# Cost-effectiveness of a long-term dental health education program for the prevention of early childhood caries

*Kowash M B, Toumba K J, Curzon M E*

## Record Status

This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

## Health technology

The health technology assessed was a dental health education (DHE) programme, involving home visits at 1- or 3-month intervals, intended to prevent early childhood caries (ECC). This programme was compared with a control group and with three other strategies. The alternative strategies were slow-release fluoride device (SRFD), community water fluoridation (CWF) and a school-based fissure sealant programme (FSP).

## Type of intervention

Primary prevention.

## Economic study type

Cost-effectiveness analysis.

## Study population

The authors presented two study populations. The first study population comprised the population which was the focus of the Leeds DHE programme. This programme focused on infants aged between 8 and 44 months who were living in a low socioeconomic area of Leeds. The other population, against which the DHE programme was compared, was a hypothetical community consisting of 7,000 children from kindergarten age to 12 years (Niessen and Douglass 1984, see 'Other Publications of Related Interest' below for bibliographic details).

## Setting

The setting was home care. The economic study was carried out in the UK.

## Dates to which data relate

The dates during which the effectiveness data were collected were not reported. However, effectiveness estimates for the DHE programme were collected from a study published in 2000, while effectiveness estimates for the SRFD programme appear to have been collected from a study published in 2005. No specific sources for the effectiveness of CWF and FSP were provided. The dates during which the resource data were collected were not reported. The cost of treating a carious surface was provided for the year 1995. The price year for all other resources was not reported.

## Source of effectiveness data

The clinical data included the number of carious surfaces prevented over the lifetime of a programme.

## Sources searched to identify primary studies

The clinical effectiveness data for the DHE programme were taken from a published paper (Kowash et al. 2000, see 'Other Publications of Related Interest' below for bibliographic details). Some details of this study were presented (study sample age, number of patient in each group and follow-up time). The SRFD programme effectiveness estimates

appear to have been collected from a study published in 2005 (Toumba and Curzon 2005, see 'Other Publications of Related Interest' below for bibliographic details). No specific sources of the effectiveness of CWF or FSP were given. However, the Niessen and Douglass study (1984) also appear to have been used for this purpose.

### Methods used to judge relevance and validity, and for extracting data

The authors did not report how the data used were identified or selected for inclusion, particularly with respect to the comparators of the intervention of interest. The methods of reviewing the literature were not reported and, given this fact, it appears unlikely that a systematic approach has been used. A justification was provided for selecting the hypothetical community of Niessen and Douglass.

### Measure of benefits used in the economic analysis

The measure of benefit used in the cost-effectiveness analysis was the number of carious surfaces that were prevented over the lifetime of the project, as reported in the different studies. The benefits do not appear to have been discounted. The authors also calculated net savings in the costs of treating dental caries as a measure of net benefit. Savings in time required for dental treatment were also presented (see 'Direct Costs' section for further details).

### Direct costs

The study reported the direct costs to the health service. These were identified as capital costs and operating costs. For the Leeds ECC programme, the capital costs included dental equipment and educational video films, etc. Operating costs included the salaries of the two health educators, paid at national rates. The travel costs of the dental health educators were also taken into account. These costs appear to have been collected alongside the study used by the authors for their analysis (Kowash et al. 2000). The unit costs and resources for this programme were only presented for the cost-savings. These included the cost of treatment by general dental practitioners, based on current National Health Service fees. These cost-savings were tabulated and the following resources were identified: examination fee, dental examination, surface amalgam restoration, resin restoration and general anaesthesia. The authors also presented the savings in time required for dental treatment for a DHE programme over a 3-year period. Savings in time were calculated for a general dental practitioner and for a community dental service, for which the unit costs and resources were presented. An average cost was provided for the Leeds DHE programme.

The authors also assessed the Leeds DHE in the hypothetical community of Niessen and Douglass. They presented the assumptions used in order to derive the net benefits, including the unit cost to restore one surface and the total number of saved carious surfaces. It was reported that the unit cost to restore one surface followed the Niessen and Douglas 1984 paradigm. The costs identified for the Leeds DHE programme included labour and transformation costs, capital costs and operating costs. Neither the unit costs nor the resource quantities for these were presented.

Only average savings and average costs, along with some assumptions regarding their calculations, were presented for the comparators SRFD, CWF and FSP. The costs for the SRFD programme were assumed to be similar to those for the FSP programme.

The price year of the cost to restore one surface was 1995. The price year for all other costs presented was not reported, but it is possible that it was also 1995. No discounting was reported even though the time horizon for the estimation of costs was 3 years.

### Statistical analysis of costs

The cost data were dealt with deterministically.

### Indirect Costs

The authors identified the time taken off from work by the parent to take the child for dental treatment, or the days taken off school by the child, as productivity costs which would equate indirect benefits given the intervention effects. However, a monetary value was not calculated for these costs, thus these were left out of the analysis.

### Currency
UK pounds sterling () for the DHE programme costs. US dollars ($) for the prevention programmes in a hypothetical community. A conversion factor of 1.6 was used to convert to $.

### Sensitivity analysis
The only variability in data that was investigated was the savings in time for dental treatment. By using minimum and maximum salary costs for a community dental service the authors provided estimates of maximum and minimum savings.

### Estimated benefits used in the economic analysis
The authors first performed an economic analysis of the DHE programme, which was the focus of a previous study (Kowash et al. 2000). For this analysis they compared the DHE programme with a control in which no home visits were delivered. The net benefit was presented as the difference in mean caries scores between the two groups. This difference was 1.46 (range: 1.75 to 0.29), which translated to 3,580 carious surfaces prevented. These benefits were observed over a 3-year period.

For the economic analysis using the hypothetical community, the 96% caries reduction for the DHE programme was used (Kowash et al. 2000). The Leeds DHE programme was analysed over a 3-year period and was compared with the other prevention programmes after 2 years. When compared with the other prevention programmes in this hypothetical community, the benefits presented as carious surfaces saved were as follows:

for the Leeds DHE programme 10,752;

for the SRFD 8,512;

for the CWF 1,400; and

for the FSP 1,728.

### Cost results
For the DHE programme compared with a control in which no home visits were delivered, the incremental cost was of 6,445. The cost-savings were 36,386. The savings in time required for dental treatment for a general dental practitioner were 5,875.23. The savings in time in a community dental service were between 2,492 (minimum savings) and 4,864 (maximum savings).

For the economic analysis using the hypothetical community, the Leeds DHE programme had a cost of $10,313 when compared with the control situation. The net savings were $107,520. The Leeds DHE programme was analysed over a 3-year period and was compared with the other prevention programmes after 2 years. For this hypothetical community, the costs for each programme were as follows:

for the Leeds DHE programme $20,626;

for the SRFD $20,413;

for the CWF $12,126; and

for the FSP $40,826.

The costs-savings were $107,520 for the Leeds DHE programme, $85,120 for the SRFD, $14,000 for the CWF and $17,280 for the FSP.

### Synthesis of costs and benefits

The estimated benefits and costs appear to have been combined in the form of incremental ratios with respect to the control strategy that had been used in the assessment of each individual strategy. However, it is not clear whether simple average ratios were in fact calculated.

For the DHE programme compared with a control, in which no home visits were delivered, the cost-effectiveness ratio (CER) was 1.8 (i.e. the cost to save one carious surface was 1.80). The authors also reported a benefit-cost ratio (BCR) of 5.6, where the costs savings were divided by the incremental costs of the intervention. However, this ratio does not represent the correct synthesis for a C/B analysis.

For the economic analysis using the hypothetical community, the Leeds DHE programme, when compared with the control situation, had a CER of $0.96/carious surface saved. The BCR was 10.43. For this hypothetical community, the CER and BCR for the comparison between the Leeds DHE over a 3-year period and the other prevention programmes after 2 years were as follows:

for the Leeds DHE the CER was 1.92 and the BCR was 5.21;

for the SRFD the CER was 2.40 and the BCR was 4.17;

for the CWF the CER was 8.66 and the BCR was 1.15; and

for the FSP the CER was 23.74 and the BCR was 0.42.

### Authors' conclusions

"The Leeds Dental Health Education (DHE) programme for early childhood caries in infants, through home visits, proved to be very favourable and capable of providing maximum benefits for resources expended."

### CRD COMMENTARY - Selection of comparators

The authors compared the Leeds DHE programme with a control group and also with three other prevention approaches. This last comparison was carried out using the hypothetical community of Niessen and Douglass (1984).The other prevention approaches were poorly described. Although no explicit justification was provided for the comparators used, it would appear that they represented current practice in the authors' setting (a "do nothing" strategy and three other prevention strategies). You should decide if these represent valid comparators in your own setting. The justification for the use of the hypothetical community was clearly explained.

### Validity of estimate of measure of effectiveness

The effectiveness estimates were derived from published research. No synthesis appears to have taken place and single studies were used for each prevention programme. The authors did not report any search method or inclusion criteria. The effectiveness of the Leeds DHE programme was based on a previous study (Kowash et al. 2000), of which very little information was provided in this paper. With respect to the comparators, it was not clear where the effectiveness estimates had been taken from. This means that an objective assessment of the quality of these estimates is not possible. Overall, it is not possible to comment on the evidence used to derive the estimates as the authors provided no information about the studies.

### Validity of estimate of measure of benefit

The measure of benefit, which was the number of carious surfaces prevented over the lifetime of the project, was obtained from the effectiveness analyses for each prevention programme. For the comparison with other prevention strategies, using the hypothetical community, the measure of benefit for the Leeds DHE programme was the same as in the effectiveness study. The benefit for the comparators was taken from other studies.

### Validity of estimate of costs

The analysis of the costs was performed from the perspective of the health system. All the relevant categories of costs and individual costs within each category appear to have been included in the cost effectiveness analysis. The resource

quantities used in the Leeds DHE programme appear to have been collected alongside the clinical study, but not all were presented by the authors. The source of some unit costs was presented (British National Health Service fees and salaries for a community dental service in the UK) but not for all unit costs (e.g. capital costs).

Only the average costs for the programme itself were presented. Cost-savings were presented in more detail than the prevention programme costs. There was no reference to the price year of all costs or to resource dates. There was no sensitivity analysis of the costs to address variation in unit costs or service provision for different settings. Although the costs could have been discounted, as they were incurred over 3 years, the authors did not report the use of any discount rate. Overall, most of the cost data were not adequately reported. The fact that cost data were poorly reported may have implications for the generalisability of the study beyond the study setting.

## Other issues

The authors stated that their results could not be compared with other ECC prevention approaches because there were no studies with adequate reporting of long term DHE programmes. The authors did not comment on the generalisability of their findings to other settings. No variation in service provision or unit costs between different settings was acknowledged. The authors do not appear to have presented their results selectively. The study focused on infants thought to be at risk of ECC and this was reflected in the authors' conclusions.

The authors acknowledged a limitation in their study in that they questioned the validity of comparing different dental prevention programmes. This situation arises because the compared approaches have focused on children of different ages. However, the authors stated that the use of the hypothetical community might have solved this problem. Nevertheless, it was noted that, while a cost-effectiveness analysis of such disparate types of studies is valid, it needs to be viewed with some caution. The authors stated that they performed both a cost-effectiveness and a cost-benefit analysis. However, with respect to what they refer to as a cost-benefit analysis they did not assign a monetary valuation to the health benefits achieved, focusing solely on the resources saved as outcome/benefits. A range of intangible benefits were in fact identified. However, a monetary value was not calculated for them and the authors left them out of the analysis. They justified doing so on account of the difficulty in quantifying these benefits. However, this exclusion makes the classification of the study as a cost-benefit analysis incorrect.

The authors presented an estimate of an effectiveness outcome, which is why the present study is classified as a cost effectiveness analysis. There was some disagreement between the values for certain figures presented throughout the study. For example, the authors reported that the cost of treating a carious surface was assessed as $20 (USA) per surface based on 1995 costs, while in another section this cost was said to have been based on 1982 USA dollars. The synthesis of the costs and benefits when comparing the Leeds DHE programme with the other prevention strategies could have been reported in the form of incremental cost effectiveness ratios between the alternative programmes.

## Implications of the study

The authors suggest that "it was the constant reinforcement of the Leeds DHE programme that led to a successful outcome and an excellent cost effectiveness", pointing out the importance of early prevention. However, the concerns about the validity of the evidence used in the economic evaluation, discussed in the commentary above, should be borne in mind when considering this recommendation. The authors also noted that the cost of the Leeds DHE study could be further minimised by having suitably trained midwives and health visitors giving the DHE messages to mothers during their routine home visits.

## Source of funding

Funded by the Sugar Bureau (London).

## Bibliographic details

Kowash M B, Toumba K J, Curzon M E. Cost-effectiveness of a long-term dental health education program for the prevention of early childhood caries. European Archives of Paediatric Dentistry 2006; 7(3): 130-135

**PubMedID**
17140541

**Other publications of related interest**
Because readers are likely to encounter and assess individual publications, NHS EED abstracts reflect the original publication as it is written, as a stand alone paper. Where NHS EED abstractors are able to identify positively that a publication is significantly linked to or informed by other publications, these will be referenced in the text of the abstract and their bibliographic details recorded here for information.

Kowash MB, Pinfield A, Smith J, Curzon ME. Effectiveness on oral health of a long term health education programme for mothers with young children. Brit Dent J 2000;188:156-68.

Niessen LC, Douglass CW. Theoretical considerations in applying benefit cost and cost effectiveness analysis to preventive dental programs. J Public Health Dent 1984;44:156-68.

Toumba KJ, Curzon ME. Clinical trial of slow releasing glass fluoride device to prevent dental caries in children. Carie Res 2005;161:201-6.

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Child, Preschool; Cost-Benefit Analysis; DMF Index; Dental Caries /economics /prevention & control; England; Female; Health Education, Dental /economics; Humans; Infant; Longitudinal Studies; Mothers /education

**AccessionNumber**
22006006751

**Date bibliographic record published**
31/01/2008

**Date abstract record published**
31/01/2008