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Public Health and Dental Caries in Young Children in Deprived Communities in Scotland

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ABSTRACT

Dental caries is the most prevalent disease worldwide, and is caused by a complex interaction of tooth susceptibility, nutrition and the oral environment. In young children it can have a major impact on their quality of life, and is the main reason why Scottish children are admitted to hospital. There have been dramatic improvements in Scottish children's oral health. This has been enabled through the introduction of Childsmile, the national oral health programme for Scottish children. Nevertheless, significant challenges exist in reducing oral health inequalities. This paper calls for a greater emphasis on the social determinants of health to ensure that all Scottish children have the benefit of good oral health.

Key Words: public health; dentistry; oral health

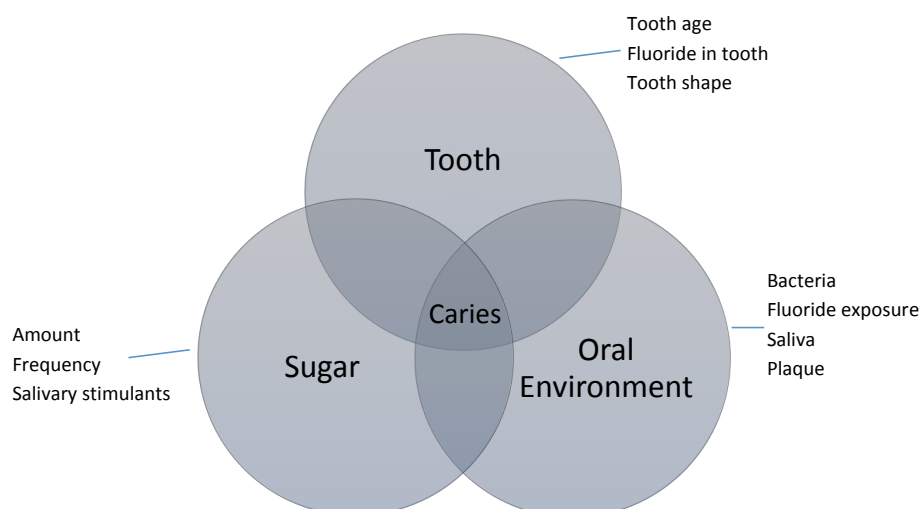
Introduction

Dental caries, also known as tooth decay, affects the vast majority of adults and 60-90% of children in industrialized countries¹. It has a complex aetiology as demonstrated in figure 1², which shows that caries occurs under conditions relating to the tooth itself, sugars present in food and drinks, and the oral environment. This paper discusses dental caries in the Scottish context, describing its aetiology, prevalence rates, policy, dental public health programmes and future directions.

Dental plaque forms continuously on tooth surfaces, and when exposed to fermentable carbohydrates, bacteria in the plaque create acid. Acid lowers the pH of the mouth, and a process of demineralisation occurs on the enamel of the teeth. Over time remineralisation occurs naturally, however, if demineralisation overtakes remineralisation, then cavities form in the teeth. Caries risk is associated with a wide range of factors including high levels of mutans streptococci bacteria, previous caries experience, poor oral hygiene, sugar consumption, low fluoride exposure, reduced salivary flow, and social deprivation³.

Sugar consumption has been identified as the major cause of dental caries⁴. Dramatic increases in dental caries were seen between the 17th and 19th centuries as the availability and consumption of sugar increased⁵⁻⁷. Caries prevalence has been in decline in developed countries since the 1960s, but is increasing in developing countries as diets change and sugar consumption increases¹. The frequency of sugar consumption is particularly important, with evidence suggesting that consumption on more than four occasions each day is likely to result in caries⁸. The correlation between diet and health is not straightforward⁹. Nevertheless, lower levels of caries are found in countries where average sugar consumption is less than 15-20kg per year, equating to 6-10% of energy intake⁸.

Figure 1 – Necessary conditions for caries development (adapted from Keyes and Jordan 1963²)



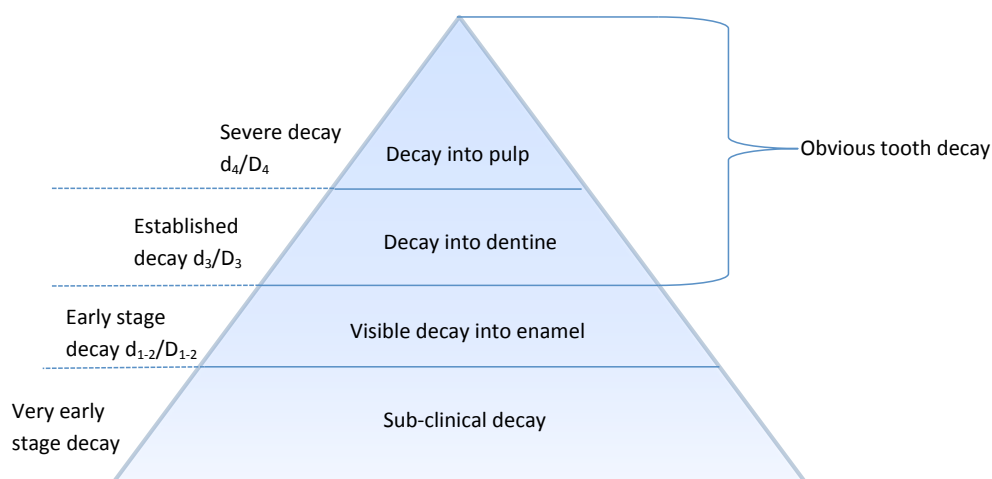
Another key determinant includes access to fluoride, either through the water supply, or from another source, such as toothpaste or topical fluoride application. Systematic reviews have suggested that water fluoridation can provide a preventive effect against decay¹⁰⁻¹¹. Other effective means include brushing with fluoride toothpaste^{12,13}, and fluoride varnish¹⁴⁻¹⁶ or fluoride gel application¹⁷, where fluoride in a highly concentrated form is applied to the teeth.

Dental caries impacts on individuals in a number of ways. The most obvious is pain and discomfort; however, the negative aesthetic appearance of caries can also have a huge impact. Caries is related to lower oral health related quality of life in both adults and children¹⁸, and has been shown to impact children's growth¹⁹. Treatment of decay in children can result in the extraction of teeth, and remains the most common reason for Scottish children to be admitted to hospital for an elective procedure²⁰. The health of the primary dentition is important, not only to prevent pain, but also to ensure that adult teeth grow into the appropriate space in the mouth. This can prevent costly orthodontic treatment in later years.

Dental Caries Prevalence in Scottish Children

Scotland has excellent epidemiological data on caries prevalence in children through the National Dental Inspection Programme (NDIP). NDIP originated in 2002, replacing the Scottish Health Boards' Dental Epidemiological Programme (SHBDEP), and gathers anonymised data on oral disease prevalence in children through school dental inspections. NDIP provides information on the number of decayed (d₃), missing (mt) and filled (ft) teeth in children across Scotland. Primary teeth are represented using lower case letters (d₃mft) and permanent teeth by upper case (D₃MFT). Only 'obvious decay' is detailed, that is, moderate or extensive decay where lesions are into dentine (the layer below the enamel) or pulp (figure 2)²¹.

Figure 2 – Caries iceberg (adapted from Pitts 2004²¹)



Basic inspection data is collected annually for 5 year old and 11 year old children, corresponding to the start and end of primary education. Detailed inspection data is available for each age group in alternate years. In 2010, 64% of 5 year olds had no obvious decay experience in their primary teeth, exceeding the national HEAT target of 60%²². The target failed to be achieved in only two out of fourteen health boards (Greater Glasgow and Clyde and the Western Isles). This represented a rise of six percentage points from 2008, and a rise of 23 percentage points over a 20 year period. There are also improvements in mean d_3mft over the same period (1.52 in 2010 compared with 3.2 in 1994).

The proportion of Primary 7 children with no obvious decay experience in permanent teeth is 69%, exceeding the national target of 60% in all Scottish health boards for the first time in 2011²³. The oral health of 11 year old children has improved greatly over the previous decade, rising from 53% of children with no obvious decay experience in their permanent teeth. A downward trend in decay prevalence was noted with D_3MFT falling from 1.29 in 2005 to 0.70 in 2011.

Undoubtedly the oral health of Scottish children is improving; however, a social gradient in oral health persists, and decay experience is not shared evenly. Health statistics are reported using the Scottish Index of Multiple Deprivation which uses area level information (including employment, income, and education) to stratify Scottish postcodes into quintiles, where 1 represents the highest level of deprivation and 5 represents the lowest level. In the least deprived areas (quintile 5) 79% of P1 children had no obvious decay compared with only 47% of children in the most deprived areas (quintile 1)²². For P7 children, 81% in quintile 5 had no obvious decay experience in their permanent teeth compared with only 54% in quintile 1²³.

It is not only in relation to deprivation that inequalities are noted across Scotland, but also between children living in urban and rural areas, and children from ethnic minorities. Conway *et al.*²⁴ reported that Pakistani children had higher d_3mft levels than white children, and that only 25% of Pakistani children had no obvious decay experience compared with 48% of white children. These differences persisted after controlling for deprivation level. Levin *et al.*²⁵ found that children in remote and rural areas have lower d_3mft and more restorative care.

Oral Health Policy in Scotland

Traditionally there has been a focus on treatment rather than prevention. However, more recently this focus has shifted, and policies and programmes are oriented towards prevention strategies. The key policy document that has influenced the direction of oral health care within Scotland in recent years is the *Action Plan for Improving Oral Health and Modernising Dental Services in Scotland*²⁶. Within the *Action Plan* one of its main principles is for NHS dentistry to be directed towards prevention, particularly in relation to oral health disparities.

Specific targets have also been created in relation to children's oral health. Of particular importance were the following targets²⁶:

By March 2008

1. All children will have access to dental care on starting nursery school and together with their parents and carers will have access to dental advice
2. The number of children aged 0-2 years under dental care/supervision will increase from 35% to 55%
3. The number of children aged 3-5 years under dental care/supervision will increase from 66% to 80%
4. All pre-school children in areas of greatest need will be offered dietary advice, dental advice, support and preventive packs through community based organisations
5. All nursery schools will offer supervised fluoride toothbrushing schemes and support healthy eating and drinking water policies

By 2010

1. 60% of 5 year old primary children (Primary 1) will have no signs of dental disease.
2. 60% of 11-12 year olds (Primary 7) will have no signs of dental disease in permanent teeth.

The current HEAT target is that²⁷:

At least 60% of 3 and 4 year old children in each SIMD quintile to receive at least two applications of fluoride varnish (FV) per year by March 2014.

To achieve these targets, guidelines have been drawn up to help policy makers, programme designers and practitioners. The prevention and management of caries in children in Scotland is focused around two Scottish Intercollegiate Guidelines Network documents^{4,28}. These guidelines draw from the evidence base around the benefits of fluoride, toothbrushing programmes, healthy diet, feeding practices, and the provision of services in areas of high deprivation. In 2010 the Scottish Dental Clinical Effectiveness Programme (SDCEP)²⁹ published guidance on the prevention and treatment of dental caries in clinical practice. The guidance provides recommendations on assessing children, delivering preventive care, managing caries, and recall frequency.

Key public health messages to achieve the targets outlined above are focused around two main areas: toothbrushing and diet²⁹. It is recommended that children brush twice per day for a period of two minutes using fluoride toothpaste (over and above toothbrushing in nursery or school). Children aged 0 to 6 should use toothpaste with at least 1000 ppm of fluoride: children over 7 should use between 1350 and 1500 ppm fluoride. Children under 7 years should be helped to brush their teeth by a parent or carer, and children should be

encouraged to spit out their toothpaste without rising their mouths. This increases the protection provided by fluoride toothpaste. Toothbrushing should commence when the first tooth breaks through. Additional advice includes attending the dental practice for preventive care from aged 6 months.

Dietary recommendations are that children are given sweet food or drinks on no more than four occasions each day, and that sugar is confined to meal times. Sweetened drinks should not be provided in feeding bottles and children should not be left with bottles at night. Salivary flow reduces during sleep, causing milk (not normally cariogenic) to raise acid levels in infants mouths. It is recommended that added sugars be restricted to less than 10% of dietary intake⁸. The most recent nutritional guidelines available in relation to oral health are the *Oral Health and Nutrition Guidance for Professionals*, which provide accurate, up-to-date information for professionals working with young families in Scotland³⁰.

As previously outlined, some of the targets set out above have been reached (i.e. 60% of children with no obvious decay). In addition, the number of dental extraction procedures in hospital has reduced by 23% since 2006/7, when 9238 extraction procedures were carried out, compared to only 7139 in 2010/11²⁰. This not only saves the NHS costly treatment, but also reduces anxiety and trauma in children who do not have to undergo general anaesthetic in hospital. Dental registration of 3-5 year olds is now at 89%; however, registration of 0-2 year olds remains low at only 41%³¹. This is of concern because evidence suggests that when children are young, those who attend regularly have lower levels of decay than those who attend for emergency care only³². The additional targets outlined have been reached through the introduction of the Childsmile programme, which is described in the following section.

Oral Health Programmes for Scottish Children

Pilot programmes to improve Scottish children's oral health have informed current practice. NHS Greater Glasgow and Clyde set up a from-birth programme in two of the most deprived areas of Glasgow City in 1997-1998 and 2003-2004. This scheme included free fluoride toothpaste, a push for healthy food and drinks policies within nurseries, and promoting attendance at the dental practice for preventive care. There were substantial reductions in d_3mft and untreated caries at a time when improvements in children's oral health were not seen in other areas of the health board³³.

In Dundee, a two year toothbrushing programme in schools and homes showed that the beneficial effect of five year old children brushing twice per day was 50%³⁴. By age 12 a significant difference in caries prevalence between the intervention ($D_3MFT = 1.32$) and control ($D_3MFT = 2.65$) was found for the children taking part.

Childsmile

Childsmile is the national oral health programme for all Scottish children^{35,36}, and it has developed from pilot programmes such as those outlined above. It is designed around the principles of the *Ottawa Charter for Health Promotion*, that is, the provision of education, sustainable resources, social justice and equity³³. Childsmile aims to reduce inequalities through a universal and targeted approach. We know that health education tends to be taken up by those who are already educated and wealthy³⁷, therefore, programmes have an ethical duty not to increase inequality³⁸.

Childsmile's demonstration programme ran between 2006-2009, with its Practice programme in the west of Scotland (NHS Greater Glasgow and Clyde, Lanarkshire and

Ayrshire and Arran), and the nursery programme in the east (NHS Lothian, Tayside, Fife). The full programme is now available across Scotland.

The Core programme is universal: every child in Scotland is supplied with fluoride toothpaste and toothbrushes on six occasions until age five years. The Core programme also includes toothbrushing in all nurseries, and P1 and P2 classrooms in the 20% most deprived areas in Scotland. Toothbrushing is carried out once every day, with each child having their own toothbrush kept within the classroom.

Childsmile Practice is focused around children's oral health from birth, where families are risk assessed to determine whether a child should be referred into the programme. The risk assessment is generally carried out by health visitors when an infant is around eight weeks old, and is based on the deprivation level of the area (SIMD) in which a family lives, whether parents are regular attenders at a dental practice, if older siblings have experienced dental decay, and the health visitor's professional judgement of caries risk. Families within the Practice Programme are helped to register and attend a local dental practice, and are given advice on toothbrushing and healthy foods and snacks. Childsmile Practice involves the full dental team through a dental health support worker, dental nurse and general dental practitioner. As children develop, they are able to receive fluoride varnish and fissure sealants at the dental practice. Fissure sealants seal off the pit and fissure surfaces of the teeth that are particularly prone to caries. The carrying out of such preventive measures has been aided by changes in dental remuneration, where dental practices are now paid by the NHS to provide these preventive treatments³⁹.

The Childsmile School and Nursery Programmes involve fluoride varnish application in schools and nurseries in the 20% most deprived areas of Scotland (SIMD quintile 1). Extended duty dental nurses and dental health support workers visit schools and nurseries to apply fluoride varnish to 3-5 year olds.

The improvement in Scottish children's oral health has been attributed to the introduction of Childsmile. Of particular note is that almost all nursery schools in Scotland now have an established toothbrushing programme. There remain concerns, however, that children experiencing the greatest degree of disadvantage are not engaged fully with Childsmile, with failure to attend rates at around 1/3rd for the Practice Programme⁴⁰.

Future Improvements in the Oral Health of Scottish Children

Leading oral health academics have called for a common risk factor approach to address poor general and oral health⁴¹⁻⁴³. They argue that the factors that affect health more generally, are also those that contribute to poor oral health. This includes individual level behaviours such as eating a poor diet, smoking, alcohol consumption and poor hygiene, but also system-level factors such as low income, lack of education and poor access to health care⁴³. By focusing on particular diseases, repetition of programmes is more likely and resources are used inefficiently. Indeed, the social gradient in oral health is identical to that in general health⁴². This is seen particularly clearly in relation to sugar consumption in Scottish children, which accounts for 17% of dietary intake, and contributes to both dental caries and excess weight⁴⁴. Sugar intake is also highest among children living in the most deprived areas⁴⁴.

Oral health promotion has been criticised for taking individualistic approaches^{42,45}. These are programmes and policies that tend to draw from psychological approaches that position behaviour as the outcome of rational decision making, and that theorise that increased knowledge and education alone will affect positive outcomes. In reality, individual

behaviours are very difficult to change, particularly in high risk groups⁴⁶. Sheiham and Watt⁴² argue that instead the social determinants of health must be addressed to reduce oral health and other health inequalities in the UK and beyond.

Newton and Bower⁴⁵ put forward the view that dental public health must engage more widely with the social science community to better understand the complexity surrounding disease experience. Childsmile has embraced this by incorporating an action research model, using a formative and summative approach to improve the programme and evaluate its impact. Progress is monitored through its Central Evaluation and Research Team, and additional commissioned research, which informs the programme as it evolves. Childsmile is also feeding into the Health Promoting Schools concept, engaging with schools to improve both oral and general health⁴⁷. Nevertheless, major challenges remain, particularly in the area of oral health inequalities in Scottish children. Marmot and Bell⁴⁸ have noted that until the 'causes of causes' are addressed, i.e. social determinants of health, and social justice issues put at the centre of policy making, inequalities will persist. It is in this direction that dental public health in Scotland must now turn to reduce oral health disparities in our children.

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