# The bitter truth regarding sugary medicines in children

By **Justine Howard**,[1] **Manas Dave**,[2] **Laura Reynolds**,[3] **Daniel Westhead**[4] and **Siobhan Barry**[5]

## Key messages

- Sugar-containing medicines contribute to the burden of dental decay
- Sugar-free medicines should be prescribed whenever possible
- All healthcare professionals should take responsibility for reinforcing caries preventative advice.

## Introduction

Many medicines have a bitter taste which is addressed by some capsules and tablets being coated to reduce unpleasant flavours. Young children often struggle to swallow solid medicines, therefore sugar-based syrups are frequently used as an alternative formulation to increase palatability and improve patient acceptance and compliance.[1]

Sucrose is the most common sugar additive in medicines. It remains widely used because it is cheap, non-hygroscopic and easy to process.[2] Although improving the palatability of medicines, sucrose has the potential to cause dental decay.[3,4] The UK Department of Health guidance 'Delivering better oral health: an evidence-based toolkit for prevention' recommends, where available, sugar-free medicines should be prescribed.[5] To be classified as 'sugar-free' the medicine should not contain fructose, glucose or sucrose as an ingredient.[5,6]

## Dental caries in the UK

Dental caries, synonymous with dental or tooth decay, is the most prevalent disease of the oral cavity and untreated dental caries in permanent teeth is the most common health condition in the world.[7] Over the last decade, the prevalence of dental caries has fallen in many parts of the UK, however in many cities, particularly in Northern regions, it remains alarmingly high. A recent oral health survey found that 29.3% of 5-year-old children have dental caries.[8] If left untreated, caries can cause substantial pain and infection, and often results in children having tooth extractions under general anaesthetic.

Toothache can result in missed school days and parents may also have to take time off work to take their children to a dentist or hospital.[9] There is also a financial consideration. Between 2021 and 2022, NHS hospitals reported 26,741 episodes of tooth extractions (with a primary diagnosis of dental decay) in 0- to 19-year-olds, costing approximately £50.9 million.[10]


## Author information

[1]Paediatric Dentistry, University Dental Hospital of Manchester, Manchester, UK; [2]Division of Dentistry, The University of Manchester, Manchester, UK; [3]Leeds Dental Institute, Leeds Teaching Hospitals NHS Trust, Leeds, UK; [4]Division of Dentistry, The University of Manchester, Manchester, UK; [5]Division of Dentistry, The University of Manchester, Manchester, UK
Corresponding author: Manas Dave, Division of Dentistry, Coupland 3 Building, The University of Manchester, Oxford Road, Manchester, M13 9PL

Email: manas.dave@manchester.ac.uk

Fig. 1 Extensive dental caries in a child

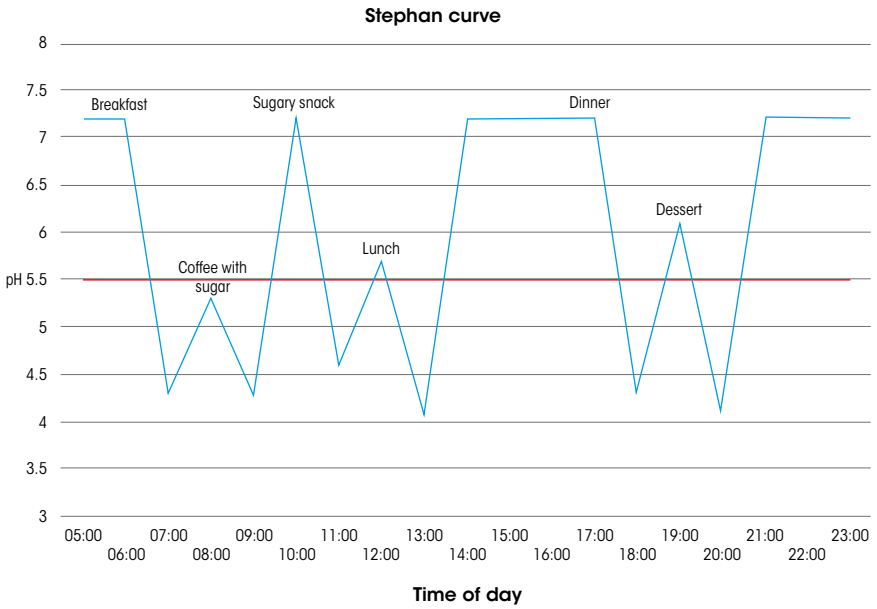


Fig. 2 The Stephan curve – after meals are consumed, the increase in sugar reduces oral pH below the critical pH of enamel (pH 5.5), resulting in tooth demineralisation

## How does dental decay develop?

Dental caries is multi-factorial involving the interaction of four essential factors: a tooth, bacteria, fermentable carbohydrates and time.[7] Figure 1 shows dental caries that has resulted in almost complete destruction of a child's upper teeth with accompanying sinus tracts, indicating a long-standing dental abscess.

## Overview of the caries process

The caries process is a dynamic host-microbial interaction as described below:

1. Dental plaque formation: Bacteria in the mouth attach to teeth forming a sticky biofilm known as plaque
2. Acid production: Bacteria in dental plaque ferment sugars and other carbohydrates in the diet, producing acid that lowers the pH of the surrounding environment
3. Demineralisation: The acidic environment dissolves/demineralises tooth enamel
4. Remineralisation: If the acidic environment is neutralised and the pH of the mouth stabilises, the process of remineralisation can occur, in which minerals such as calcium and phosphate (present in saliva) are redeposited into weakened enamel
5. Continued demineralisation: If the acidic environment persists, the process of demineralisation can continue and eventually penetrate enamel to reach its underlying structure (dentine). Dentine is weaker than enamel and is more susceptible to decay, so once enamel is penetrated, decay can easily and quickly spread through the tooth causing cavities to develop.

Figure 2 shows the 'Stephan Curve'. The curve illustrates how the oral pH dips after eating and drinking fermentable carbohydrates. When pH drops below 5.5, demineralisation of tooth enamel occurs, this is known as the critical pH for enamel. When pH rises above 5.5, enamel remineralisation occurs. The longer oral pH is below 5.5, the more susceptible teeth are to developing caries.

*'The cariogenic effect is greater if the medicines are taken at bedtime, at which point the cleansing and buffering capacity of saliva is significantly reduced due to a drop in saliva production at night.'*

## How can caries risk/susceptibility be reduced?

Effective toothbrushing helps to remove soft dental plaque and use of a fluoridated toothpaste can help to strengthen teeth by remineralising the tooth surface. However, the most important factor for reducing dental caries is diet, as this is the only feasible modifiable risk factor involved in caries development. Reducing the frequency and amount of sugar consumed throughout the day limits the amount of time teeth are susceptible to decay. Dentists regularly educate patients on the importance of limiting sugars to mealtimes and reducing sugary snacks. This advice becomes more challenging to follow in children who are prescribed sugar-based medicines, particularly if the medicines are given at separate times to meals, multiple times a day. The cariogenic effect is greater if the medicines are taken at bedtime, at which point the cleansing and buffering capacity of saliva is significantly reduced due to a drop in saliva production at night.[11]

## Cariogenic potential of sugar-containing medications

Several studies have shown a drop in dental plaque pH resulting from consumption of sucrose-sweetened medicines.[12,13,14] Clinical observations linking long-term oral medication with rampant dental decay have been noted since 1953, when James and Parfitt described extensive decay in children taking iron tonics.[15] It was concluded that the cariogenic effect of the sugary medicine was the main cause. Roberts and Roberts examined the dental health of 44 children

aged nine months to six years who had been prescribed daily sucrose-containing liquid medicines for at least six months for a chronic medical condition and compared this to 47 children of a similar age who were either not taking any medication or taking solid medicines. Children on long-term sugar-based liquid medicines had a DEF(s) score (relating to the number of decayed, extracted or filled surfaces of teeth) significantly higher at 5.55 vs. 1.26 ($P = 0.02$) in the control group, despite there being no difference in the children's eating habits.[16]

particularly important for children who are taking medications long-term (defined as daily or alternate days for more than three months). Many medically compromised children have other risk factors for poor oral health, including social deprivation, learning disabilities and restricted eating habits.[11]

Not only is social deprivation a risk factor for poor oral health, but it is also an indicator of more severe dental disease. In 2021–2022, children and young people living in the most deprived communities accounted for almost 3.5 times the hospital caries-related tooth extraction episodes compared with those living in the most affluent communities.[10] Patients with learning disabilities have an additional concern, with research suggesting that 40 to 60% of patients with learning disabilities will struggle to cope with dental treatment when it is needed.[18] This further highlights the importance of effective prevention strategies in these high-risk patients.

*'It is reassuring that many oral medicine suspensions and solutions are only available in sugar-free formulations, however there are still many commonly prescribed medicines available in a sugar-containing formulation.'*

## Are sugar-free medicines counterproductive?

While acknowledging the benefit of sugar-free medicines in patients with chronic conditions, Sundar (2012) argues that exclusive use of sugar-free medicines for short-term illness (eg antibiotics and analgesics) is not clinically justifiable.[17] While this statement may be appropriate for low caries-risk individuals, it may not be appropriate for patients with a high baseline caries risk. Dental decay is preventable; therefore, healthcare professions should minimise all risk factors to mitigate its burden and prevalence.

Alongside prescribing sugar-free medicines, prescribers should also promote the sugar-free drink and snack message to help reduce the risk of dental caries. It is difficult to establish from the literature what children eat and drink alongside taking medicines but anecdotally we are aware that children are often given sweet drinks to help wash away the taste of medicines. Consuming sugary snacks and drinks alongside sugar-free medicines would be counterproductive and this advice should be given to parents/guardians.

## High-risk/susceptibility children

Prescription of sugar-free medicines is

## Recommendations

Recommendations to help reduce the dental risk of sugar-containing medicines[2] are as follows.

*Family:*

- Parents/carers should be educated about sugar and the risk of tooth decay
- Parents/carers should be informed if a medicine contains sugar and be advised to administer sugar-containing medicines at mealtimes rather than at a separate time
- If medicines are prescribed at bedtime, these should be administered at least 30 minutes before the child goes to sleep to allow time for the oral environment to neutralise prior to toothbrushing (toothbrushing in an acidic environment can increase the risk of tooth wear)
- If sugar-containing medicines must be taken at a separate time to food, the child should be encouraged to use a fluoride-containing mouthwash after each dose, to help mitigate the risk of tooth decay.

*Prescribers:*

- All prescribers should be aware of the underestimated side effect of sugar-containing medications
- Prescribers should preferentially prescribe sugar-free medicines
- Electronic prescribing systems should default to sugar-free formulations, where available
- If there is no sugar-free alternative, medicines should be prescribed to be taken at mealtimes wherever possible.

*Pharmacists:*

- Pharmacists should promote the use of sugar-free medicines
- Pharmacists should have the authority to dispense sugar-free preparations rather than sugar-containing preparations.

*Pharmaceutical companies:*

- All sugar-containing medicines should be clearly labelled warning about risks of tooth decay and advice to take medicines at mealtimes
- Drug companies should be encouraged to replace sugar with non-cariogenic sweeteners
- Drug companies should develop smaller tablets/capsules to aid children in taking solid medicine formulations.

## Conclusion

The burden of poor oral health cannot be underestimated. Children with tooth decay may have pain, infection and difficulties with eating, sleeping and socialising.

In most children, tooth decay is preventable and with diet being the most important modifiable risk factor in preventing the condition, prevention strategies should be aimed at trying to reduce the amount and frequency of sugar children consume. As health professionals it is important that we deliver this message in every aspect of care, including through the medications we prescribe.

It is reassuring that many oral medicine suspensions and solutions are only available in sugar-free formulations, however there are still many commonly prescribed medicines available in a sugar-containing formulation. Table 1 highlights some commonly prescribed sugar-containing medicines with suggested sugar-free alternatives. Prescribers are

**Table 1 Commonly prescribed sugar-containing medicines for paediatric patients and sugar-free alternatives. *These figures relate to at least one UK licensed product**

| Medication with sugar | Prescribed for | Sugar content g/5 ml* | Sugar-free substitution |
|---|---|---|---|
| Loratadine 5 mg/5 ml oral solution | Allergic conditions | 3.0 g | Loratadine 5 mg/5 ml oral solution sugar free |
| Piriton syrup (chlorphenamine 2 mg/5 ml oral solution) | Allergic conditions | 2.4 g | Chlorphenamine 2 mg/5 ml oral solution sugar free |
| Amoxicillin 125 mg and 250 mg/5 ml oral suspension | Bacterial infections | 2.7 g | Amoxicillin 125 mg and 250 mg/5 ml sugar-free oral suspension |
| Azithromycin 200 mg/5 ml oral suspension | Bacterial infections | 3.7 g | Azithromycin 200 mg/5 ml oral suspension sugar free available by special order |
| Cefalexin 125 mg and 250 mg/5 ml oral suspension | Bacterial infections | ~3.0 g | Cefalexin 125 mg and 250 mg/5 ml oral suspension sugar free |
| Ciproxin (ciprofloxacin 250 mg/5 ml oral suspension) | Bacterial infections | 1.4 g | Consider prescribing an alternative sugar-free fluoroquinolone antibiotic |
| Clarithromycin 125 mg and 250 mg/5 ml oral suspension | Bacterial infections | 3.1 g | Consider prescribing an alternative sugar-free macrolide antibiotic |
| Co-amoxiclav 250 mg/62 mg/5 ml oral suspension | Bacterial infections | Unknown | Co-amoxiclav 250 mg/62 mg/5 ml oral suspension sugar free |
| Co-trimoxazole 80 mg/400 mg/5 ml oral suspension | Bacterial infections | 2.5 g | Co-trimoxazole 40 mg/200 mg/5 ml oral suspension sugar free |
| Flucloxacillin 125 mg/5 ml oral solution | Bacterial infections | 3.2 g | Flucloxacillin 125 mg/5 ml oral solution sugar free |
| Metronidazole 200 mg/5 ml oral suspension | Bacterial infections | 1.7 g | Consider prescribing an alternative sugar-free antibiotic |
| Phenoxymethylpenicillin 125 mg and 250 mg/5 ml oral solution | Bacterial infections | 2.9 g | Phenoxymethylpenicillin 125 mg and 250 mg/5 ml oral solution sugar free |
| Lactulose 3.1-3.7 g/5 ml oral solution | Constipation | Unknown | Lactulose 10 g/15 ml oral solution 15 ml sachets sugar free |
| Lansoprazole 15 mg orodispersible tablets | Gastrointestinal ulceration, GORD, H. Pylori infection | 13.8 mg | Consider prescribing an alternative PPI |
| Morphine sulfate 10 mg/5 ml oral solution | Pain | 2.3 g | Morphine sulfate 10 mg/5 ml oral solution sugar free special order |
| Brufen (ibuprofen 100 mg/5 ml syrup) | Pain and inflammation | 3.3 g | Ibuprofen 100 mg/5 ml oral suspension sugar free |
| Paracetamol 120 mg and 250 mg/5 ml oral suspension paediatric | Pain and pyrexia | 3.0 g | Paracetamol 120 mg and 250 mg/5 ml oral suspension paediatric sugar free |

constantly evaluating risk/susceptibility and benefit when deciding optimal treatment strategies for patients. Tooth decay as a potential adverse effect of treatment should be a factor in this shared decision-making process.

## Consent

The parents/guardians of the child in Figure 1 gave written permission for publication of the photograph.


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