'check-up'.<sup>17</sup> This is an equivalent level to that reported for a similar age group from examination of dental records.<sup>18</sup> In the

**Table 4 Results of baseline and final reproducibility exercises expressed by the kappa statistic.**

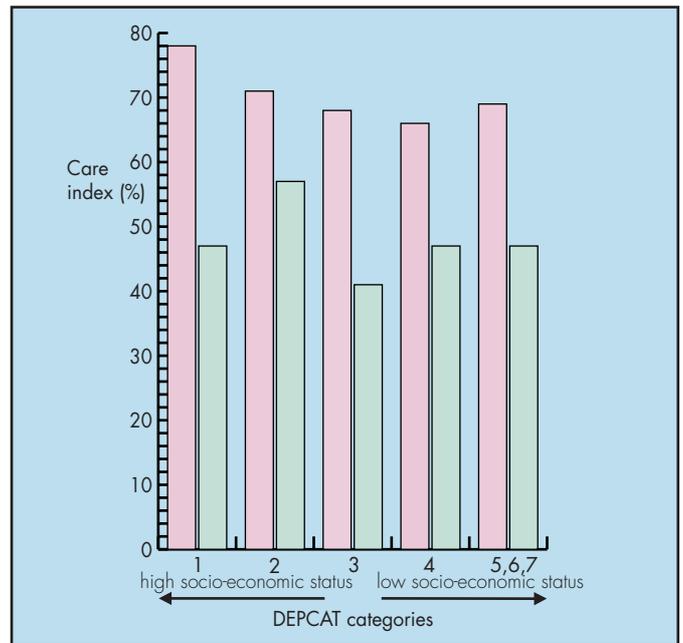
	Baseline examination	Final examination
D <sub>3</sub> MFT	0.80	0.82
D <sub>3</sub> MFS	0.78	0.86
D <sub>1</sub> T	0.80	0.79
D <sub>1</sub> S	0.74	0.70
MT	no missing teeth to permit analysis	1.0
FT	0.90	0.63
FS	0.86	0.59
Sealed Surface	0.94	0.85
Number of subjects	15	15
radiographs	0.78	0.76
% of main of sample	7.2	8.0

present study 65.4% of subjects were seen at both the baseline and final examination and 53.2% of subjects were seen at all four examinations. The subjects had a small window of two days to attend. This became particularly problematic at examination-time and when subjects were on work experience and holiday periods also presented problems. From conversation with the practitioners we are aware that many of the subjects who were unable to attend for the study examination were still attending for regular care (it should be remembered that the subjects were registered under the Capitation Scheme and therefore attended with some degree of regularity, in order to remain registered). This suggestion is supported by the 586 subjects who returned questionnaires in the final year and therefore can be considered to have remained part of the project.<sup>13</sup> Taking these factors into account attendance was high indicating that the practitioners perception of attendance pattern was as accurate as other measures of predicting attendance.<sup>18</sup>

Over the period of the study there was a substantial rise in the caries experience in the cohort. The 1992/93 Scottish Health Boards' Dental Epidemiological Programme (SHBDEP) survey of children provides the closest opportunity for comparison of the SCCS sample with the Scottish population of 12 year old children as a whole.<sup>19</sup> The sample of 'regular' attenders had a slightly lower mean D<sub>3</sub>MFT of 1.8 compared with the 2.1 of the SHBDEP sample. The components of the D<sub>3</sub>MFT Index were slightly higher in the SHBDEP sample except for the number of filled teeth: D<sub>3</sub>T=0.87, MT=0.19 and FT=1.01, compared with D<sub>3</sub>T= 0.58, MT=0.05, and FT=1.14 for the present study. As might be anticipated for a sample of dental attenders, the result of the Care Index calculation was higher at 0.64, compared with 0.49 for the SHBDEP sample.

The radiographic examination showed a significant diagnostic yield in addition to clinical examination alone, for both occlusal and approximal surfaces and emphasises the need for appropriate radiographic examination.<sup>20</sup>

The proportion of subjects having experienced dentinal caries was 62% which is similar to the 64% reported in the SHBDEP survey. Likewise the figures for the uneven distribution of disease are comparable at 39% of those examined in the SHBDEP survey hav-



**Fig. 6 Socio-economic status (DEPCAT) versus Care Index baseline (n=352) and the final examination (n=308). Data for DEPCAT Category 5,6 and 7 have been united because of the small sample. (Clinical visual examination only). Red, baseline examination; Green, final examination.**

ing experienced all of the unrestored dentinal caries and 34% of the SCCS sample having all of the untreated disease experience.

The preponderance of disease in the occlusal surfaces of the molars was also found in the SHBDEP survey and in other research.<sup>21,22</sup> Figures 2 and 3 demonstrate increasing disease prevalence in the second molars, indicating the need for active prevention by practitioner and patient in these years to protect these teeth.

The 1993 survey of Children's Dental Health in the United Kingdom, reported a higher DMFT for Scottish subjects between the ages of 12 and 15 years, than for the United Kingdom sample as a whole.<sup>17</sup> For example, the mean D<sub>3</sub>MFT at age 12 was 2.0 for the Scottish sample and 1.3 for the UK sample.

Sixty percent of 12 year olds in the Scottish sample had at least one sealed permanent tooth, a similar proportion to that reported by the SHBDEP survey the previous year.<sup>19</sup>

Contemporary data at the D<sub>1</sub> diagnostic threshold are not available for other samples of British children, therefore comparison with random population samples is not possible. At the D<sub>3</sub> diagnostic threshold, it would appear that the SCCS sample's dental health is better than that of the Scottish population as a whole, the Scottish population having a greater caries prevalence than the rest of the British population. The finding that this sample of regularly attending patients had better dental health, in general, than samples including less frequently attending counterparts is in agreement

**Table 5 Socio-economic status (DEPCAT) versus dental caries status (D<sub>3</sub>MFT) at baseline and the final examination (excluding radiographic data). Data for DEPCAT 5,6 and 7 Categories united also presented because of small sample. 1= high socio-economic status and 7= low socio-economic status.**

DEPCAT Categories	Baseline examination mean D <sub>3</sub> MFT (n=352)	Baseline examination S.D.	Final examination mean D <sub>3</sub> MFT (n=308)	Final Examination S.D.
1 n=40	0.78	1.33	2.26	2.56
2 n=103	1.50	1.81	3.18	3.27
3 n=97	1.55	1.85	4.10	4.09
4 n=80	1.88	1.96	4.18	3.15
5 n=22	2.45	3.50	5.00	4.66
6 n=6	2.67	1.86	4.57	1.90
7 n=4	1.50	1.29	4.25	2.63
5, 6 & 7 n=32	2.38	3.02	4.82	3.96

with other reports. For example, White and Anderson (1996), in their assessment of the NHS Capitation Scheme demonstrated slightly better dental health among registered patients compared with non-registered individuals.<sup>23</sup> The OPCS National Survey reported similar levels of decay experience between those claiming to be either regular attenders or occasional attenders at the ages of 12 and 15. Those who reported only attending when in trouble had a higher caries experience than those who claimed to attend either regularly or occasionally.<sup>17</sup>

As expected, subjects of lower socio-economic status had higher caries levels (D<sub>3</sub>MFT) than those of higher socio-economic status.<sup>24</sup> However, the value for Care Index was independent of socio-economic status for this sample of 'regular' attenders, a finding which differs from population samples.<sup>24</sup> This may reflect the benefits of dental attendance or may reflect the attitude of the patients to dental health. Further the Index fell for all DEPCAT Categories over the course of the study. The reason for this fall and the level being less than optimal is unclear but may represent a 'wait and see' rather than a restorative philosophy. The fact that practitioners were under a capitation payment system may also have influenced treatment options, although it has been suggested that dentists provide the treatment they feel necessary regardless of administrative system.<sup>25</sup>

Levels of reproducibility were acceptable, however, there was a drop in the Kappa value for filled teeth, filled surfaces and sealed surfaces between the baseline and final examination. This may have been due to the increased use of posterior composites and glass ionomers by the community dental officer whose patients provided this sample.

There is a significant move in the profession to encourage and promote research in and with general practice.<sup>26</sup> The present study has demonstrated the feasibility of this and the benefits which are available from such research, as have other workers.<sup>23,27-29</sup> However, research in general practice requires a great deal of commitment from all involved, in order to overcome the obstacles to successful completion. The next stage in this process is to increase the participation from all dental primary care workers, in all aspects of the research process.

All research has cost implications. For example a mobile surgery was used in the present study which although relatively expensive, offered major advantages particularly to avoid inconvenience and cost to the practices. This is one example of study design being adapted to suit the conditions of primary dental care. All studies should be cost-efficient and this is as true for research in primary dental care as any other field. Although many practitioners give their time freely to conduct research themselves or in collaboration, in well designed research bids the commitment of primary care workers should be recognised. The benefits to the profession and patient outcome are well worth the costs.

## Conclusions

The patients had a slightly better level of dental health than their peers in the Scottish adolescent population as a whole, although there was a wide diversity within this sample of 'regular' attenders.

Throughout the project the volunteer GDPs and their staff provided a high degree of co-operation. The project has demonstrated that research with primary care is possible. The next step in advancing research in primary dental care is to develop further the partnership between the practice and university participants.

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