IN BRIEF

- GDPs seem to be providing appropriate preventive care consistent with the aetiological causes of dental disease.
- Preventive care appears to be provided as an alternative to restorative care for some carious primary teeth.
- Preventive care in these high-risk children appears to be reactive to disease progression and is not particularly effective.
- There were widespread differences in the provision of preventive care amongst GDPs, this and the concerns about effectiveness point to a need for an evidence based and adequately funded prevention programme for GDPs to apply in their practices.

The influences on preventive care provided to children who frequently attend the UK General Dental Service

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Objectives To identify the relationship between the preventive and restorative care provided to children who frequently attend the General Dental Service in the UK after taking into account socio-economic status, gender and dental caries experience.

Setting General dental practices in the North West of England.

Subjects and materials The study design involved a retrospective investigation of case notes of 677 children who regularly attended 50 general dental practitioners. The complete history of the dental care received by each child during the primary dentition period was recorded. Analyses took place at the patient level. Information was recorded on the total number of carious teeth and restorative and preventive care provided to the children. Preventive care was categorised as dietary advice, oral hygiene instruction, prescription of fluoride tablets and application of fluoride varnish. Socio-economic status was measured using the Townsend score of the electoral ward of residence of each subject. Logistic regression models, taking into account the clustering of the subjects within dental practices were fitted to identify whether or not socio-economic status was significantly associated with provision of each category of preventive care, after controlling for gender, the total number of teeth affected by caries and the proportion of carious teeth which were restored.

Results Children from poorer backgrounds were significantly more likely to receive oral hygiene instruction than their more affluent peers. Socio-economic status did not influence dentists' decisions to prescribe fluoride tablets, but children from affluent backgrounds were significantly more likely to have fluoride varnish applied to their teeth than children from deprived backgrounds after controlling for other factors. The more teeth affected by decay significantly increased the odds of giving dietary advice, prescription of fluoride tablets and

application of fluoride varnish, but had no effect on whether or not oral hygiene instruction was given. As the percentage of decayed but filled teeth decreased the odds of giving dietary advice or applying fluoride varnish increased significantly.

Conclusion It would appear that dentists are providing appropriate preventive care according to the aetiological causes of dental disease. They also look to be providing preventive care in compensation for decisions not to restore carious primary teeth. However the preventive care provided seems to be reactive to disease patterns, and in this high risk group of patients does not seem to be particularly effective.

Prevention of dental caries is most effectively tackled at the population level through public health interventions such as water fluoridation.¹ However, there is a role for general dental practitioners (GDPs) to play in primary prevention,² especially amongst children who attend their surgeries on a regular basis. It is clear that trying to control dental caries by placing restorations is expensive and doomed to failure if the oral environment remains amenable to the development of dental caries. Recent questions have been asked of the merits of restoring primary teeth in the General Dental Service (GDS).³ Milsom *et al.*⁴ in a series of analyses demonstrated that the total number of carious primary teeth was the most important determinant of whether or not a child experiences dental pain, and, in the GDS at least, the proportion of carious teeth restored did not significantly influence pain experience. A separate and contemporary study⁵ also looked at the outcomes of unrestored primary teeth attending two dental practices in the North of England and found that over 80% of carious unrestored primary teeth remained symptomless until natural exfoliation. Therefore it is probably more appropriate to shift the focus of the care young children receive in the GDS onto prevention. This approach has been advocated in the past,⁶ but in order to make informed policy decisions we need a greater understanding of how preventive care is provided in the GDS and whether or not it is effective.

The factors that influence dentists' decisions about the care they provide for children are multiple, complex and interrelated.^{3,7} One factor which may be influential is a difference in the quality of healthcare provided to the rich and poor in society. Research by medical colleagues has suggested that patients from less affluent

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backgrounds are more likely to receive shorter consultations.⁸ More recently in primary dental care Tickle *et al.*⁹ have demonstrated that regularly attending children from less affluent backgrounds are more likely to be treated by extraction than their more affluent counterparts. If there are socio-economic inequalities in the provision of preventive advice and treatment given to children attending the GDS this would give cause for concern, as children from deprived backgrounds should benefit most from preventive care because they are more likely to have higher levels of caries¹⁰ and poorer oral hygiene.¹¹ Therefore one would hope that children from less affluent backgrounds should receive more, rather than less preventive care than their more affluent counterparts.

Regularly attending children who are prone to developing new carious lesions represent a real problem group of patients for GDPs. The intensity of preventive care should be related to each patient's risk of developing the disease but it may also be related to the amount of restorative care provided. There has been a dramatic fall of the restorative index in 5-year-old children over the last 15 years¹² and some commentators have registered concerns about 'supervised neglect',¹³ that is dentists watching caries develop in the primary dentition and providing no care. Although the original capitation studies could find no evidence for this practice,¹⁴ Tickle *et al.*³ have recently demonstrated that GDPs selectively chose not to restore some primary molar teeth. The authors postulated that these findings could be a manifestation of a holistic approach to the dental care of children, a philosophy which underpinned the policy decision to move to a capitation payment system for the care of children in the GDS. The adoption of this philosophy was empirically supported by the findings of Lennon *et al.*¹⁵ who demonstrated an increase in prevention activity under capitation. It could be that dentists who have problem patients with caries-active mouths are concentrating on preventive care at the expense of restorative care. Therefore if allegations of supervised neglect are incorrect one would expect to see an increased preventive care for those children with multiple unrestored carious teeth.

Our research team has recently reported on the outcomes of restorative care of the primary dentition provided in a group of GDS practices.^{3,4} This paper reports on additional data collected during the study concerning the provision of preventive care in the GDS. The aim of this aspect of the study was to gain an understanding of the preventive care provided to children with caries who frequently attend the GDS. More specifically the study attempts to identify the relationships between:

- Restoration/non-restoration of the primary dentition
- Socio-economic status
- Dental caries experience
- Gender

and the preventive care provided.

METHOD

Data were collected retrospectively from the clinical case notes of 677 children attending 50 general dental practices in four health authorities in the North West Region of England. The study population was the same and the data collection methods were similar to those previously reported in the *British Dental Journal*.⁴ Before each dentist was recruited to the study they had to meet a set of criteria. They must have had at least 10 children who were born between 1/1/84 and 31/12/85. Dentists with more than 20 patients meeting the patient selection criteria had 20 cases selected at random for inclusion in the study. These children must have had their care provided by the same dentist from or before 31/12/90. Therefore the complete dental history of these children during the primary dentition period was available and the relationship with the dentist responsible for their care was continuous throughout this period.

GDPs can only have an influence on the dental health of children who attend on a regular and frequent basis. Therefore only frequent attenders were included in the study, and frequent attenders were defined as those children attending the dental surgery at least once every 18 months from 31/12/90 up to September 1999, when the data were collected. Only children who had a history of interproximal caries experience in their primary molars were included in the study. These represent problematical patients for GDPs as they attend regularly but are prone to caries.

The data were transcribed from the children's clinical records by trained and calibrated data abstractors; a data capture proforma was used to guide this process. The data abstractors recorded each time that preventive advice was given or preventive treatment was administered. This care was categorised into:

- dietary advice
- oral hygiene instruction
- fluoride toothpaste advice
- prescription of fluoride tablets
- application of fluoride varnish

The socio-economic status of each subject was measured using the Townsend score¹⁶ of the electoral ward of residence of each subject. This variable was added to the study data file by reference to each subject's postcode and subsequently categorised into quintiles.

All analyses were performed at subject level. The preventive items listed above were used as dependent variables, each of which was dichotomised; for example ever/never prescribed fluoride tablets. Independent variables used in the models included Townsend quintiles, gender, total caries experience, and the percentage of carious teeth treated by restoration. The models produced took into account the clustering of the children within practices using generalised estimating equations with logit link and exchangeable correlation matrix to make the comparisons between the groups.

RESULTS

The study population had a mean Townsend score of -0.17 (SD 3.55) and a range of -6.48 to 10.41. The mean age that these children first attended the dentist was 3.4 years (SD 1.3). The mean age that caries was first recorded was 5.88 years (SD 2.05). The frequency distributions for the provision of preventive advice and treatment were all highly skewed. In the clinical notes of 69.0% (N = 467) of children there was no record of dietary advice given, the mean number of times dietary advice was given was 0.67 (SD 1.57) with a range of 0 - 14. Some 51.3% of children (N = 347) had no record of oral hygiene instruction, and the number of times this preventive advice was recorded as given ranged from 0 - 16. Only 13.9% of children (N = 94) were prescribed fluoride tablets and 14.2% (N = 96) had fluoride varnish applied to their teeth. Only 1% of children (N = 7) had a record of receiving advice about the use of fluoride toothpaste and therefore no analyses were performed using this variable.

There was great variation in the provision of recorded preventive care amongst the 50 GDPs. The mean number of episodes of the four categories of preventive care provided to the children by the 50 dentists ranged from 0 - 9.3 for dietary advice, 0.1 - 10.1 for oral hygiene instruction, 0 - 1.5 for fluoride varnish and 0 - 0.8 for fluoride tablets.

There was no evidence that poorer children received more counselling about their diet than their more affluent peers (OR = 1.19, 95% CIs 0.99, 1.42) (Table 1). In the same model the total number of carious teeth (OR=1.10, 95% CIs 1.01, 1.21) and the percentage of filled teeth (OR = 0.99, 95% CIs 0.98, 0.99) both had significant independent effects on whether or not dietary advice was given. The more teeth affected by decay and the fewer carious teeth that were filled (calculated as a percentage of all carious teeth) significantly increased the odds of the child receiving dietary advice.

Table 1 Odds ratios, 95% confidence intervals and *P*-values from a logistic regression fitted for the dependent variable dietary advice ever/never given independent variables (The clustering of the children within dentist is taken into account in the analysis) (*n* = 658 children in 50 dentists)

Dependent variable dietary advice given	<i>P</i>	Odds ratio	Lower and upper 95% confidence intervals
Gender	0.57	0.91	0.67, 1.24
Townsend score of ward of residence (quintiles)	0.07	1.19	0.99, 1.42
Total number of carious teeth	< 0.05	1.10	1.01, 1.21
Percent of carious teeth filled	< 0.05	0.99	0.98, 0.99

Table 2 Odds ratios, 95% confidence intervals and *P*-values from a logistic regression fitted for the dependent variable oral hygiene instruction ever/never given and independent variables (The clustering of the children within dentist is taken into account in the analysis) (*n* = 658 children in 50 dentists)

Dependent variable Oral hygiene instruction given	<i>P</i>	Odds ratio	Lower and upper 95% confidence intervals
Gender	< 0.01	0.69	0.49, 0.90
Townsend score of ward of residence (quintiles)	< 0.05	1.18	1.03, 1.35
Total number of carious teeth	0.67	1.02	0.94, 1.09
Percent of carious teeth filled	0.65	1.00	0.99, 1.01

A different picture emerged when recorded oral hygiene instruction was the dependent variable, the results of which are presented in Table 2. Poorer children were significantly (OR = 1.18, 95% CIs 1.03, 1.35) more likely to receive oral hygiene instruction than children from more affluent backgrounds, as were boys (OR = 0.69, 95% CIs 0.49, 0.90) rather than girls, after controlling for the total number of carious teeth and percentage of carious teeth filled, neither of which were significant predictors for oral hygiene instruction.

Tables 3 and 4 show the results of multiple logistic regression analyses when fluoride tablet prescription and fluoride varnish application were considered as dependent variables. Only the total number of carious teeth was a significant (OR = 1.13, 95% CIs 1.01, 1.25) predictor for prescription of fluoride tablets after controlling for socio-economic status, gender and percentage of filled teeth. The likelihood of prescribing fluoride tablets increased as the total number of carious teeth increased. Whereas gender (OR = 1.66, 95% CIs 1.03, 2.68), socio-economic status (OR = 0.78, 95% CIs 0.64, 0.96), the total number of carious teeth (OR = 1.25, 95% CIs 1.15, 1.35) and the percentage of filled teeth (OR = 0.99, 95% CIs 0.98, 0.99) were all significant and independent predictors for the application of fluoride varnish. Interestingly, the odds of applying fluoride varnish increased significantly as affluence increased and as the percentage of filled carious teeth fell. Girls were 1.66 times more likely to have fluoride varnish applied than boys were, and the odds of applying fluoride varnish increased by 1.25 for each additional carious tooth present in the mouth.

DISCUSSION

This paper is part of a series of papers reporting different facets of how dental care is provided in 50 GDS practices for children with carious primary teeth. The study accessed information recorded in patient case notes. Previous studies using data collected in the GDS have registered concern about the recording of prevention

Table 3 Odds ratios, 95% confidence intervals and *P*-values from a logistic regression fitted for the dependent variable fluoride tablets ever/never prescribed and independent variables (The clustering of the children within dentist is taken into account in the analysis) (*n* = 658 children in 50 dentists)

Dependent variable fluoride tablets prescribed	<i>P</i>	Odds ratio	Lower and upper 95% confidence intervals
Gender	0.67	1.10	0.71, 1.71
Townsend score of ward of residence (quintiles)	0.87	1.02	0.79, 1.33
Total number of carious teeth	< 0.05	1.13	1.01, 1.25
Percent of carious teeth filled	0.83	1.00	0.99, 1.01

Table 4 Odds ratios, 95% confidence intervals and *P*-values from a logistic regression fitted for the dependent variable ever/never had fluoride varnish applied and independent variables (The clustering of the children within dentist is taken into account in the analysis) (*n*=658 children in 50 dentists)

Dependent variable fluoride varnish applied	<i>P</i>	Odds ratio	Lower and upper 95% confidence intervals
Gender	< 0.05	1.66	1.03, 2.68
Townsend score of ward of residence (quintiles)	< 0.05	0.78	0.64, 0.96
Total number of carious teeth	< 0.001	1.25	1.15, 1.35
Percent of carious teeth filled	< 0.05	0.99	0.98, 0.99

activity.¹⁷ This may be due to the fact that there are no specific fees for preventive advice or care in the GDS. However, one would expect that the prescription of fluoride tablets would be accurately recorded as a prescription has been issued. It must be remembered that the patient record has evolved principally as an *aide-memoir* to help clinicians in the care of their patients. It could be postulated that GDPs are more likely to record information on preventive care if they are concerned about a particular child's oral health. Therefore although preventive care is likely to be under-recorded, when it is recorded it is more likely to indicate a notable cause for clinical concern.

Previous studies¹⁸ have shown that boys have worse oral hygiene than girls and so it was no surprise to find that boys had significantly more oral hygiene instruction, after controlling for possible confounding variables. The fact that socio-economic status was also a significant independent predictor for giving oral hygiene instruction is probably a result of the close relationship between socio-economic status and poor oral hygiene in children.¹¹ Interestingly, total caries experience and percentage of teeth filled were non-significant predictors for oral hygiene instruction. This suggests that the dental health education given by GDPs was tailored according to dental health needs, in this case provided to improve gingival health rather than to prevent caries.

The total number of carious teeth had a significant positive relationship with dietary advice, prescription of fluoride tablets and application of fluoride varnish; all interventions aimed at preventing dental caries. Care is required in the interpretation of this finding as these associations could be due to an increased tendency to record prevention advice and treatment provided for children with high levels of caries. However, preventive activity had a strong positive association with the severity of disease, and the results suggest that GDPs are reacting to the presence of disease in their prescription of preventive care. This association is also a source for concern, as it suggests that the preventive care provided

in the GDS is ineffective for this group of high risk patients. The mean age that these children first attended the dentist was 3.4 years; it could be that, although the children were regular attenders, preventive care was initiated too late to be effective.

Dentists were significantly more likely to provide dietary advice and fluoride varnish to children with more unrestored carious teeth. These findings counter allegations of supervised neglect and demonstrate that GDPs are concentrating their preventive efforts on children with high caries rates. The percentage of filled carious teeth had no association with the prescription of fluoride tablets, only the total number of carious teeth was a significant predictor for this intervention. High levels of parental vigilance and supervision are needed to ensure that children take fluoride tablets, but those whose children stand to benefit most are least likely to follow this regime¹⁹ and this may have influenced GDPs' decisions to prescribe fluoride tablets. As only a small proportion of children were prescribed the supplements (13.9%) it looks as if GDPs are highly selective about the use of this means of prevention.

Multiple variables were independently and significantly associated with the application of fluoride varnish. One would have expected application to be related to the total number of carious teeth in an effort to prevent disease. The surprising finding was that unlike other preventive interventions, the odds of applying fluoride varnish increased significantly as affluence increased. This could be linked to the finding that the odds of applying fluoride varnish (like those of providing dietary advice) increased significantly as the percentage of restored carious teeth fell. It seems that dentists are treating unfilled carious teeth by coating the carious surface with fluoride varnish. Greater pressure to do this could come from the parents of more affluent children who expect some form of palliative care or an explanation for leaving a carious primary tooth unrestored. This could explain why children from more affluent backgrounds were more likely to receive this type of therapy.

To conclude it would seem that dentists are providing appropriate preventive care according to the aetiological causes of dental disease. They also seem to be providing preventive care in compensation for decisions not to restore carious primary teeth and therefore allegations of supervised neglect cannot be supported. However, the preventive care provided may be reactive to disease patterns and in this high risk group of patients does not seem to be particularly effective. This is a cause for concern, given the emphasis placed on the provision of practice-based oral health promotion in *Options for change*.²⁰

This area of study is plagued with practical difficulties, particularly in obtaining a truly representative sample of GDPs, collecting data in dental practices and ensuring that the measurement and recording of clinical activity is free from bias. These issues have been discussed in recent publications of the *British Dental Journal*.^{3,4} This study also concentrated on GDPs' problem patients and informa-

tion was not collected on GDPs' prevention success stories, that is children who retained caries free mouths. Despite the limitations of the study it provides a glimpse of how preventive care is provided in the GDS. If prevention is to play a prominent role in GDS patient care, robust methods to ensure that this activity is accurately recorded must be put in place. In addition we need further primary care-based studies to provide clear evidence to show which preventive interventions work most effectively in the hands of GDPs.

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1. Horowitz H S. The effectiveness of community water fluoridation in the United States. *J Public Health Dent* 1996; **56** (5 Spec No): 253-258.
2. Levine R. *The scientific basis of dental health education*. 4th ed. London: Health Education Authority, 1996.
3. Tickle M, Milsom K M, King D, Kearney-Mitchell P, Blinkhorn A S. The fate of the carious primary teeth of children who regularly attend the general dental service. *Br Dent J* 2002; **192**: 219-223.
4. Milsom K M, Tickle M, Blinkhorn A S. Dental pain and dental treatment of young children attending the general dental service. *Br Dent J* 2002; **192**: 280-284.
5. Levine R S, Pitts N B, Nugent Z J. The fate of 1587 unrestored carious deciduous teeth: a retrospective general practice based study from northern England. *Br Dent J* 2002; **193**: 94-98.
6. Elderton R J, Osman Y I. Preventive versus restorative management of dental caries. *J Dent Assoc S Afr* 1991; **46**: 217-221.
7. Tickle M, Milsom K M, Kennedy A. Is it better to leave or restore carious deciduous molar teeth? A preliminary study *Prim Dent Care* 1999; **6**: 127-131.
8. Blaxter M. Equity and consultation rates in general practice. *Br Med J* 1984; **288**: 1963-1967.
9. Tickle M, Milsom K M, Blinkhorn A S. Inequalities in the dental treatment provided to children: an example from the United Kingdom. *Community Dent Oral Epidemiol* 2002; **30**: 335-341.
10. Tickle M, Williams M J, Jenner A M, Blinkhorn A S. The effects of dental attendance and socio-economic status on dental caries experience and treatment patterns in 5-year-old children. *Br Dent J* 1999; **186**: 135-137.
11. Schou L, Wight C. Does dental health education affect inequalities in dental health? *Community Dent Health* 1994; **11**: 97-100.
12. Nugent Z J, Pitts N B. Patterns of change and results overview 1985-6-1995/6 from the British Association for the Study of Community Dentistry (BASCD) co-ordinated National Health Service surveys of caries prevalence. *Community Dent Health* 1997; **14** (Supp 1): 30-54.
13. Curzon M E J, Pollard M A. Do we still care about children's teeth? *Br Dent J* 1997; **182**: 242-244.
14. Holloway P J, Lennon M A, Mellor A C, Coventry P, Worthington H V. The capitation study 1: Does capitation encourage 'supervised neglect'? *Br Dent J* 1990; **168**: 119-121.
15. Lennon M A, Worthington H V, Coventry P, Mellor A C, Holloway P J. The capitation Study 2. Does capitation encourage more prevention? *Br Dent J* 1990; **168**: 213-215.
16. Townsend P, Phillimore P, Beattie A. *Health and Deprivation: inequalities and the North*. London: Croom Helm, 1988.
17. Blinkhorn A S, Hassal D C, Holloway P J, Mellor A C, Worthington H V. An assessment of capitation in the new General Dental Services contract. *Community Dent Health* 1996; **13** (Supp1): 4-20.
18. Kiyak H A. Age and culture: influences on oral health behaviour. *Int Dent J* 1993; **43**: 9-16.
19. World Health Organisation. Fluoride and Health. *Report of a WHO expert committee on oral health status and fluoride use*. Geneva: WHO technical report series 846, WHO, 1996.
20. Department of Health. *Options for change*. London: HMSO, 2002.