IN BRIEF

- Asks the question, should PCTs place dental health educators with GDPs to give dental health education to parents of at-risk young children?
- Mothers received advice on toothbrushing, fluoride toothpaste and sugar control every 4 months for 2 years.
- Their children showed little difference in caries experience to a control group.
- Test group mothers had more knowledge, better attitudes and toothbrushing skills than controls.

A cluster randomised, controlled trial of the value of dental health educators in general dental practice

A. S. Blinkhorn,[1] D. Gratrix,[2] P. J. Holloway,[3] Y. M. Wainwright-Stringer,[4] S. J. Ward[5] and H. V. Worthington[6]

Aim To test the effectiveness of dental health educators in general dental practice.

Objective To evaluate the effectiveness and cost of primary care trusts seconding dental health educators free of charge to suitable general dental practices to provide dental health counselling to mothers of regularly attending pre-school children at risk to caries.

Method Two-cell, parallel group, cluster randomised, controlled clinical trial of two years' duration. *Clinical setting:* 30 general dental practices in North-West England. *Participants:* 269 mothers of 334 pre-school children. *Interventions:* Those in the test group were given visits to a dental health educator over a 2-year period to counsel mothers of at-risk, pre-school children. The rest were held as a control. *Main outcome measures:* Caries prevalence of the children and dental health knowledge, attitudes and toothbrushing skills of the parents. The full costs of the exercise were kept throughout. The statistical analysis controlled for the clustering of children within practices.

Results After 2 years, 271 (81%) children and 248 (92%) mothers remained in the study. There was an 18% difference in mean dmft between the groups in favour of the test group children but this was not statistically significant. At the end of the study there was an 18% difference in mean dmft between the groups in favour of the test group children but this was not statistically significant. No difference in plaque levels was found. The mothers in the test group were more knowledgeable, had better attitudes towards the dental health of their offspring and better toothbrushing skills than those in the control. Each 2-hour session to counsel ten parents cost £40.

Conclusion Primary care trusts should carefully consider the cost value of seconding dental health educators to counsel parents of regularly attending, at-risk, pre-school children when considering such an option.

[1]Professor of Oral Health, The Unit of Oral Health and Development, The University Dental Hospital of Manchester; [2]Senior Dental Officer, Department of Dental Public Health, Tameside General Hospital; [3]Emeritus Professor, Dental Health Unit, Skelton House, Manchester Science Park;[4]Research Assistant, Dental Health Unit, Skelton House, Manchester Science Park;[5]General Dental Practitioner, Ashton-Under-Lyne; [6]Professor of Evidence Based Care, Oral Health and Development, The University Dental Hospital of Manchester.

*Correspondence to: Professor A. S. Blinkhorn, Oral Health and Development, University Dental Hospital, Higher Cambridge Street, Manchester, M15 6FH
E-mail: anthony.blinkhorn@man.ac.uk.

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Although child dental health in Britain has improved over the past 30 years, it would seem that this improvement has now ceased, leaving a considerable proportion of the child population with an unacceptable burden of dental disease.[1] This is particularly the case in the North West of England among financially less well endowed families. In the absence of public health measures such as water fluoridation, it is important to test other possibilities that might lessen dental disease in the child population.

Because of this, the Department of Health is encouraging general dental practitioners, particularly, to carry out more prevention.[2] Even in less affluent communities, a reasonable proportion of children visit a dentist, particularly GDPs, on a regular basis for preventive reasons. These children would seem to be prime targets for dental health advice, particularly in the younger age groups where their parents bring them for inspection and treatment and can exercise greater control over their hygiene practices than may be possible with their older siblings. There is evidence that practitioners think that this is worthwhile but that a number of factors preclude this from taking place in many general dental practices.[3,4] Although the use of dental health educators in practice to offer preventive advice has long been thought to make a considerable improvement to the dental health of young children, the costs and benefits of this strategy are still open to question.

Among the barriers to providing dental health advice in a busy general dental practice are the low priority given to prevention and the lack of trained personnel with the time to discuss prevention with appropriate patients. Even if trained individuals are present in a practice they frequently become seconded to other duties when colleagues become ill or leave. A further barrier is that dentists perceive a lack of adequate compensation for active prevention (dental health advice). In addition the benefits of prevention need to be discounted, reducing the immediate value to the practice, and this is confounded if the child leaves the practice before the benefits become tangible.

As the Department of Health has offered help and encouragement to local funding bodies to develop new schemes to improve dental health in childhood,[5,6] possible methods for overcoming these problems become apparent. One would be for a Primary Care Trust (PCT) to employ qualified dental health educators and to second these free of charge to selected general dental practices on a sessional basis to give dental health counselling to parents of children at risk to caries. However, the impact of this on dental

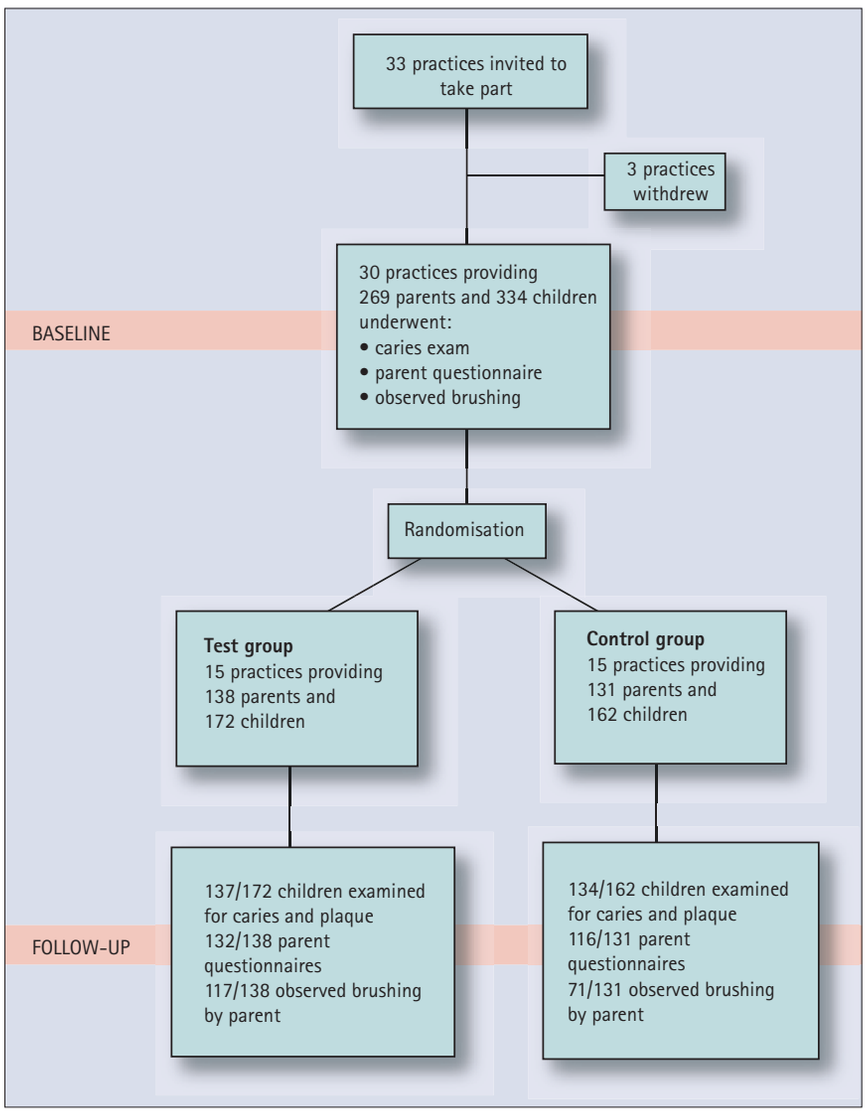

Fig. 1 Flowchart of the number of children, parents and practices taking part in the trial

health and its financial viability need to be measured before it can be recommended to funding agencies. It is with these considerations in mind that the current model for dental health counselling of regularly attending mothers of at-risk, pre-school children was formulated.

The aim of the current investigation was, therefore, to evaluate the effectiveness and costs of trusts seconding salaried dental health educators to selected, co-operating general dental practices to control dental caries in regularly attending, young children at risk. This included, in addition to reducing the prevalence of caries in children, the ability of such a programme to improve the dental health knowledge, attitudes and toothbrushing skills of the parents of these children.

METHOD

The study took place in the West Pennine District of North-West England. The district is made up mainly of the two boroughs of Tameside and Oldham, both relatively economically disadvantaged with a considerable racial mix. The prevalence of caries in the district is amongst the highest in the country, with a mean dmft among 5-year-olds of 2.4.[1]

The study was a two-cell, parallel group, cluster randomised, controlled clinical trial of 2 years' duration. The randomisation was at the level of the cluster which was the general dental practices that volunteered and were subsequently chosen to participate. A cluster randomised design was used because this was a pragmatic study of a specific model measuring cost as well as effectiveness based on dental practices rather than individual patients. In order to be included, each practice had to accept the nature of the study, had to have premises which would allow the study to take place in a suitable environment, had to have a well organised recall system and no stated dental health policy. The sample size calculation was based on detecting a reduction in the proportion of children with a caries increment >1 from 0.50 to 0.25. A sample size of an average of 10 children in 15 clusters per study group had greater than 90% power to detect this reduction assuming an intra-class correlation coefficient of 0.05. In the event, 33 practices were chosen; however, three had to withdraw, two because they were unable to provide at least 10 patients who fitted the criteria and one because the practice was planning a refit (Fig. 1). The practices were asked to provide between 10–15 patients, 1–6 years of age. These young patients in particular rely on active prevention (dental health education) to control their disease rates as passive prevention (fissure sealants and topical fluoride) is often inappropriate at this age. It is also believed that good hygiene habits introduced during this primary socialisation stage in a child's development are likely to stay with it into later life, and parents can also exercise greater control of the children's behaviour at this age. The children were also required to be in good general health, to attend on a regular basis, to have some caries experience and, in the opinion of their dentist, to be at risk to caries over the next two years. Although the prediction of risk to dental caries is still imprecise, it is best judged on an intimate knowledge of the dental and medical histories of the child and its family,

Table 1 Knowledge and attitude questionnaire — results after 2 years (percentages in parentheses)

	Test (n = 132)	Control (n = 116)
1. How often should a child's teeth be brushed? (twice a day/other*)	106 (80)	90 (78)
2. What type of brush is best for a young child? (small/other*)	130 (98)	114 (98)
3. How much toothpaste should be placed on the brush? (small pea-size/other*)	92 (70)	62 (53)
4. How much fluoride should the paste contain? (1000 ppm/other*)	105 (80)	7 (6)†
5. How should you brush your child's teeth? (behind the child/other*)	85 (64)	37 (32)
6. When is it best to give sugary foods and drinks to young children? (at meals/other*)	119 (91)‡	77 (66)
7. Which four of the following foods cause most decay in children? (sugar/sweets/biscuits/soft drinks/other)	42 (32)	7 (6)
8. How important is decay in milk teeth? (very important/other*)	104 (79)	83 (72)
9. If your child had decay in a baby tooth what treatment would you want? (filled/other).	75 (57)	57 (49)

*Questions 1–6 had four other options
Question 7 had six other options
Questions 8 & 9 had three other options
†Out of total n = 114
‡Out of total n = 131

Table 2 Toothbrushing observation where mothers brushed — results after 2 years (percentages in parentheses)

	Test (n = 117)	Control (n = 71)
Position of parent in relation to child (behind/any other)	88 (75)	10 (14)
Parent's method of holding toothbrush (finger grip/any other)	113 (97)	15 (21)
Amount of toothpaste placed on brush (small pea/any other)	116 (99)	13 (18)
Mean length of time teeth were brushed (in seconds)	30	25
Whether the front and back teeth were brushed (yes/no)	111 (95)	15 (21)

Table 3 Inter- and intra-examiner agreement based on dmft in deciduous molars and canines

	Number of children	Reliability (intra-class correlation coefficient)	Mean difference in dmft (95% confidence interval)
Inter-examiner agreement: trainer and study organizer Baseline exam	30	0.97*	0.23 (–0.01, 0.47)
Intra-examiner agreement: dental epidemiologist Final exam	20	0.98*	0.05 (–0.27, 0.37)

* $P < 0.001$

together with its socio-economic background and its clinical status.[7–10] Some families had more than one child who fitted the criteria, and so there were more children than parents involved.

At the beginning of the study, 30 practices provided 269 parents who contributed 334 children (Fig. 1). The participating dentists explained the nature of the study to the parents and asked them to sign a consent form. From then on the dentists were asked to recall and treat the patients in the normal routine of the practice.

The patients and parents were then seen by a research worker (YMW-S), an hygienist/therapist with an MSc in Dental Public Health, who carried out the dental health counselling on a one-to-one basis and ran the day-to-day organisation of the study (study organiser). She also examined the children for dental caries according to a precise protocol for which she was trained and calibrated to an experienced dental epidemiologist. A final calibration exercise comparing their inter-examiner agreement on 30 children showed that the level of agreement was generally good and the reliability for the dmft for the deciduous molars and canines (decalcification lesions omitted) was 0.97 (Table 3). There was no evidence of any bias with one examiner recording more disease than the other.

The study organiser also administered a nine item, multiple choice questionnaire designed to measure the dental health knowledge and attitudes of the parents (Table 1). In addition she observed the mothers brushing their children's teeth to measure their toothbrushing skills (Table 2). Notes were made of the position of the mother and child (*mother standing behind the child*), how the toothbrush was held (*finger grip*), the amount of paste applied to the brush (*small pea-size*), the length of time taken and whether or not both the back as well as the front teeth were included.

Once this was completed the participating practices were randomly allocated to groups by the study statistician stratified by age and caries levels of the children involved, using computer generated random numbers.

The study organiser then gave dental health counselling to the parents of the test group practices in toothbrushing, including the use of appropriate fluoride toothpaste,[11] and sugar control[12,13,14] over the course of two visits. This included hands on demonstrations of how to clean a small child's teeth together with the free issue of toothpaste and a small toothbrush, the analysis of 24-hour diet records and supporting commercial dental health educational leaflets. She then recalled these parents and children every 4 months over the next 2 years to reinforce the counselling and to issue more toothpaste and toothbrushes when appropriate. The control group parents and children were seen only once at the beginning of the study, when they were given toothbrushing instruction and a tube of fluoride toothpaste.

At the end of the 2-year period, the study organiser again administered the same questionnaire to the remaining parents and monitored their toothbrushing skills as at baseline. Because it might be argued that her personal knowledge of the test group children might have biased her recording of their dental health status, an independent, experienced dental epidemiologist (DG) examined all the children separately away from the practices so that she would remain unaware of the group allocation of the children. This involved examining the children in schools, nursery schools or at their homes if this was necessary. The epidemiologist examined the children for caries using the same criteria as at baseline and also for plaque deposits scoring presence or absence of plaque on back and front teeth separately. Although the sample size calculation was based on caries increment, the need for the final examinations to be carried out independently by an examiner blinded to group allocation meant that the final results had to be based on prevalence data at the end of the study.

Prior to these clinical examinations the dental epidemiologist conducted repeat examinations on different groups of children to assess her intra-examiner reliability (Table 3). The reliability (intra-class correlation) value was 0.98 indicating a good level of

Table 4 Mean dmft(SD) in deciduous molars and canines at final examination by the dental epidemiologist (decalcification lesions omitted)

Control group (n = 134)	Test group (n = 137)	Coeff (SE)*	P value
3.22 (2.85)	2.65 (2.56)	0.55 (0.44)†	0.21

*From GEE model level
†Intracluster correlation coefficient = 0.101, design effect Deff = 1.8

Table 5 Number and percentage (in parentheses) of children with and without plaque in the test and control groups

	Control group	Test group
With plaque	82 (61)	72 (53)
Plaque free	52 (39)	65 (47)
Total	134 (100)	137 (100)

agreement and there was no evidence of any bias between the examinations.

Finally, throughout the study a record was kept of all expenditure, including the time and cost of travelling to the practices and talking to the parents.

Statistical analysis

The children were clustered within the unit of randomisation, the general dental practices. The cross-sectional caries data in both groups were compared using generalised estimating equations (GEE) with identity link and exchangeable correlation coefficients to control for the effects of clustering. This was carried out separately for both the baseline data collected by the study organiser and the final examinations recorded by the independent dental epidemiologist.

The baseline data were used solely to allocate practices to groups. As the study organiser was aware of the group allocation during the course of the study it was not appropriate to base the results on the calculation of increments as this may have resulted in bias.[15]

Differences between the parents' knowledge of and attitudes towards dental health and their toothbrushing skills in the test and control groups were compared at the beginning and end of the study using the same GEE approach with logit link function.

RESULTS

Sample statistics

At the beginning of the study there were 15 practices including 138 families with 172 children in the test group, and 15 practices including 131 families with 162 children in the control. The mean age of the children in the control group was 4.2 (SD 1.3) years which was similar to the mean age for the children in the test group of 4.1 (SD 1.2) years, there being no significant difference between them (P = 0.44).

All the practices remained in the study throughout. At the end of the study, the independent epidemiologist examined 137 (80%) children in the test group and 134 (83%) in the control. The study organiser administered the same questionnaires as at baseline to 132 (96%) mothers in the test group and 116 (89%) in the control. The toothbrushing skills of 17 (85%) mothers in the test group and 71 (54%) mothers in the control group were also monitored (Fig. 1). The main reasons for not being examined were families moving from the district or not being available at the time of the examination, although both researchers went to considerable lengths to follow up the latter.

Caries levels

Caries levels at the beginning of the study, before randomisation to study group, were measured by the study organiser. The mean dmft in deciduous molars and canines was 1.97 (SD 2.19) for children in the test group and 2.17 (SD 2.33) for children in the control group. There were no significant differences between the groups on any of the parameters analysed.

The final examination, including the deciduous canines and molars, was carried out by the dental epidemiologist who was blinded to the child's study group. Analyses were conducted at the level of both teeth and surfaces, including and excluding early, decalcified lesions.

An example of the results from the dental epidemiologist is given in Table 4. The mean dmft (excluding decalcification lesions) in the test group was 2.65 (SD 2.56) and 3.22 (SD 2.85) in the control. Although these statistics favour the test group children by 18%, this difference was not significant. The statistical comparisons for the surface codes, and when early lesions were included, confirmed these findings.

Plaque scores

With a heavy emphasis on toothbrushing skills during the counselling sessions to the test group mothers, it was anticipated that less dental plaque would be evident in the test than in the control group children. In order to investigate this possibility, the independent epidemiologist recorded the presence of plaque during the final examinations. The number of children with plaque free mouths in the test group was 65 (47%) and in the control group was 52 (39%) (Table 5). Although this difference of 8% was in favour of the test group children it was not large enough to be statistically significant (GEE coefficient −0.35 (SE = 0.25), P = 0.16). Of the 271 children examined, 117 (43%) were free of plaque (Table 5). The general level of plaque in both groups was low. Of the 154 (57%) children with some plaque, 96 (62%) had less than 50% of sites with plaque.

Knowledge and attitudes

All 269 mothers attempted the questionnaire at baseline. The majority of mothers correctly indicated that their children's teeth should be cleaned twice a day (71%; 190) using a small toothbrush (94%; 254) bearing a small pea-sized amount of paste (52%; 141). However, few knew the appropriate level of fluoride in the paste (3%; 8/266: 1,000 ppm for at-risk children[11]), and only a third (38%; 102/268) knew that it was best to stand behind the child to brush the teeth.[12] Most (62%; 165/266) knew that the best time to allow children to eat sweet things was at meal-times but few knew the four food and drinks groups that provide most of the sugar in a child's diet (7%; 18).[14,16] Three-quarters (75%; 201/268) of the mothers thought that decay in milk teeth was very important, but less than half (47%; 125/267) thought that these teeth should be filled. There were no significant differences between the two groups on any of these items.

At the end of 2 years the same questionnaire was completed by 248 (92%) mothers, 132 in the test and 116 in the control. More mothers in both groups knew that their children should have their teeth brushed twice a day (79%; 196) using a small toothbrush (98%; 244), but significantly more mothers in the test group (70% v 53%) knew that the correct amount of paste was a small pea-size. The test group mothers also knew the correct level of fluoride in the paste (80% v 6%) and the best position to adopt when cleaning a child's teeth (64% v 32%). They also knew the best time to allow their children to eat sweet things (91% v 66%), and they were significantly more knowledgeable on the foods and drinks that contain the greatest amount of sugar in a child's diet (32% v 6%). Attitudes towards decay in baby teeth had deteriorated slightly in the control group (77–72%) but had improved in the test group (73–79%), the same trend being apparent over the need to fill these teeth (51–49% in the control and 43-57% in the test group) (Table1). Overall, both the dental health knowl-

edge and attitudes towards the treatment of milk teeth were statistically significantly better in the test than in the control group parents ($P < 0.001$).

Toothbrushing skills

At baseline, 47% (124/265) of the children insisted on brushing their own teeth. Of the remaining 141, 45% (63) of the parents stood behind the child to brush, 86% (121) used a finger grip, 46% (65) used a small pea-sized amount of paste, 75% (106) brushed both the back and front teeth and the average brushing time was 33 seconds. No significant differences were noted at baseline between the two groups.

At the final examination, 84% (117/138) of the test group mothers brushed their children's teeth compared with 54% (71/131) of the control group. For those whose mothers did the brushing, 75% (88) of the test group stood behind the child compared with 14% (10) in the control, 97% (113) used a finger grip compared with 21% (15), 99% (116) used a small pea-sized amount of paste compared with 18% (13) and 95% (111) brushed both back and front teeth in the test group compared with 21% (15) in the control. The average brushing time for the test group was 30 seconds and 25 seconds for the control (Table 2). All of these differences were statistically significant.

Costs

As no significant improvements in dental health were seen in the test group when compared with the controls, a detailed analysis of costs was not appropriate. However, a session of dental health counselling for 10 patients took 2 hours. For this purpose at least 12 appointments were made to account for non-attendance. In order to allow for travelling time to and from the practice, and setting and clearing up before and after, a routine session took three hours. One session/week was allowed for administrative purposes.

If costs are calculated on a sessional basis, then full staff costs for a dental health educator would be £28.87. Travel would cost £4.30 at 43p/mile, and materials (toothpaste, toothbrushes and leaflets) would cost £6.20 (62p/patient). The total cost for a session of 10 patients would then be £39.37.

DISCUSSION

It is discouraging that the current study failed to reveal any worthwhile outcome to this model in terms of dental health. When it is recalled that the plan was to offer the mothers in the test group up to eight one-to-one counselling sessions in the 2-year duration of the study, and that these contained detailed discussions of the need for the regular use of fluoride toothpaste, toothbrushing instruction and the control of sugar intake, it is surprising that the only positive outcomes to be discovered were an improvement in dental health knowledge and improved toothbrushing skills. Although the improved dental health knowledge and skills are to be welcomed the resource used to achieve this might seem to be excessive. In the event, three quarters of the mothers attended at least five counselling sessions. Current dental health knowledge would predict that these would have an effect on the prevention of caries.[17,18] Possible reasons for this disappointing result need to be explored.

As counselling for children who do not get dental disease seemed to be a waste of precious resources, it was decided to concentrate effort on those at high-risk. These were essentially young children whose dentists considered that they would experience caries in the next two years. Each participating dentist was asked to provide 10–15 patients in this category. In the event many of the dentists had difficulties in providing sufficient patients that met these criteria and two practices had to withdraw from the study because of this problem. Several of the children recruited were free of caries at the beginning of the study and a considerable proportion of these were free from disease at the final examination. This suggests two things. Firstly, even in a high caries, low socio-economic area such as this in the North West of England, most children who go to the dentist regularly are not at high risk. It is also possible that dentists are not so skilled at selecting from their regular attenders those who will get further caries over the next two years. If either or both of these concepts are true, then any substantive scheme based on this model would suffer by including a proportion of children who were not at 'high risk'. Because of this it would seem inefficient to spend the time of a skilled dental health educator counselling selected parents.

A further problem encountered at the beginning of the study was to persuade the mothers to attend the practices for separate appointments for dental health counselling. The logistics of the study made it practically impossible for the dental health educator to be present at the practice when the appropriate children attended for their regular inspections, so separate appointments on a specific session were required. This led to many broken appointments, particularly at the beginning, rendering the cost per visit expensive. However, during the second year, many of the mothers got to know the dental health educator as a friend and so attended on a more reliable basis. It should be appreciated, however, that young mothers from these economically disadvantaged communities have many problems to overcome, making dental attendance a low priority in their working days, thus, failed appointments are to be expected. Many go out to work to enhance the family income, and can only attend in the late afternoon or early evening, thus complicating the problem of arranging their attendance during an ordinary working session. This last situation also meant that the children were not always in the care of their parents. They were often cared for by other members of the family or friends or may have been under the care of a child minder or nursery school. The implementation of preventive dental health practices might have been compromised under these circumstances.

No attempt was made to define what happened on an every day basis in the home environment. Reported behaviour is notoriously inaccurate[19] and for this reason only questions on knowledge and attitudes were included in the questionnaire. The same could be said about observing a mother brushing her child's teeth. There is little doubt that giving information on diet and teaching toothbrushing skills to the mothers in the test group rendered them more knowledgeable and skilful, but whether this translated into everyday routines at home is open to question. It is notoriously difficult to alter people's behaviour on a long term basis.[20]

What this experience did highlight were the many difficulties these mothers of very young children faced in controlling food intake and oral hygiene measures. Quite often, the child controlled the mother rather than the other way round, and the environment in which they lived controlled them both. Some of the children insisted on brushing their own teeth despite the entreaties of their mothers.

It may be argued that 2 years is too short a period to expect to reap the benefits of this concentrated educational programme. This may be so with respect to caries progression, but it is difficult to explain why no difference was found in oral hygiene levels, particularly when the test group parents demonstrated better toothbrushing skills than those in the control group. The explanation may be that these regularly attending young children, even in the control group, seemed to have relatively clean mouths.

Whatever the explanation, it would be difficult to expect a general dental practitioner or a funding body to make such a long-term investment for a questionable future return.

It should be noted in respect of the result of this trial that Kay and Locker,[21] in a systematic review of the effectiveness of dental health education, failed to find evidence of an effect on caries, found only a temporary effect on plaque accumulation but a sustained positive effect on knowledge. In a similarly designed clinical trial on the effectiveness of dental health education in the control of caries in adolescents, Blinkhorn *et al.*[22] failed to demonstrate a difference in caries increment over an 18-month period between the test and control groups.

Regularly attending children of GDPs may be the wrong target group for dental health initiatives over and above whatever benefits they may derive from their attendance behaviour. This does not deny that a few children with particular problems will be discovered by GDPs who may wish to refer them for specialist advice and care. Neither does it deny the value of passive preventive care such as fissure sealants or the prescription of fluoride supplements that were not tested in this particular model. However, these fall within the remit of the dentist or operating dental auxiliary, not within the capacity of a visiting dental health educator.

CONCLUSION

The model tested of seconding a qualified dental health educator to general dental practices to counsel mothers of regularly attending, at-risk, young children failed to reveal a substantial improvement in dental health over a 2-year period. However, there were clear benefits in relation to dental health knowledge, attitudes and toothbrushing skills among these mothers.

On the basis of this result, Primary Care Trusts should carefully consider value for money before adopting such a strategy to improve the dental health of young children within their localities.

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