

Tooth brushing behaviour in Europe: opportunities for dental public health

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Although in nearly all European countries there has been an improvement in the levels of dental caries in children and young adults, both dental caries and periodontal breakdown still represent a major public health problem. The improvements have been less marked in many Central and Eastern European countries and there appears to have been no improvement in those from deprived socio-economic groups. Tooth brushing habits in different European countries appear to vary considerably with reports of over 75% of adults and children brushing more than once a day in some countries, but less than 45% doing so in others: plaque levels generally remain high. Systematic reviews have revealed that there is good evidence to show that brushing twice per day with a fluoride toothpaste is effective at preventing dental caries and that this brushing regimen also prevents gingivitis and periodontal breakdown. Recent studies have demonstrated the cost effectiveness of prevention as far as dental caries is concerned. Unfortunately, few studies have investigated the cost effectiveness of prevention of periodontal diseases. It is concluded that improvement in dental public health remains a fundamental need in Europe and that there is an opportunity to address this through changes in tooth brushing behaviour. It is therefore necessary for all dental and general health practitioners, public health workers and the oral care industry, to address this issue together and reach out to those who do not normally attend for oral health care to help them brush effectively twice a day using fluoride toothpaste.

Key words: Dental caries, gingivitis, periodontitis, fluoride toothpaste, tooth brushing, prevention

A visit to the databanks of the relevant WHO Collaborating Centres at the Universities of Malmö and Nigata indicates that dental caries and periodontal breakdown still represent a major public health problem^{1,2}. Within Europe, although there has been an improvement in the levels of dental caries in children and young adults in nearly all countries, segments of the population still experience significant levels of both these diseases and provision of treatment remains a considerable financial burden. The total spend on all aspects of care and treatment provided by dentists in the 'old' European Union (15 countries) has been estimated as US\$54 billion in 2000³. It seems likely that at least 66% of these costs

related to treating dental caries and its consequences and periodontal diseases.

Dental plaque is the primary aetiological factor for both caries and periodontal diseases. From this, it follows that oral health promotion programmes have focused traditionally on personal oral hygiene in order to improve dental public health.

Against this background, this overview paper will consider:

- Epidemiological trends for dental caries and periodontal diseases in Europe
- Tooth brushing habits in Europe
- The role of tooth brushing and fluoride toothpaste

in oral disease prevention

- The cost benefits that result from the prevention of dental caries and periodontal disease
- The opportunities that exist to improve the current situation.

Epidemiological trends for dental caries in Europe

Over the last 30 years, there has been a striking reduction in the prevalence of dental caries in 12-year-olds in all Western European countries and some improvement in Central and Eastern European countries. *Table 1* and *Figure 1* show the changes that have occurred in the mean national DMFT scores of 12-year-olds in representative countries from the North (Sweden), South (Portugal), East (Poland) and West (United Kingdom) of Europe between the early 1980s and the early 2000s. Such mean national DMFT scores are widely quoted. However it is unwise to make a direct comparison of the DMFT scores between countries⁴ because different methodologies are used to collect these data, some of the surveys concerned are not national and they are frequently collected in different years. Nevertheless they illustrate the general improvement that has occurred. Indeed, the improvement is even more dramatic if the data from the early 1970s are considered. In this decade a national mean DMFT score for 12-year-olds of 6.0 or higher was not unusual⁵.

In countries such as Germany and the United Kingdom, where national epidemiological surveys have been performed at regular intervals, similar trends to those seen in children have been seen in other age groups and those in their 20s and 30s have lower levels of dental

caries than their parents and grandparents experienced when they were a similar age^{6,7}. The changes in caries levels have been attributed to the use of fluorides in water, salt and toothpaste. However, fluoridated water and salt are available in only a few European countries and many more Europeans access fluoride through toothpaste.

Table 1 Changes in national mean DMFT scores for 12-year-olds from exemplar countries in the North, South, East and West of Europe between the 1980s and the first decade of 2000.

Country	Score in the 1980s	Score in the 2000s
Sweden	3.1 (1985) ^a	1.0 (2005) ^a
Portugal	3.7 (1984) ^b	1.5 (2003) ^c
Poland	4.4 (1985) ^d	3.5 (2005) ^e
United Kingdom	3.1 (1983) ^f	0.8 (2003) ^g

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- ^c Almeida CM, Petersen PE, André SJ *et al.* Changing oral health status of 6- and 12-year-old children in Portugal. *Comm Dent Health* 2003 20: 211-216.
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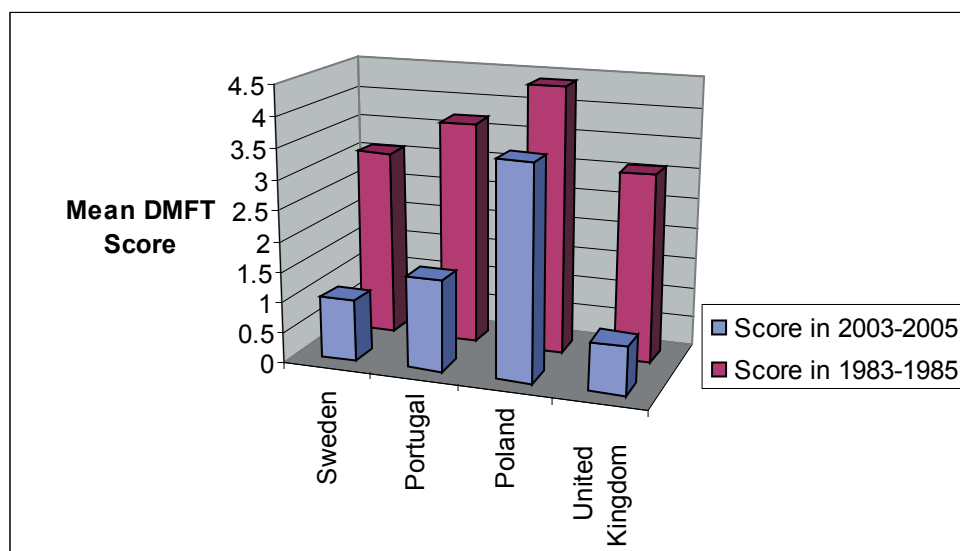


Figure 1. Histogram showing the changes in national mean DMFT scores for 12-year-olds from Sweden, Portugal, Poland and the United Kingdom between the 1980s and the first decade of 2000.

Encouraging as the overall trend appears, it conceals inequalities. As can be seen from *Table 1* and *Figure 1*, Poland has experienced a slower rate of improvement than is typical of that seen in many other Central and Eastern European countries. This may reflect the fact that since 1989 the provision of oral health care for children from public health services has greatly diminished⁸ and that many people are unable or unwilling to pay private fees for their oral health care. It has also become clear that, in all European countries, there has been little improvement in caries prevalence in children from socio-economically deprived groups⁹. Around 20% of 6-year-olds all over Europe still experience high caries levels¹⁰.

The status of root caries is less clear: the criteria for diagnosis are not well standardised and this gives rise to considerable variation in the prevalence figures reported in different studies, ranging from 15-90%¹⁰. The trend for reduction in edentulousness^{7,11} and ageing populations may pose a challenge in the future, as susceptible exposed root surfaces are likely to become more prevalent.

In summary, caries remains a significant problem for several segments of the population within Europe and needs to be addressed in order to improve dental public health.

Epidemiological trends for periodontal diseases in Europe

While some problems exist with the epidemiological data for dental caries, these are relatively minor compared to the problems regarding data for periodontal diseases. As Papapanou¹² has stated, "*A fundamental prerequisite for any epidemiological study is an accurate definition of the disease under investigation. Unfortunately, in periodontal research, uniform criteria have not been established.*" The same author also highlighted the problems, when he pointed out that epidemiological studies of periodontal diseases have assessed a wide range of clinical features including gingivitis, pocket probing depth, clinical attachment level and radiographically assessed alveolar bone, all in a particularly inconsistent manner¹². This means that the considerable variation in prevalence of disease reported in different studies and in different decades may be attributable not only to the particular populations examined but also the differences in measures used. For example, on the website of WHO Collaborating Centre at the University of Nagata², the most up to date data from surveys of periodontal health amongst 35-44-year-olds, from three of the four European countries considered previously in this paper, are: Poland (1990) 9% with no disease and 6% with at least one 6mm pocket, Portugal (1984) 3% with no disease and 8% with at least one 6mm pocket, United Kingdom (1988) 4% with no disease and 13% with at least one 6mm pocket.

Comparison between studies is impossible and it is therefore extremely difficult to draw any firm conclu-

sions on national trends as far as the levels of periodontal diseases in the European population are concerned. However, the literature indicates that the periodontal condition of many populations throughout Europe appears to be poor and that very few individuals are free from disease. The established trends of ageing populations combined with decreased edentulousness are unlikely to improve this situation.

Tooth brushing habits in Europe

Published data on tooth brushing habits comes almost exclusively from surveys in which subjects are asked to self-report their behaviour. In Europe, perhaps unsurprisingly, many people claim to brush at least twice a day.

A survey of oral hygiene habits of children and adolescents in 41 countries across the WHO European region and North America indicated that in 2005/2006, there were wide differences in tooth brushing frequency between countries (*Figure 2*). In Switzerland, Sweden, Netherlands, Germany, Denmark and Norway more than 75% brushed more than once per day, whereas in Finland, Romania, Greece, Lithuania, Turkey and Malta fewer than 46% brushed more than once per day¹³. At a national level, one study found that 64% of Polish schoolchildren reported that they brushed their teeth twice per day¹⁴. In the United Kingdom, the 2003 national Child Dental Health Survey reported a finding that 75% of children from all age groups brushed their teeth twice per day¹⁵. However, the same survey found that the percentage of children in all the age groups surveyed (5,8,12 and 15 years) with plaque present in their mouths had risen since 1993. For example for 15-year-olds in 1993, 57% had plaque present and in 2003 this had risen to 63%. Boys were more likely to have plaque present as were children from lower socio-economic groups¹⁵.

Studies on adults show similar patterns, with high prevalence of twice daily brushing reported but high levels of plaque found on examination. In 1995, tooth brushing frequency within an urban population of 25-54-year-olds in the Netherlands was reported to have remained unchanged since the previous decade: 71% of subjects claimed to brush at least twice per day and 24% once per day. Tooth brushing frequency was only weakly associated with oral hygiene¹⁶, confirming the finding from previous studies^{17,18}.

In a study of 544 male prisoners in four penal institutions in Italy 78.5% claimed to brush more than once per day. Unlike in many other studies with prison populations, the DMFT scores were apparently similar to the rest of the country. However, the periodontal status and plaque control of the prisoners was poor, with 89.6% reported to have a need for oral hygiene instruction according to community of periodontal index treatment needs¹⁹.

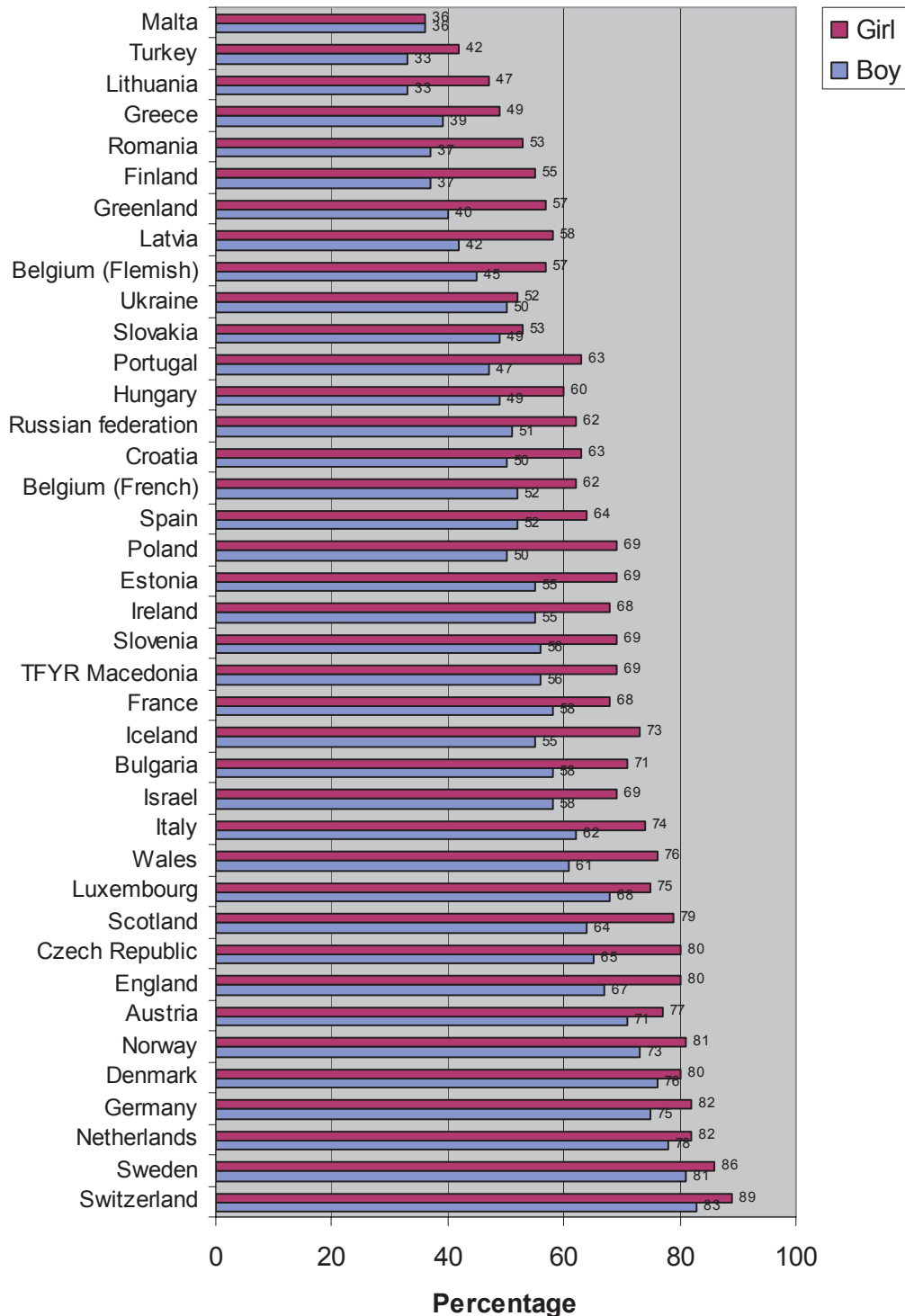


Figure 2. Histogram showing the percentage of 11-year-old children brushing more than once a day in 39 WHO European countries¹³.

In the United Kingdom, the Adult Dental Health Survey (ADHS) of 1998 reported that 74% of adults claimed to clean their teeth at least twice daily and that 69% of these twice per day brushers had visible plaque, compared with 79% who reported brushing only once per day⁷, suggesting that the majority needed to improve their brushing techniques. Overall, 72% of all dentate adults had visible plaque on at least one tooth and on

average over eight teeth in a mouth had visible plaque. Men (76%) were more likely to have plaque present than women (68%) and those in the higher socio-economic classes had less plaque⁷.

The situation in Europe is similar to North America. In a Canadian study, 96% of respondents reported brushing at least daily. A further finding from this study was that good preventive oral health behaviour

was commoner in better educated respondents and females²⁰. These findings confirmed those of a previous study²¹ which were that socio-economic status, ethnicity and sex were important considerations when planning dental health education (including tooth brushing).

In summary, in many European countries the majority of the population claims to brush at least once a day, but the data indicate that the brushing behaviour currently in practice does not provide efficient plaque control. This apparent discrepancy may be due to an over-estimation of brushing frequency as a consequence of self-reporting, poor brushing technique or lack of appropriate oral hygiene products. There is therefore a compelling need to improve the population's oral hygiene, in an effort to reduce the oral disease still experienced in Europe. In this respect all members of the dental team have a major role to play²².

The role of tooth brushing and the use of fluoride toothpaste

The contribution of tooth brushing *per se* to oral health remains difficult to quantify. Evidence exists for an anti-caries effect through efficient oral hygiene²³, and this is particularly clear in studies involving supervised brushing²⁴ or professional tooth cleaning²⁵. For prevention of caries at a population level, it has become apparent that regular exposure of the tooth surfaces to fluorides is key and that the major anti-caries benefit of tooth brushing is provided through application of fluoride toothpaste²⁶.

The classic experimental gingivitis study of Løe *et al.* established dental plaque as the causal factor of gingival inflammation and for the effectiveness of tooth brushing in the prevention of gingivitis²⁷. Gingivitis and periodontitis may be considered to be a continuum of the same inflammatory disease and the consensus view in Europe is that prevention of gingival inflammation prevents periodontitis²⁸. Few have investigated the effect of plaque removal directly upon chronic periodontitis. A systematic review published in 2005 found only three relevant randomised controlled trials in this field and perhaps not surprisingly concluded that the evidence for personal oral hygiene in the prevention of chronic periodontitis is still lacking²⁹. Nevertheless, the body of literature suggests that it does have a beneficial effect.

Another, earlier systematic review³⁰ found that caries and periodontal diseases can be controlled by regular tooth brushing with a fluoride toothpaste. More recently, a systematic review by the Cochrane Oral Health Group²⁶ has provided a firm evidence base for the practice of regular twice a day brushing with a fluoridated toothpaste to prevent dental caries. This review was updated in 2005 and unsurprisingly found that removing dental plaque by tooth brushing helps prevent gingivitis and confirmed that tooth brushing with a fluoride toothpaste prevents tooth decay.

The use of fluorides in the prevention of dental caries is perhaps the most reviewed topic in dentistry. The Cochrane Oral Health Group has performed systematic reviews on five aspects. These are: the use of fluoridated milk³¹, fluoride gels³², varnishes³³, mouthrinses³⁴ and toothpastes²⁶ for preventing dental caries in children and adolescents. In addition, a review group from the University of York has performed a systematic review of public water fluoridation³⁵. The conclusions from three of the five systematic reviews, performed by the Cochrane Oral Health Group, was that there was some evidence for the beneficial effects of fluoride gels, varnishes and mouthrinses but that more high quality evidence was required for these uses of fluoride and also for the use of fluoridated milk. The systematic review from the University of York found that the quality of the evidence for the beneficial effects of water fluoridation was low but that its use did reduce the incidence of caries but to a lesser extent than had been previously reported³⁵.

The strongest evidence was for the beneficial effects of fluoride toothpaste for preventing dental caries in children and adolescents. This review included 74 studies, involving 42,000 children. Unusually for systematic reviews, there was no comment that further studies were needed and the authors' conclusion was that *supported by more than half a century of research, the benefits of fluoride toothpastes are firmly established. Taken together, the trials are of relatively high quality, and provide clear evidence that fluoride toothpastes are efficacious in preventing caries.*²⁶

Cost benefits that result from the prevention of dental caries and periodontal diseases

A number of studies have reported the cost effectiveness of preventing dental caries.

In 2003, a systematic review of an economic evaluation of dental caries was published³⁶. It concluded that *the scarcity of well-conducted studies, as well as contradictory evidence in the reviewed articles, makes it difficult to judge the health-economic effects of the studied caries-prevention methods*³⁶. However, since this paper was published a number of studies, including one by one of the authors of this systematic review³⁶ have suggested that for dental caries the benefits of prevention exceed the costs³⁷. Three of the other studies published since 2003 have related to cost savings arising from the use of fluorides³⁸⁻⁴⁰. Of these, two concluded that the use of a fluoride toothpaste to prevent dental caries was very cost effective^{38,39}. All of these studies have considered cost savings in the care of children and adolescents. However, as previously mentioned, it should be remembered that in Europe there is an ageing population and an increase in levels of root surface caries. High fluoride toothpaste appears to have a role in the treatment of such lesions⁴¹.

There appear to have been few studies into the cost effectiveness of the prevention of periodontitis. This is

perhaps surprising since as long ago as 1984 one author commented that *even in the economically developed countries there is a need for greater awareness of periodontal disease among both practitioners and the public. In many of these countries, now that caries is becoming better controlled, the time is ripe for considerably more prevention and treatment of periodontal disease*⁴². Some 13 years later, two other authors commented that *the cost-benefit ratio of some oral hygiene products needs to be considered*⁴³. In 2005, the results of a literature review on the cost-benefit, cost-effectiveness and cost-utility analyses of periodontal prevention were published⁴⁴. Only 14 papers were found, of which only one reported actual costs for prevention of periodontal diseases. It was concluded that there was no evidence that mass programmes aimed at the public, in general, rather than at individuals, were effective and that, in future, economic parameters as well as patient-centred outcomes should be included in clinical trials relating to periodontal diseases⁴⁴.

The opportunities to improve the current situation

As life expectancy increases and health costs rise, it becomes increasingly important for all members of society, including the population of Europe, to take more individual responsibility for their own health care and for preventing disease. It is apparent that much still needs to be done to improve the oral health of the population and that everyone must therefore take a greater interest in preventing oral diseases in their own mouths. The best available evidence suggests that the simple expedient of effective twice daily brushing with good quality fluoride toothpaste will do much to reduce the risks of caries and periodontal diseases. This is one preventive habit that all dentate individuals can follow, provided that there is universal access to affordable fluoride toothpaste. Fluoride clearly reduces the risk of developing caries and helps to prevent early carious lesions from progressing. If performed adequately, good brushing removes or displaces dental plaque and prevents gingivitis and reduces the risk of periodontitis. The problem is that many people do not brush adequately and some people are unable or unwilling to purchase suitable toothbrushes and fluoride toothpaste.

Campaigns to provide toothbrushes and fluoride toothpaste have been funded by either dental companies or by national or local government. From the data reviewed above, it would seem that the campaigns to date have fallen short of their aims. As the reasons for this become better understood, this may provide opportunities for doing things differently, with improved outcomes. It is already apparent that one-to-one advice and monitoring from suitably trained individuals can be effective³⁰: these may be teachers, dental nurses or dental hygienists, co-ordinated by dentists.

The challenge for public health is not only to ensure that all those who attend dental offices / cabinets /

practices are given high quality oral hygiene advice and that their oral hygiene is monitored, but also to reach out to the socio-economically deprived members of the community to help them also to prevent dental caries and attachment loss. As the population of Europe is some 700 million, many of whom do not regularly visit a dentist or a dental hygienist, the challenge should not be underestimated. It is the responsibility of all, be they dental or general health practitioners, public health workers or in the oral care industry, to address this issue together. Indeed, partnership between the different players and their collaboration with patients and the population at large is crucial in order to design and deploy effective interventions at multiple levels. The opportunity to improve dental public health in Europe and reduce health costs through achieving this change in the population's tooth brushing behaviour is one that must be realised.

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Disclosure

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