Oral Health in Ireland:

A Handbook for Health Professionals

Third edition, 2024

DHF Dental Health Foundation Ireland

UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh

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Foreword

Since the publication of the second edition of Oral Health in Ireland, a handbook for Health Professionals, there have been several important changes that have occurred with respect to oral health and oral health promotion both globally and in Ireland.

Three recent documents, The World Health Organisation (WHO), Global Oral Health Action Plan (2023-2030), the Irish Government's National Oral Health Policy, Smile agus Sláinte (2019) and the Platform for Better Oral Health in Europe, Oral Health Manifesto (2024 -2029) recently launched in the European Parliament are of great significance to oral health promotion. They highlight the need for policy makers and governments to engage with the issue, while stressing the importance of a Life Course Approach and emphasis on a common risk factor approach to promoting better health outcomes. The risk factors common to oral diseases or conditions and many of the non-communicable diseases are diet, tobacco use, unsafe alcohol consumption and lack of physical activity.

The evidence-based approach that was introduced in the second edition continues to be supported in this third edition. The evidence-based approach identifies clinical practice, professional expertise and the patients' needs and preferences as essential to decision making.

Poor oral health impacts on a significant proportion of the population, globally untreated tooth decay is the most common global health condition, impacting approximately a third of the global population (34%). Tooth decay, gum diseases, tooth wear, traumatic tooth injuries and oral cancer are some of the common oral diseases and conditions that impact the Irish population, and all can to a degree be prevented. This third edition of Oral Health in Ireland, a handbook for Health Professionals sets out information and recommendations on a range of conditions including the above. The handbook focuses on enabling health and allied health professionals to promote and support an inclusive approach to discussing risk factors, preventing disease, and empowering individuals to act on their health and well-being, aligning with 'Healthy Ireland'.

A welcome addition for health and allied health professionals in this edition is for example the relevance of sustainability, the United Nations Sustainable Development Goals (UNSDG) in Dentistry and the importance of the integration of oral health within the wider domain of health for success. Since the last edition, there has been a move away from the placement of

fillings containing mercury with the adoption of the Minamata Convention on Mercury, which further emphasises the important role of prevention rather than treatment.

Finally, I would like to congratulate the Dental Health Foundation Ireland, the Oral Health Services Research Centre, Cork University Dental School and Hospital, University College Cork. on the development of the 3rd edition. I would also like to acknowledge all the contributions of previous contributors to the two earlier editions.

Emeritus Professor Denis O'Mullane

Oral Health Services Research Centre and Cork University Dental School and Hospital University College Cork

Oral Health across the Life Course

Introduction

Untreated dental caries is the most common disease according to the World Health Organisation (WHO) Global Burden of Disease Study 2019. Despite progress in preventive dentistry, 3.5 billion of the world's population have experienced both tooth decay (dental caries) and gum (periodontal) diseases throughout their lives.[1]

Advances in the prevention and treatment of oral diseases mean that many children born in this century will keep their teeth into old age, and the condition of these teeth will depend on how well they are cared for over a lifetime. The vital role that oral health plays in our daily lives in terms of eating, speaking, smiling and socialising, is becoming better recognised by society, which more than ever before is concerned with self-presentation, self-image and aesthetics.[2]

Many behaviours that cause poor general health are also implicated in oral diseases and conditions. High sugars intake, for example, is linked to obesity, heart disease, diabetes, and dental caries. Smoking is linked to cardiovascular disease, respiratory disease, gum disease and cancer, including mouth head and neck cancer.

In addition to sharing common risk factors, poor oral health impacts on general health. Research has shown a link between gum disease and heart disease.[3] A link between gum disease in pregnancy and poor pregnancy outcomes has also been reported, although further research is required.[4] The prevention of oral infection may also play a role in the control of diabetes.[5]

Healthy Ireland conducted a series of interviewer-led surveys where participants self-report on their experience of nutrition and health. The 2021 survey found that 52% of those aged over 65 years in Ireland reported suffering from a chronic illness (lasting 6 months or more). Interestingly, 90% of all participants who were asked, reported that they would like to make at least one change to improve their health.[6] The 75th World Health Assembly adopted a new global strategy on oral health in May 2022, emphasising that oral disease prevention and the promotion of oral health should be integrated with chronic disease prevention and general health promotion, because the risks associated with general disease and oral disease are linked.[7] The WHO Draft Global Oral Health Action Plan 2023-2030 sets out a framework to guide the progress from goals to achievements in public oral health across the globe.[8]

The FDI Vision 2030[9] is designed to identify challenges and determine opportunities for improvements in the provision of oral health services. It integrates several of the United Nations Sustainable Development Goals (UN SDG) and Universal Health Coverage (UHC). The seventeen UN SDGs[10] were adopted by all Member States in 2015 to provide a shared blueprint for peace and prosperity for people and the planet, now and into the future, with the desire to achieve this by 2030. Within dentistry the aim is for improvements in education, access to dental care, environmental awareness, and sustainability of materials.[9]

It is almost 40 years since the proclamation of the Ottawa Charter for Health Promotion of 1986;[11] the principles of this charter are as relevant today as they were then. They outline the steps needed to promote health:

- **Build healthy public policy**
- **Create supportive environments**
- **Strengthen community actions**
- **Develop personal skills**
- **Reorient health services**

Examples of legislative measures that contribute to building healthy public policy and creating supportive environments in Ireland are the Health (Fluoridation of Water Supplies) Act 1960; SI 42 of 2007 (Fluoridation of Water Supplies Regulations);[12,13] Section 47 (1) of the Public Health (Tobacco) Act, 2002 as amended by Section 16 of the Public Health (Tobacco) (Amendment) Act, 2004, which prohibits the smoking of a tobacco product in a specified place[14]; and the Public Health (Alcohol) (Labelling) Regulations 2023.[15] In addition, the introduction on May 1st 2018, of the Sugar Sweetened Drinks Tax (SSDT) and its amendment on January 1st 2019 [16], is a taxation and healthy public policy that may contribute to addressing the obesity epidemic as well as improving oral health. The health benefits of the tax, particularly in advancing the WHO aim of reducing these non-communicable diseases (NCDs), requires evaluation.[17, 18]

Health is achieved and maintained through good living and working conditions, good social and emotional supports, healthy environments, and positive health behaviours. As a nation, we share a common goal of good health and quality of life, enabling a healthy and economically productive population. Achieving this common goal requires cooperation and teamwork, in creating supportive environments, developing personal skills and strengthening community action across the public and private sectors in diverse areas, for example, health, welfare, commerce, industry, and employment.

Recognising that a broad spectrum of people in diverse sectors – not just dentists, dental nurses and dental hygienists – have a role to play in oral health promotion[19], and that there was a need for a single publication in which the current scientific knowledge of the different oral diseases and conditions is presented, Oral Health in Ireland was first published by the Dental Health Foundation in 1999. This third edition of Oral Health in Ireland: a Handbook for Health Professionals reflects the latest updates in scientific knowledge over the past 13 years, keeping in mind the multi-disciplinary view of oral health.

As with the previous editions, this third

edition is intended as an adjunctive guide for the promotion of healthy practices and the prevention of oral disease. It provides a concise, scientifically based document on oral health promotion for use by health and allied health professionals in the Republic of Ireland. It is timely at this juncture with the publication of a national oral health policy, Smile agus Sláinte in 2019 – to present day.[20]

The handbook is written from the perspective of the promotion of oral health, but it has the potential to also impact on general health through appreciating the shared risk factors for many non-communicable disease and a common risk factor approach.

The document sets out to describe:

- **Oral health terminology and the determinants of oral health and disease**
- **Relevant information on the current oral health status and oral health practices of Irish children and adults**
- **Methods of disease prevention**
- **Common risk factors between oral health and general health**
- **Information on nutrition and oral health**
- **Oral healthcare products**
- **Sustainability in Dentistry**
- **Sources of information on oral health in the Republic of Ireland**

Chapter 1
The Healthy Mouth: Understanding Structure and Function

Oral health is achieved when the teeth and oral environment are not only healthy but also: comfortable and functional, socially acceptable and free from sources of infection.

Comfortable and functional, that is, food can be chewed thoroughly and without pain or discomfort, and the teeth are not sensitive to different stimuli such as sweet foods, hot and cold temperatures.

Socially acceptable, whereby, the mouth does not give rise to bad breath, and the appearance of the teeth and gums are acceptable and do not cause embarrassment.

Free from sources of infection which may affect general health, whereby, good oral hygiene should be maintained to minimise the risk of oral infections which may adversely impact on general health (e.g., gum disease may be a risk factor for cardiovascular disease, diabetes mellitus, bacterial pneumonia, and other systemic disorders).

This state of positive oral health should persist for life, and given a healthy lifestyle, is achievable for most of the population.

Structure and function is a useful starting point for the consideration of factors affecting the mouth and oral health. This chapter begins with a brief description of tooth types and their functions, with some background information on the development of teeth and the numbering system used to describe them. The number and condition of teeth in the mouth at any given age are indicators of oral health status. The chapter then continues with an overview of the soft tissues of the mouth, and of saliva, which plays an essential role in maintaining a healthy oral environment. Finally, dental plaque (plaque biofilm), which facilitates the development of oral disease, is described.

Tooth Types and Functions

The human mouth has four different tooth types, they are incisors, canines, premolars and molars. Each tooth type has its own specific function for the biting, cutting, tearing, crushing and chewing of food.

The incisors at the front of the mouth have a sharp biting/cutting surface and are used for cutting or shearing food into small chewable pieces. There are eight incisors in both primary (baby) and permanent (adult) sets of teeth (dentitions).

The canines are situated at the "corners" of the dental arches. They have a sharp, pointed surface. Their function is to grip and tear food. There are four canine teeth in both primary and permanent dentitions.

The premolars, unlike the incisors and canines, have a flat biting surface. Their function is to tear, chew and crush food. They are only present in the permanent dentition. In the permanent dentition there are eight premolars.

The molars are the largest of the teeth. They have a large flat chewing and crushing surface. The function of the molars is to chew and crush food. There are eight molars in the primary dentition and twelve in the permanent dentition.

Figure 1: Tooth types.

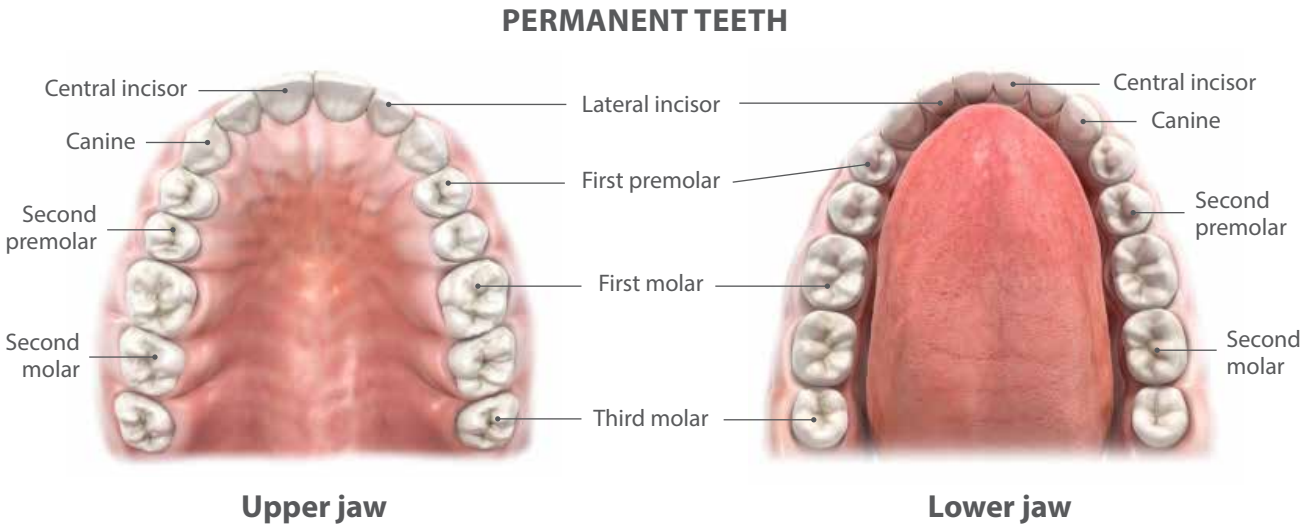


Figure 2

Development of Teeth

Before Birth: Formation of Tooth Buds

By the third week after conception, the primitive mouth has formed. Over the next few weeks, the tongue, jaws, and palate develop. During the sixth week, the formation of embryonic cells or tooth buds that eventually form into teeth commences. By eight weeks, the tooth buds of all the primary (baby) teeth can be discerned; by twenty weeks, the tooth buds of some permanent (adult) teeth start to develop.

After Birth: Eruption of Primary and Permanent Teeth

The development of the teeth within the jaw continues after birth. Normally, the first primary teeth start to appear in the mouth around six months after birth. The primary central incisors, lateral incisors, first molars, canines and second molars normally appear in this order at intervals from 6–24 months. By age two and a half years, most children have their full complement of 20 primary teeth – 10 teeth in the upper (top) jaw and 10 teeth in the lower (bottom) jaw. As the child grows, the jaws also grow, and spaces may begin to appear between the primary teeth. This growth makes spaces for permanent teeth, which are larger and there are more of.

Tooth eruption times vary widely from child to child for both the primary and permanent dentitions and the ages shown in the tooth eruption charts on page 15 represent average times of eruption.

From as early as age 5 years, the first permanent teeth, normally the four first permanent molars, begin to erupt into the mouth. These teeth erupt at the very back of the mouth behind the last primary tooth. As no teeth fall out to make way for these new first permanent molars, it is not unusual for the emergence of the first molars to go unnoticed. At the same time, the two primary lower central incisors begin to loosen and fall out as the permanent lower central incisors emerge in their place. Over the following six years or so, the remaining 18 primary teeth fall out and are replaced by permanent teeth. From about age 12 -13 years but it may be as young as 11 years of age, the

four second permanent molars appear behind the first permanent molars. The last teeth to appear are the third molars or wisdom teeth. Not everybody has third molars and there is considerable variation in the age at which they erupt.[21]

Developmental Abnormalities

Owing to the occurrence of genetic aberrations (congenital) or disruptions at any stage in the normal process of development (developmental or acquired), certain conditions may arise in relation to the formation of a tooth bud and structures. Examples of anomalies in tooth number/size or shape include hypodontia, oligodontia, supernumerary teeth, macrodontia, microdontia, dilaceration, gemination, fusion and taurodontia.[22] When there has been a defect with the development of tooth structure the result is classed as Amelogenesis Imperfecta (affecting enamel), Dentinogenesis Imperfecta (affecting dentine), or Molar Incisor Hypomineralisation (MIH). Recent studies show the high prevalence of MIH in the Irish population, with 58% of dentists polled observing cases of MIH weekly. Early recognition and management are key in the case of these dental anomalies to limit the potential negative consequences for the patient.[23]

Symptoms of Teething

During the first two years of life, the most common side effect of teething is drooling or dribbling. Though the response to tooth eruption is very varied, symptoms of teething may include disturbed sleep, feeding irritability and swollen tender gums. Severe symptoms such as diarrhoea, fever and convulsions require medical attention and should not be attributed merely to teething.

The Importance of Primary Teeth

Some parents still consider that the primary teeth are not important because they fall out and are replaced by permanent teeth. However, besides their obvious importance for eating, appearance and speech, healthy primary teeth are also essential for guiding permanent teeth, which develop underneath them, into their correct positions. The primary molars, usually the last of the primary teeth to fall out, are normally not replaced by their permanent successors; the second premolars until about 12 years of age.

Early neglect of primary teeth can result in a number of problems. Tooth decay in a young child can quickly lead to pain and infection (abscess) and, because of their young age, dental treatment can be difficult and may have to be carried out under general anaesthetic – a procedure not without risk. If a young child's primary molar tooth is taken out early (extracted) due to severe tooth decay, then the guide for the permanent successor is lost. The space available for the permanent tooth can be reduced, resulting in crowding or misalignment of the permanent dentition. A number of longitudinal studies have also found that children who experienced tooth decay in their primary (baby) teeth had a greater risk of developing tooth decay in their permanent (adult) teeth than children who maintained healthy primary teeth.[24,25,26] These findings underscore the importance for parents and carers to establish positive oral health habits (e.g., healthy eating, daily toothbrushing) for their children from an early age, starting when the first tooth appears. Dietary advice for parents / carers of young children is provided in Chapter 4 – Nutrition

and Oral Health, and toothbrushing advice is provided in Chapter 2 – Oral Health & Disease Prevention. It is also important that children be brought for their first dental check-up before all the primary teeth have erupted, ideally before age 2 years.

Summary points

- **There are 20 primary teeth**
- **Primary teeth are important for eating, appearance, and speech as well as for guiding permanent teeth, which develop underneath them, into their correct positions**
- **In the primary dentition lower incisors are usually the first teeth to erupt at about 6 months; all 20 primary teeth are normally in the mouth between 2 and 2.5 years of age**
- **All 20 primary teeth typically fall out**
- **The primary molars are usually the last primary teeth to fall out, and normally remain in the mouth up to about age 12-13 years**
- **There are 32 permanent teeth including four wisdom teeth**
- **The first permanent teeth to erupt (from as early as age 5 years) are the four first permanent molars behind the last primary molar tooth. Parents should be particularly vigilant and look out for the arrival of these teeth to ensure that they are brushed**
- **Permanent incisors erupt between age 6 and 9 years**

Tooth Eruption

Average eruption times of primary teeth

Figure 3

Tooth		Eruption (months)
Upper	Central incisor	7
	Lateral incisor	8
	Canine	16–20
	First molar	12–16
	Second molar	21–30
Lower	Central incisor	6 ½
	Lateral incisor	7
	Canine	16–20
	First molar	12–16
	Second molar	21–30

Average eruption times of permanent teeth

Figure 4

Tooth		Eruption (years)
Upper	Central incisor	7–8
	Lateral incisor	8–9
	Canine	11–12
	First premolar	10–11
	Second premolar	10–12
	First molar	6–7
	Second molar	12–13
	Third molarr	17–21
Lower	Central incisor	6–7
	Lateral incisor	7–8
	Canine	9–10
	First premolar	10–12
	Second premolar	11–12
	First molar	6–7
	Second molar	12–13
	Third molar	17–21

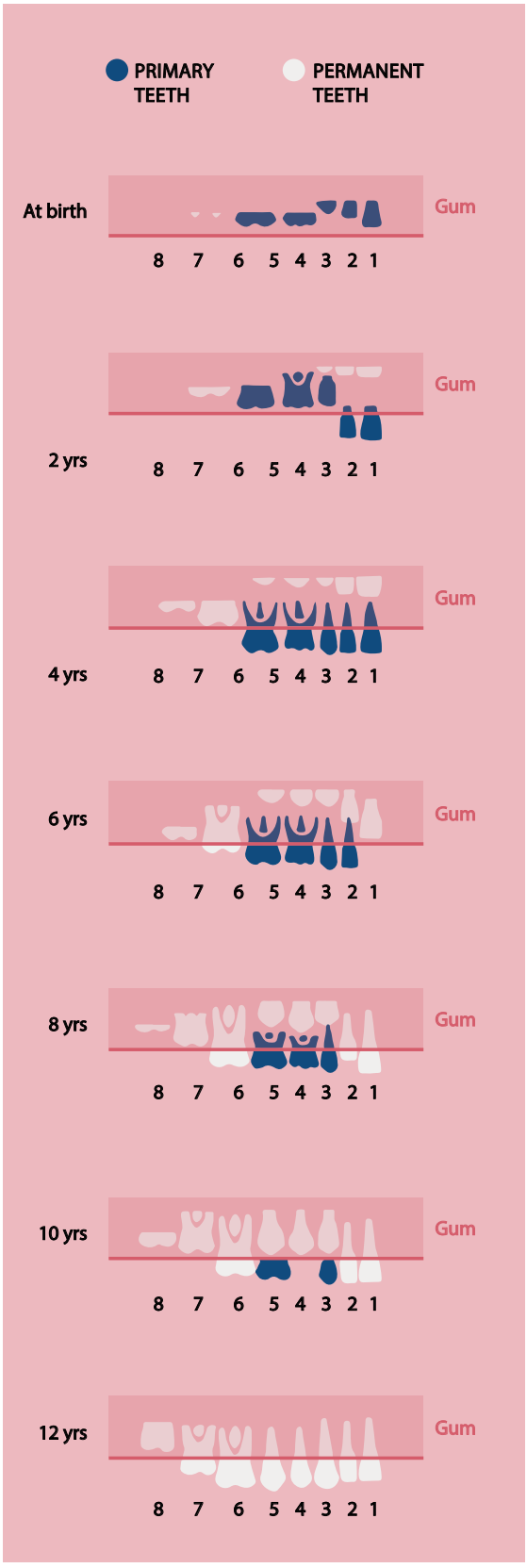
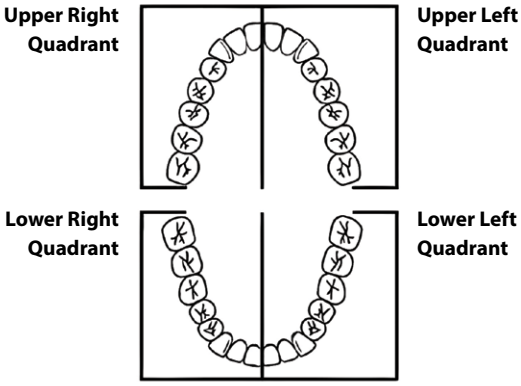


Figure 5: Schematic representation of primary and permanent dentitions at different ages and stages of development.

Dental Shorthand

Dentists use a variety of numbering systems for tooth identification. The FDI (Federation Dentaire International) system is one that is generally used worldwide. This system uses two numbers to identify the location of the tooth and the specific tooth. The mouth is divided into four quarters or quadrants as shown in the diagram below, there is a different number for each quadrant (1 to 4) for the permanent dentition and 5 to 8 for the primary dentition. The teeth in the permanent dentition are number 1 to 8, and the primary dentition 1 to 5, where 1 is the central incisor in both dentitions.



Primary (20 teeth)

5.5	5.4	5.3	5.2	5.1	6.1	6.2	6.3	6.4	6.5
8.5	8.4	8.3	8.2	8.1	7.1	3.1	3.2	3.3	3.4

Quadrant

Upper right = 5
Upper left = 6
Lower left = 7
Lower right = 8

Permanent (32 teeth)

1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8
4.8	4.7	4.6	4.5	4.4	4.3	4.2	4.1	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8

Quadrant

Upper right = 1
Upper left = 2
Lower left = 3
Lower right = 4

Anatomy of the Tooth and Surrounding Structures

The tooth has two anatomical parts: the crown and the root. The crown is the part of the tooth that is normally visible in the mouth (above the gum line). The shape of the crown determines the function of the tooth. The root of a tooth is the part embedded in the jaw. It anchors the tooth in its bony socket and is normally not visible (below the gum line). The gum line is where the tooth and gum meet. The anatomy of

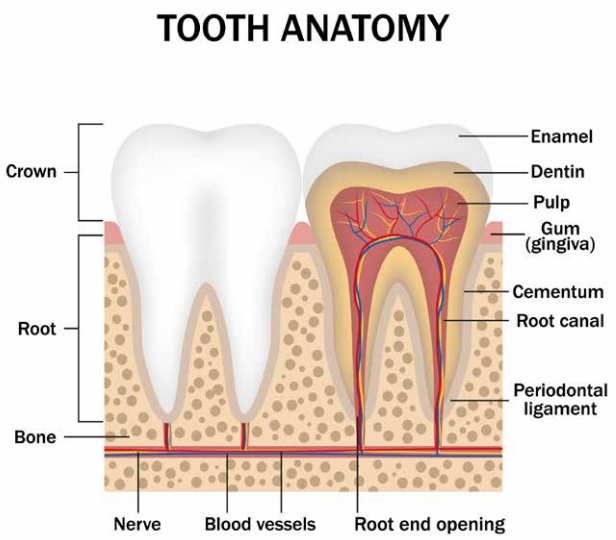


Figure 6: Tooth anatomy.

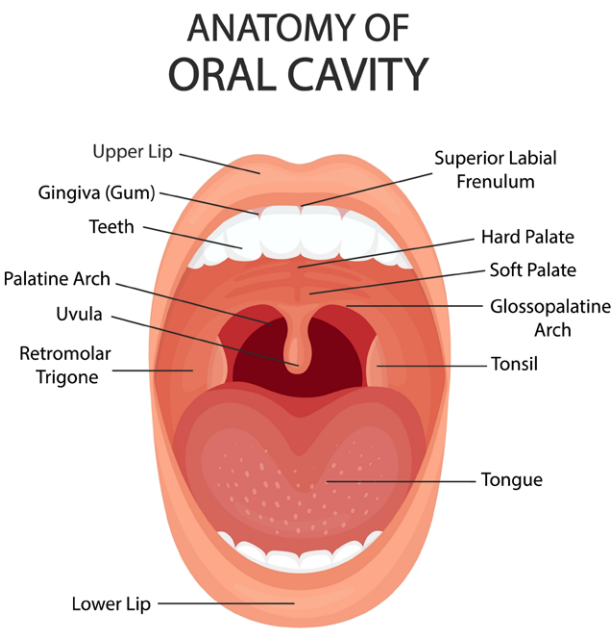


Figure 7: Soft and hard tissues of the mouth.

teeth and the mouth structures which surround and support them are described below.

Structures of the tooth

Enamel: The hard outer layer of the crown. Enamel is the hardest substance in the body, yet it can decay and breakdown if the teeth are not properly cared for.

Dentine: Not as hard as enamel, this forms the bulk of the tooth and can be sensitive if the protection of the overlying enamel is lost. The dentine contains tubules or tiny channels that communicate between the outer layers of the tooth (enamel surface and cementum) and the pulp. These tiny channels carry sensations such as heat or cold from the outside of the tooth to the inside.

Pulp: Soft tissue containing the blood and nerve supply to the tooth. The pulp extends from the crown to the tip of the root, where it connects to the nerves and blood supply of the mouth. The pulp enables sensations of tooth sensitivity or pain.

Cementum: The layer of bone-like tissue covering the root. It is not as hard as either enamel or dentine.

Structures around the tooth

Periodontal ligament: The periodontal ligament is responsible for attaching the tooth to the jawbone. It is made up of thousands of fibres which fasten the cementum to the bony socket. These fibres anchor the tooth to the jawbone and act as shock absorbers for the tooth, which is subjected to heavy forces during chewing.

Gingivae (gums): Soft tissue that immediately surrounds the teeth and bone. It protects the bone and the roots of the teeth and provides an easily lubricated surface.

Bone: provides a socket to surround and support the roots of the teeth.

Nerves and blood supply: Each tooth and periodontal ligament has a nerve supply and the teeth are sensitive to a wide variety of stimuli. The blood supply is necessary to maintain the vitality of the tooth.

Oral mucosa: This is the term used to describe the moist tissue that lines the mouth.

Dental Plaque (Biofilm)

Dental plaque is a causative factor for both tooth decay (dental caries) and gum diseases (periodontal diseases). Dental plaque is an almost colourless sticky bacterial film, which adheres to the tooth surface. It is not removed by rinsing with water. The build-up of dental plaque around the gum margin leads to the development of gingivitis (inflammation of the gums) in most people.


Figure 8

Teeth with plaque **before** using a disclosing tablet.


Figure 9

Teeth with plaque **after** using a disclosing tablet.

Gingivitis is characterised by inflamed, reddened gums which bleed easily during normal toothbrushing. The longer plaque is left on teeth, the greater the risk of developing gingivitis. Thus, daily careful plaque removal is required to prevent gingivitis. The most important plaque control method is toothbrushing, which should be established as a daily routine from early childhood. Plaque is also involved in causing tooth decay. When foods containing sugars are eaten, the bacteria in plaque break down the sugars and acid is produced. This acid then dissolves the surface of the enamel under the plaque, causing tooth decay. Plaque is difficult to see, which makes it difficult to remove. A special dye in the form of a disclosing tablet can be used to stain the dental plaque making it easier to see. These tablets are available in most pharmacies and are an aid to dental plaque removal. A more detailed discussion of the factors influencing the decay process and methods for the control of plaque is given in Chapter 2 – Oral Health & Disease Prevention.

Saliva

The teeth and oral tissues are constantly bathed in saliva. Saliva is secreted by the salivary glands. The production of saliva increases when food or drinks are consumed. The presence of saliva is vital to the maintenance of both healthy hard and soft oral tissues. Saliva has many important functions.

Functions of Saliva

Fluid/Lubricant: Coats the oral mucosa and helps to protect against mechanical, thermal and chemical irritation. It assists smooth airflow,

speech and swallowing.

Ion Reservoir: Holds ions needed for the maintenance of enamel near the tooth. It helps prevent tooth decay.

Buffer: Helps to neutralise plaque acids after eating, therefore preventing tooth decay.

Cleansing action: Clears food and aids swallowing.

Oral Hygiene / Antimicrobial actions: Helps control bacteria in the mouth.

Pellicle formation: Forms a protective coating on the tooth surface.

Taste: Acts as a solvent, thus allowing interaction of food with taste buds to facilitate taste.

Chapter 2
Oral Health & Disease Prevention

There are two primary diseases seen in oral healthcare, which affect the teeth and their supporting structures, dental caries and periodontal diseases.

- **Dental Caries (tooth decay):** the occurrence of destruction of tooth structure, due to acid produced by the action of bacteria in dental plaque on sugars from foods eaten. This may results in cavitation or holes in the teeth.
- **Periodontal (gum/peri-implant) Diseases:** an inflammatory reaction along the gingival margin of a tooth/implant and below the margin in response to bacterial accumulation, may result in the destruction of the tissues that support the teeth/implants.

Thankfully, there are treatments available to combat both diseases at a preventive and therapeutic level. An example of a countrywide preventive intervention was the introduction of water fluoridation in Ireland in the 1960s which has led to a reduction in the prevalence of tooth decay.[12,13,27]

In addition to dental caries and periodontal diseases other oral conditions to consider are:

- Dental Trauma
- Tooth Wear
- Tooth Sensitivity
- Dry Mouth
- Halitosis (bad breath)
- Cold Sores
- Mouth Ulcers
- Mouth Head and Neck Cancer
- Medication-related osteonecrosis of the Jaw (MRONJ).

As research has progressed in related health fields, there has been an agreed understanding that oral health and disease risk factors have an overlap with general health and disease. This has facilitated a collaborative approach which will be discussed in the next chapter: Oral Health & General Health: The Common Risk Factor Approach, which is advocated for in Smile agus Sláinte, National Oral Health Policy.[20] For both healthcare professionals and the patients we treat across the community, this common risk factor approach allows a more effective and efficient practice in prevention and treatment.[20]

Risk Factors Affecting both General Health and Oral Health

There are a number of common risk factors that affect both general health and oral health.

For example, tobacco smoking, which is the single most preventable cause of death and illness is a major risk factor for cardiovascular diseases, respiratory disease and cancers. Smoking is also an important risk factor in gum diseases and mouth cancer. People who smoke have poorer gum health than non-smokers. Another example is alcohol, excessive use of which is a major risk factor in cardiovascular diseases, mental illness and traumatic injuries. Both alcohol and smoking, working singly or in combination, are major risk factors in the incidence of oral cancer. Poor nutrition and diet is also a common risk factor for cardiovascular diseases, cancers, and oral diseases. (See Chapter 3 – Oral Health & General Health: The Common Risk Factor Approach.)

It is clear from the examples above that strategies for the control of oral diseases should not be developed in isolation but as part of a "common risk factor approach" designed to control those risks common to several chronic diseases. For all health professionals and the wider community, the common risk factor approach is particularly efficient in health promotion and is adopted in the health promotion initiative 'Making Every Contact Count' (MECC), also supported in the national oral health policy.[19,20,28,29]

Tooth Decay (Dental Caries)

Tooth decay or dental caries is a destructive process by which the action of acids produced from a reaction of oral bacteria present in dental plaque (biofilm) and substrate (sugars such as sucrose from diet) on the enamel or dentine of the tooth, causes a loss of calcium and phosphate. This is called demineralisation. If allowed to progress, this demineralisation spreads and eventually the weakened structure may breakdown and collapse to form a cavity or hole in the tooth. The most commonly affected locations are the pits and fissures (chewing surfaces), and hard-to-clean areas between the teeth (interproximal areas).

In the older population, where reduced saliva and gingival recession are common, this can lead to the occurrence of tooth decay on exposed root surfaces.[30]

Tooth decay is so prevalent in most industrialised countries it is expected to affect 60-90% of children and adults.[31]

The presence of saliva has an essential role to play in the prevention of tooth decay. It acts as a buffer which dilutes and neutralises the acid produced by the oral bacteria present in the dental plaque. This means that the acid is no longer available to cause demineralisation of enamel and/or dentine. Saliva also acts as a reservoir for calcium, phosphate and fluoride which can help to remineralise the affected enamel and/or dentine. This process of demineralisation and remineralisation continues throughout the day, and is associated with eating and drinking. If there is more demineralisation than remineralisation, the process can no longer be reversed or 'healed' and will progress to a hole or cavity in either the primary or permanent teeth. This can then lead to symptoms such as tooth sensitivity, pain, broken teeth and infection. The Stephan Curve[32] displays as a graph the change in pH over time when demineralisation and remineralisation at the tooth surface occurs. From the graph it can be seen that the loss of tooth minerals (demineralisation) occurs at

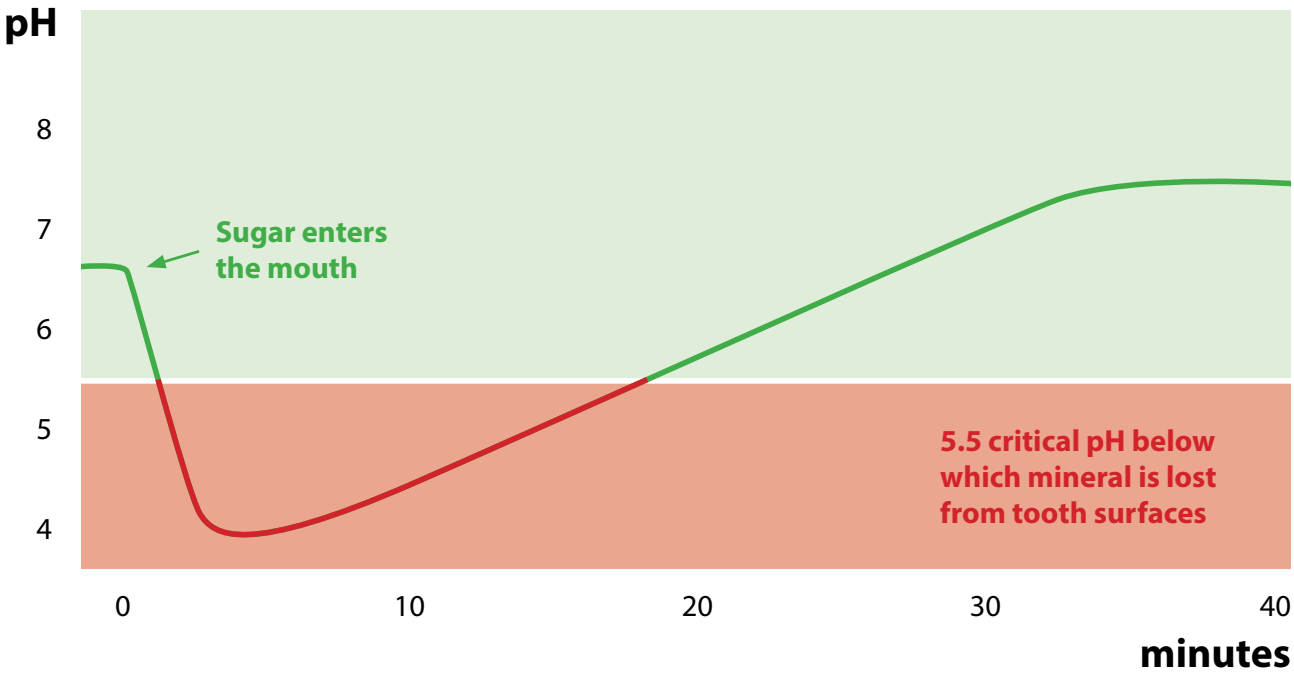


Figure 10: Stephan Curve – Plotting pH within plaque biofilm against time.

a much quicker rate than remineralisation. It is generally accepted that when the acidity of the dental plaque reaches a pH of 5.5, termed the critical pH of enamel, demineralisation of dental enamel will commence and demineralisation of dentine and cementum can occur in a less acidic environment.[32]

When restorative treatment is required because of tooth decay the main treatment option is to remove the infected tooth structure by drilling, and then filling with a suitable dental material, which restores the shape and function of the tooth. Extensive breakdown due to tooth decay may require additional treatment to restore the tooth, such as a root canal filling and the placement of a crown, or perhaps an extraction.

Materials commonly used to restore teeth include composite resins, glass ionomer cements and compomers, and dental amalgam in some situations. The latter is being phased down for environmental and health reasons,[33,34] as identified at the 2013 Minamata Convention on Mercury.[35] There has been a global agreement to work towards phasing out the use of dental amalgam as a filling material, which is reflected in Ireland's national plan for the phase-down to phase-out of amalgam towards 2030. The choice of available materials and strategies for dental caries management are identified in the national oral health policy, an example where health and environmental concerns are very much intertwined.[36,20] There is ongoing progress needed in the determination of cost-efficient alternative materials for dental restorations.[37,38]

Regarding dental restorations, the practice of Minimal Intervention Dentistry (MID) and its subdivision of Atraumatic Restorative Treatment (ART) have been widely practiced and popularised since their inception. Borne out of necessity in under-resourced circumstances,

their principles are concentrated on a biologic approach to dental caries management, focusing on prevention, early detection, and minimising loss of tooth structure. While large dental carious lesions may be beyond the scope of ART, there is a growing number of studies confirming the success in managing smaller lesions and concurrently, diminishing the risk of dental anxiety regarding operative dentistry.[39,40]

Prevention of Dental Caries

The prevention of dental caries can be approached in three ways:

- Reduce frequent consumption of sugars
- Use of fluoride
- Apply pit and fissure sealants.

Reduce Frequent Consumption of Sugars: There is overwhelming evidence that frequent consumption of sugars is associated with dental caries and other health concerns. The WHO Global Action Plan for the Prevention of Non-Communicable Diseases resolves to highlight and address this, as does the WHO Guideline on Sugars intake for adults and children.[41,42,43,44] Dietary advice is aimed at limiting the frequency and reducing overall sugars intake. Studies have shown that sugar consumption remains a moderate risk factor for dental caries even when populations have adequate exposure to fluoride,[45] and that exposure to fluoride coupled with a reduction of sugar intake has an additive effect on dental caries reduction. The Dental Health Foundation has a helpful poster to show children and their caregivers the effect of this (the sugar clock).

As shown in the modified Stephan curves on page 22, the intake of sugars between meals increases the periods of time in which plaque pH drops below the critical level of 5.5. When plaque pH is lower than 5.5, demineralisation will occur. Subjecting teeth to frequent bouts of demineralisation allows less time for their remineralisation; thus, teeth become more susceptible to decay.[32]

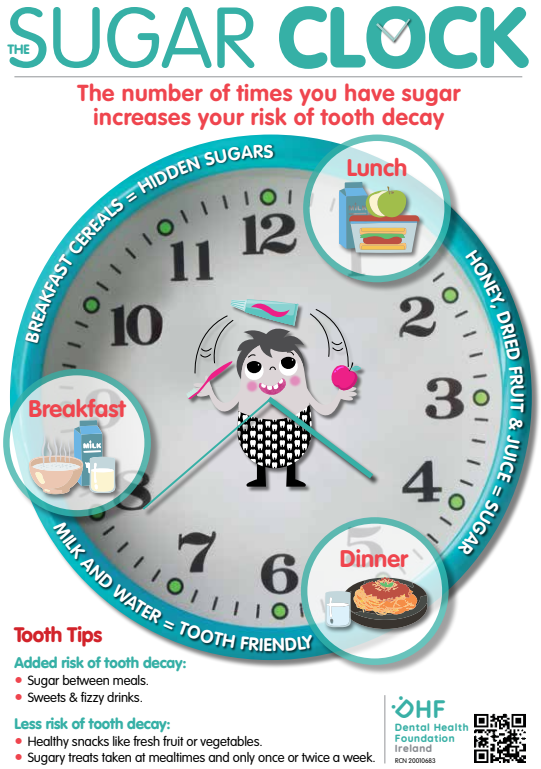


Figure 11: www.dentalhealth.ie/resources/publications/sugar-clock/

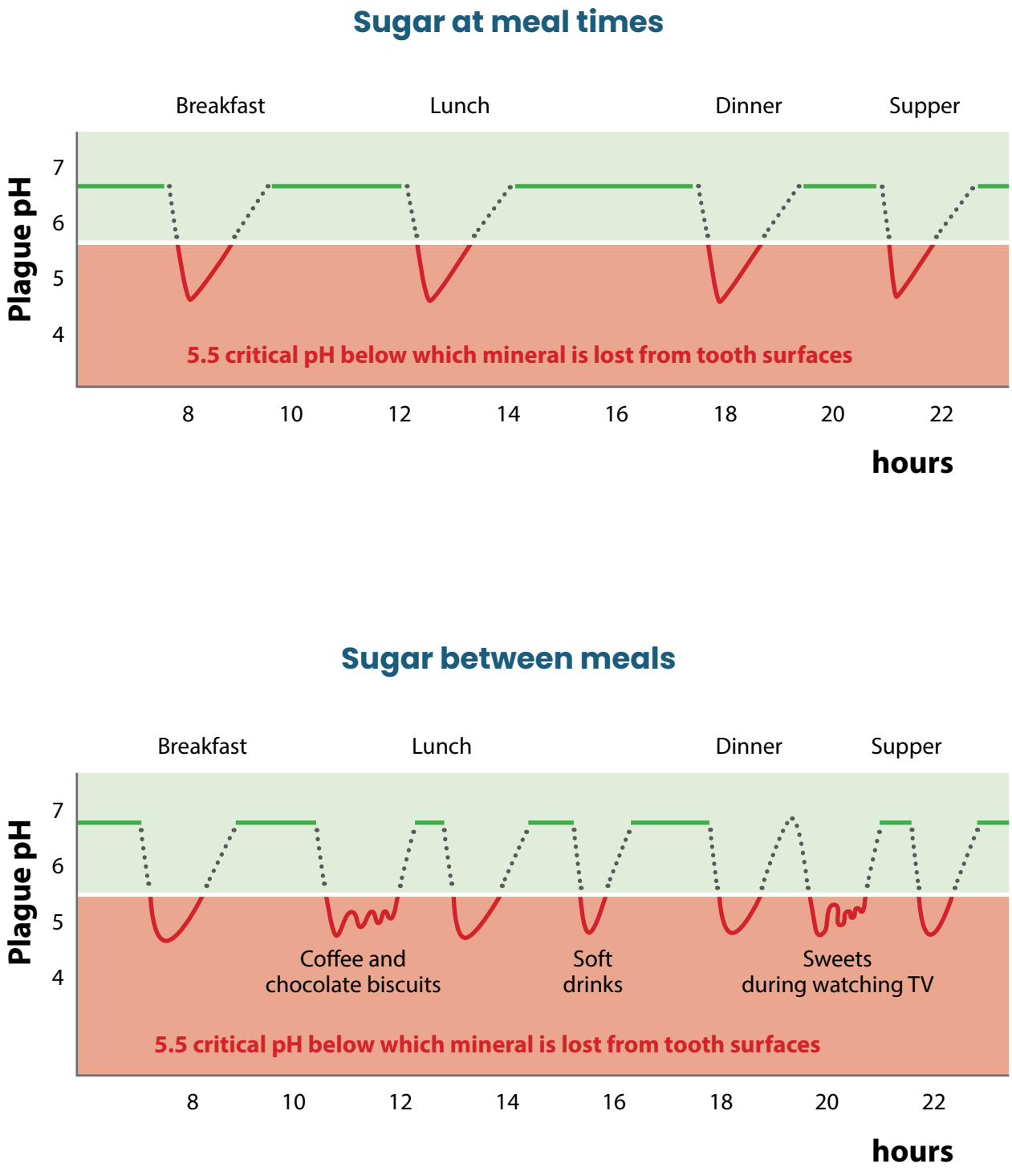


Figure 12: Representation of the Stephan Curve, where (i) adequate time is given for saliva to return to a neutral pH and (ii) with frequent food or drinks intakes the pH does not have an opportunity to return to a neutral pH and there is more demineralisation than remineralisation taking place.

The importance of reducing the frequency of snacking and the intakes of sugars is thus a significant factor in the prevention of tooth decay.
Detailed advice on nutrition and oral health is given in Chapter 4 – Nutrition and Oral Health.

Use of Fluoride: Fluoride is a substance that naturally occurs in some water sources. Derived from fluorine, the element is known for its properties in helping to prevent tooth decay. It can be used topically in the form of fluoride toothpaste, mouth rinse and varnish, or systemically in the form of fluoridated water, milk and salt. In Ireland, it is estimated that approximately 71% of the population reside in communities served with water supplies containing a regulated amount of fluoride.[27] The permissible range of fluoride in drinking water in Ireland is currently set at 0.6-0.8 mg/l, which may also be referred to as parts per million (ppm). This concentration of fluoride in drinking water is deemed optimal for the oral health of all age groups, including infants.[12.13]

The dramatic improvement seen in oral health in Ireland since the introduction of water fluoridation in the mid-1960s, particularly among children and young adults served with water supplies containing a regulated amount of fluoride (often labelled "Full Fl" in graphs), has been attributed to the preventive effect of fluoride present in water and in toothpaste.

Fluoride works mainly by slowing down the process of demineralisation, whereby calcium and phosphate are lost from the tooth when exposed to acid following ingestion of food and drinks which contain sugars.[32] The tooth may look whiter or more opaque in appearance. Fluoride also helps to "heal" (remineralise) surfaces which show early signs of calcium or phosphate loss. Most benefit is obtained if a low level of fluoride is constantly maintained in the mouth throughout the day.[46]

Fluoride delivered directly (or topically) to the tooth surfaces by toothpaste, varnish or mouth rinse helps to maintain a low level of fluoride in the mouth and provides added benefit to the fluoride delivered via water fluoridation. Fluoride toothpastes introduced in the mid-1970s, now account for over 95% of toothpaste sales in the Republic of Ireland.[27] The sale of mouth rinses, many of which contain fluoride, has also increased since the mid-1980s. Regulated intervals of fluoride varnish application (by dental professionals), according to dental caries risks, has proved effective in the prevention and treatment of early carious lesions.[47]

A significant advantage of water fluoridation is that its effects in reducing tooth decay are available to everybody receiving the fluoridated water supply, which is acceptable for infant use. It is of importance to note that bottled drinking waters may contain high amounts of fluoride, depending on their source. It is permissible for bottled natural mineral waters to contain up to 1.5 mg/l of fluoride. However, when the fluoride concentration exceeds 1.5 mg/l, the message "contains more than 1.5 mg/l of fluoride: not suitable for regular consumption by infants and children under 7 years of age" must be clearly carried on the bottle label (SI No. 282/2016).[48]

Fluoride toothpaste is an important source of additional fluoride and should be used twice a day to help maintain a constant level of fluoride in the mouth. Daily fluoride mouth rinse is particularly useful for people who are prone to high levels of decay and for people wearing orthodontic braces. Fortnightly fluoride mouth rinse programmes are used in a number of schools in non-fluoridated areas of the Republic of Ireland. It is advisable that fluoride mouth rinsing be carried out at a different time of the day from fluoride toothbrushing so that the added benefits from these topical fluorides is maximised. Fluoride varnish and gels are alternative forms of topical fluoride that require application by a dentist or dental hygienist.

Despite the widespread availability of fluoride toothpaste, the most recent national oral health surveys show that only 58% of Irish children brush their teeth at least twice a day as recommended, and that older people (aged 65+) in particular have poor oral hygiene habits. Only 52% of older people who have natural teeth (i.e., are not toothless) brush their teeth at least twice a day and 4.5% never brush.

There are no known side effects of water fluoridation at the optimal level, other than dental fluorosis.[49] Dental fluorosis is mainly a cosmetic condition, commonly characterised by fine white lines or white patches on the teeth. The risk of developing dental fluorosis is linked to the ingestion of excess fluoride during enamel formation (amelogenesis) of the permanent teeth in childhood. International research indicates that the early use of fluoride toothpastes in young children can lead to the development of fluorosis in permanent teeth.

In Ireland, dental fluorosis remains at the very mild to mild level as measured by the Dean's Index.[50] However, the increase in the prevalence of dental fluorosis when levels of water fluoridation had remained constant (at 0.8–1.0 mg/l (ppm) between 1964 and 2007), suggests that young children are swallowing excess fluoride from toothpaste. As a result of this finding, in 2007 the permitted level of fluoride in water was adjusted from 0.8–1.0 mg/l (ppm) to 0.6–0.8 mg/l (ppm) as a means of reducing the total intake of fluoride among young children.[13] Recommendations from the Forum on Fluoridation on the appropriate use of fluoride toothpaste in young children resident in the Republic of Ireland were: children were that: children aged 2–7 years should use only a small pea-sized amount of fluoride toothpaste (containing 1000–1500 ppm Fluoride) and be supervised by an adult when toothbrushing; children under 2 years of age should not use toothpaste except on professional advice.[51] These suggestions are also reiterated in the

Figure 16: It is recommended to use a pea-sized amount of fluoride toothpaste of at least 1,000ppm for 2-7 year olds.

The Report from the Forum on Fluoridation advised:

From 0 until 2 years of age

- **Start to clean a baby's teeth as soon as the first tooth appears**
- **Brush a baby's teeth with a soft toothbrush and water only**
- **Do not use toothpaste**
- **Professional advice on the use of fluoride toothpaste should be considered when a child below 2 years of age is thought to be at high risk of developing dental decay (e.g. children with special needs)**

From 2 until 7 years of age

- **Use a small pea-sized amount of fluoride toothpaste 1000–1500 ppm. (Paediatric toothpastes with low concentrations of fluoride (e.g., 500 ppm) require further research before their use can be recommended)**
- **Supervise brushing twice a day, in the morning and at night just before bedtime**
- **A child under seven years needs help from an adult when brushing teeth**
- **A child should never eat or swallow toothpaste**
- **Clean the teeth thoroughly twice every day with fluoride toothpaste**

Smile agus Sláinte National Oral Health Policy document.[20]

For children at high risk of developing dental decay, regular dental recall is recommended along with the biannual application of fluoride varnish.[47]

Pit and Fissure Sealants: In the permanent teeth of children, tooth decay occurs most commonly on the pit and fissure surfaces of the back teeth (chewing surfaces), these teeth typically erupt between the age of 5 and 6 years. A very effective preventive measure is the application of a pit and fissure sealant, which is a layer of resin that is professionally applied by the dentist or dental hygienist to the pit and fissure surfaces, thus providing a mechanical barrier to the accumulation of plaque biofilm in the pits and fissures of the tooth.[52] This should be done as soon as possible after the back teeth erupt into the mouth. The sealant prevents access of plaque and plaque acids to the enamel surface. The effectiveness of pit and fissure sealants at preventing dental caries has been demonstrated in a number of systematic

Figure 14: Pit and fissure sealants

reviews and guidelines for the application of pit and fissure sealants. Pit and fissure sealants are only effective when they remain on the chewing surfaces of the teeth and should be seen as only one part of a comprehensive preventive plan.[52]

When devising a strategy for the control of tooth decay for an individual patient or for a community, it is strongly recommended that a combination of these preventive measures, reduced frequency of consumption of sugars, use of fluoride, application of pit and fissure sealants be used, taking into consideration the effort required and the cost to the individual, society or public finances.

Periodontal / Peri-implant (Gum) Diseases

Periodontal or gum diseases are related to a pathological inflammatory condition of the gingiva and supporting structures (periodontium) surrounding the teeth or an implant. The inflammatory condition is triggered by bacteria and other microorganisms present in the mouth. Although current evidence is absent, it is likely that most Irish adults suffer from some form of periodontal disease. A survey carried out for the Irish Dental Association by Behaviours and Attitudes (an independent market research firm) indicates that 80% of those polled believed their gums were healthy, but in the last national survey 80% had some form of gum disease.[53,54] In 2017 The European Federation of Periodontology (EFP) agreed with the American Academy of Periodontology on an innovative approach for a common classification scheme of periodontal and peri-implant diseases and conditions.[52,53, 54,55]

The four most common periodontal diseases are:

- **Gingivitis – inflammation of the gum at the neck of the tooth**
- **Periodontitis – inflammation affecting the bone and tissues of the teeth**
- **Peri-implant mucositis – inflammation of the gum around the implant**
- **Peri implantitis – inflammation of the supporting tissues and bone loss around the dental implant**

Gingivitis

A high proportion of children and adults will have signs of gingivitis, which is characterised by redness, swelling or puffiness of the gums, and gingival bleeding. With the institution of good oral hygiene habits gingivitis is reversible. Gingivitis occurs in both acute and chronic forms. Acute gingivitis is usually associated

Figure 15: Healthy gingiva.

with specific infections, micro-organisms, or trauma. Chronic inflammation of the gum tissue surrounding the teeth is associated with the accumulation of dental plaque (biofilm) around the teeth and gums.

Instruction to groups and individuals on the effective removal of dental plaque from around the teeth and gums with a toothbrush and dental floss is important for the prevention of gingivitis. The inclusion of toothbrushing as an activity of daily living from a young age can assist in mouths being generally cleaner and showing less signs of inflammation.

Figure 16: Gingivitis, bleeding at gingival margins.

Periodontitis

When the bone and supporting tissues are effected the condition is termed periodontitis and is characterised by the formation of pockets or spaces between the teeth and gums. This may progress and cause chronic periodontal destruction leading to loosening or loss of teeth. The dynamics of the disease are such that the individual can experience episodes of rapid disease activity in a relatively short period of time, followed by periods of no activity.

Though most adults are affected by gingivitis, gingivitis fortunately does not always develop into periodontitis. Progression of gum disease is influenced by a number of factors which include poor oral hygiene practices, smoking, some medications and a genetic predisposition. One of the challenges for early detection of periodontitis disease is its 'silent' nature – the disease does not cause pain and can progress unnoticed, teeth becoming loose or appearing loner may be the signs first noticed by the individual. In its early stages, bleeding gums during toothbrushing may be the only sign; as the disease advances and the gums deteriorate, the bleeding may stop and there may be no further obvious sign until the teeth start to feel loose or appear longer. In most cases, periodontitis responds to treatment; although the destruction of bone and gum recession is largely irreversible, the progression can be halted.

Figure 17: Gingivitis, bleeding at gingival margins.

Peri-implant mucositis and peri-implantitis

Dental implants have become an increasingly popular solution for the replacement of missing teeth. An implant consists of a titanium screw inserted into the bone of the top or bottom jaw. A crown, bridge or denture can then be

attached to the implant. There is a wealth of evidence indicating their success. However, there are challenges, including some involving the supporting tissues, which can affect the long-term success of the dental implant. When the supporting tissues around the implant are not maintained in a healthy state it can give rise to or peri-implant mucositis or peri-implantits. These conditions are most often inflammatory by nature, a consequence of poor oral hygiene practices, smoking or trauma (dental injuries). Peri-implant mucositis refers to the reversible occurance of soft tissue inflammation surrounding the dental implant, while peri-implantitis is the futher progression of irreversible destruction and loss of soft tissues and bone. Daily oral hygiene and regular reviews with a dentist can aid prevention. Monitoring and dental attendance for the occurrence of such issues is essential.[56]

Factors Affecting Periodontal Health

The rate of progression of poor periodontal health in an individual is dependent on the virulence (or strength of attack) of the bacterial plaque and on the efficiency of the local and systemic immuno-inflammatory responses in the person (host). The overall balance between the dental plaque biofilm challenge and the body's immuno-inflammatory responses is critical to periodontal health. Current research suggests that host responses are influenced by specific environmental and genetic factors which can determine general susceptibility of the host, or local susceptibility of a site (tooth) within the mouth, to poor periodontal health. In this regard, it is common for more severe forms of periodontal disease to present in individuals with compromised immune systems, e.g., those with diabetes, HIV (Human Immunodeficiency Virus)/AIDS infection, leukaemia, and Down syndrome. Epidemiological studies have also implicated periodontal disease as a risk factor for cardiovascular disease.[57]

Figure 18: Peri-implant mucositis.

There is increasing evidence that smoking and stress cause an acceleration of the disease process. A particularly virulent type of disease affecting the gingiva, Acute Necrotising Ulcerative Gingivitis (ANUG) occurs more frequently in smokers. Diet also impacts on periodontal health, from both the perspective of plaque build-up and that of the body's immuno-inflammatory responses.

As stated earlier, most periodontal diseases can be easily prevented by daily thorough plaque removal.[58] However, irregularities around the teeth such as overhanging edges on fillings, poorly shaped fillings, and some types of partial denture designs make tooth cleaning difficult and encourage the accumulation of dental plaque. The presence of calculus (tartar) – plaque that has mineralised and hardened – may also cause plaque to accumulate more easily and requires professional removal by dentist

or dental hygienist (scaling). For the majority of the population, however, periodontal health can be effectively maintained by adopting the appropriate oral hygiene practices, and the avoidance of behavioural and environmental risk factors (e.g., tobacco smoke, stress, poor diet, all of which are risk factors for additional non-communicable disease).

Dental Plaque (Biofilm) Control

Plaque biofilm control is important in the prevention of dental caries and is the main approach to preventing periodontal diseases. This must be considered at two levels: what individuals can do for themselves by way of plaque control on a daily basis, and what dentists and hygienists can do to eliminate plaque retention factors in individuals and to advise patients on the most appropriate home care techniques.

Toothbrushing and keeping the mouth clean

The most important plaque control method is toothbrushing, which should be established and supervised as a daily routine from early childhood, typically when the first tooth appears. Parents/carers should brush their young child's teeth (with tap water until age 2 years, unless otherwise advised).[51] Toothbrushing should be supervised typically until the child has the manual dexterity to effectively brush his/her own teeth (age 6–7 years). As the child is developing manual dexterity and independence, it is important for parents to continue with supervision as the first permanent teeth to erupt are often the first permanent molars right at the back of the mouth.

Figure 19: Presence of plaque (biofilm) along the gingival margin.

Dental plaque is the community of microorganisms found on a tooth surface as a biofilm. The biofilm is less susceptible to antimicrobial agents and allow microorganisms to propagate. Of clinical relevance is the fact that biofilms are less susceptible to antimicrobial agents, while microbial communities can display enhanced pathogenicity (pathogenic synergism). The structure of the plaque biofilm might restrict the penetration of antimicrobial agents, while bacteria growing on a surface grow slowly and display a novel phenotype, one consequence of which is a reduced sensitivity to inhibitors. Plaque is natural and contributes (like the resident microflora of all other sites in the body) to the normal development of the physiology and defences of the host.[59]

Toothbrushing skills should be taught to people of all ages. The precise technique is less important than the result, which is that plaque is effectively removed every day without causing damage to the teeth or gums.

Recommended Toothbrushing Technique

A gentle scrub technique (Modified Bass technique) with very short circular movements, angled at 45 degrees towards the cervical margin of teeth can dislodge plaque at the gum margins. It is effective for most people with sufficient dexterity, is easy to teach and readily accepted. Thus, careful use of a gentle scrub method using a toothbrush with densely packed, round-ended synthetic filaments of soft texture should be encouraged for effective plaque removal. A toothbrush with a small brush head may also be recommended, as a small brush head enables better access to the back of the mouth and to tooth surfaces than a large brush head. While a variety of powered toothbrushes have become increasingly available, only powered toothbrushes with a rotation oscillation action (i.e., brush head moves in one direction and then the other) have been found to be better than manual toothbrushes at removing plaque and reducing gum inflammation and are no more likely to cause injuries to gums.[60]

Faulty toothbrushing techniques involving excessive pressure may considerably increase gingival recession (i.e., the gum line recedes

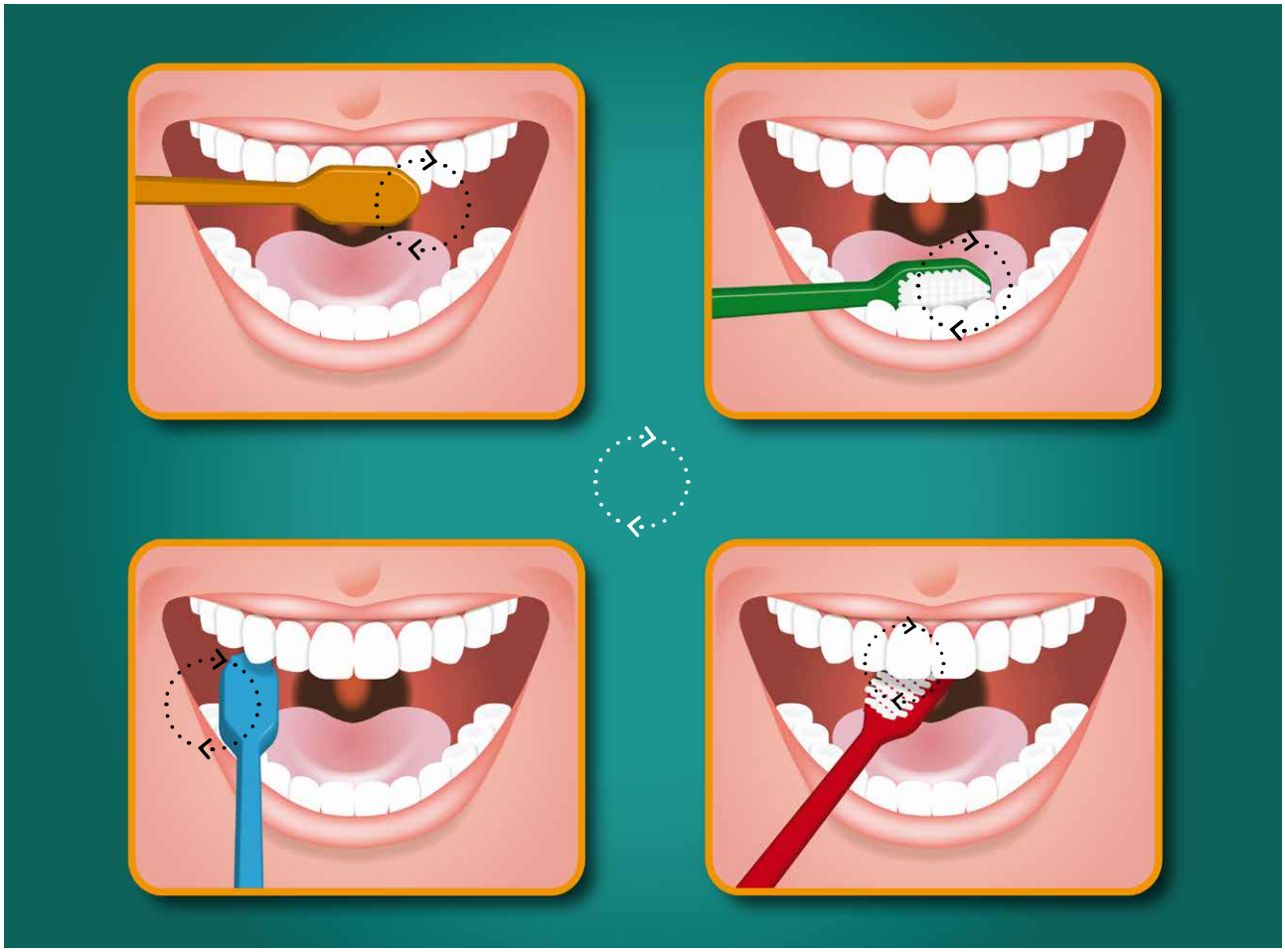


Figure 20: Short circular movements angled at 45 degrees along the gum margin.

leading to exposure of the roots of the teeth), and loss of tooth substance by mechanical abrasion, and must therefore be corrected.

Dental Plaque (biofilm) removal can be aided with the use of:

- **Plaque disclosing agents**
- **Dental floss and other interdental cleaning aids**
- **Mouth rinses**

Plaque disclosing agents colour plaque biofilm to make it easily visible and are a useful aid for improving plaque control. Plaque disclosing tablets should be used after brushing the teeth to reveal areas where plaque still remains. Plaque disclosing agents will not in themselves remove plaque, but simply direct users to areas that they have missed with their toothbrush.

Dental floss and other interdental cleaning aids are of value when used correctly, which usually requires professional advice and instruction. An additional method of plaque control is the use of antiseptics, of which chlorhexidine is the most effective. Although chlorhexidine is available over the counter in Ireland in the form of mouth rinses and gels, its tendency to stain teeth and impair taste makes its long-term use generally unacceptable, and it should be considered only for short term use in consultation with a healthcare provider. Toothpastes and mouth rinses containing other antiseptic agents, while less effective than chlorhexidine, do not have these side effects and are of some value to gum health, so can be considered as a routine adjunct to appropriate toothbrushing.

Figure 21: Plaque disclosing tablets.

Recommended Flossing Technique

Starting with clean hands, break off about 18 inches of dental floss from its dispenser. Wind one end of the floss around a middle finger of one hand. Wrap the other end and most of the floss on the same finger of the other hand, leaving a small length (3 to 4 inches/7 to 10 centimetres) stretching between the hands.

With the floss held tightly between thumb and forefinger, use a gentle sawing motion to guide the floss between adjacent teeth. A slight amount of pressure might be needed to get the floss past the contact point of the teeth if they are tight against each other. Take care not to snap the floss against the gums when doing this to avoid injury.

When the floss reaches the gumline, curve it into a C shape against one tooth and gently slide it into the space between the gum and the tooth. With the floss kept tight against the side of the tooth, gently move the floss away from the gum with up and down motions. Repeat this gentle up and down motion to clean plaque off the adjacent tooth. Move the floss back out from between the flossed teeth

Figure 21: Flossing in between teeth.

and repeat this procedure until all teeth have been cleaned. Make sure to floss the sides of all teeth, including the far side of the last teeth in each quadrant. As the floss gets frayed or dirty, unwind unused floss from one hand and take up the used slack on the other hand. Wash hands again after flossing. Further detailed discussion on oral hygiene practices will be expanded in Chapter 5 Oral Healthcare Products.

Professional Treatment: It is the responsibility of the dental clinician to ensure that any dental treatment provided minimises plaque retention; this is a part of treatment planning. Clear advice must be given on the need to clean bridges, dentures, dental implants, and orthodontic appliances (braces) effectively and regularly. Calculus (or tartar) is a form of mineralised and hardened plaque, which can form on teeth both above or below the gum level and within periodontal pockets. Calculus cannot be removed by toothbrushing and careful professional scaling is needed for its removal. While appropriate professional treatment is important, it must be stressed that the highest priority for dental plaque control is effective daily oral hygiene by the individual, supervised and supported if required.

Summary points

Periodontal diseases can be prevented with:

- **Daily meticulous removal of dental plaque (biofilm) by toothbrushing, use of floss or other interdental aids**
- **Regular visits to the dentist/ hygienist, the frequency determined by the individual and the dental professional**
- **Avoidance of behavioural and environmental risk factors (e.g., smoking, stress, poor diet)**

Dental Trauma

The most common teeth to be damaged during an accident are the upper central (front teeth) incisors. Primary incisors can be damaged especially when infants are learning to walk. The most common injury sustained to primary (baby) teeth is intrusion, i.e., the tooth is pushed up into the gum. This type of traumatic injury in young children can also result in damage to the underlying, developing permanent incisor tooth. Injuries may also arise in both the primary and permanent dentitions later in childhood as a result of a fall from a height (i.e., bicycle, scooter, trampoline accident) or from direct impact (e.g., sports equipment). Damage can range from a small chip off the enamel to a fracture involving the dental pulp. Occasionally, the tooth can also be displaced (subluxed) or, more rarely, knocked out completely (avulsed).

Traumatic injuries to teeth can be complicated to treat and can have long term financial, aesthetic and functional problems for the patient. A recent year-long study carried out by the Dublin Dental University Hospital estimates the average cost of treating dental trauma exceeds €1000 and requires up to four visits to the dental surgery.[61]

Prevention and Management

Most traumatic injuries to teeth arise from accidents during normal, everyday activities such as informal play, and prevention in these circumstances is difficult, scanning the area for possible slips trips or falls is always of value. Wearing of mouthguards or helmets with face shields during organised contact sports will reduce the likelihood of fracturing a tooth. Wearing safety helmets (e.g., for cycling, skateboarding) and car seatbelts should also be advised. Children who have prominent upper

Figure 23: Dental trauma to a permanent central incisor.

incisors are more prone to dental injuries, and early orthodontic correction for these children is recommended. When a tooth is accidentally damaged or knocked out, it is important that professional advice from a dentist is sought immediately. Parents/carers should be informed and encouraged to try replanting adult whole teeth, if knocked out, as per Dental Health Foundation poster but be advised to make no attempt to reinsert a primary (baby) tooth that is knocked out as they could damage the permanent (adult) tooth that is developing under the gum – the child should always be brought to a dentist to be checked. Guidance for both dental professionals and the general public on the steps to follow regarding assessment and management of dental trauma can be found at https://dentaltraumaguide.org/

Advice: knocked out adult front tooth

- **The tooth should be held only by the crown and put back into the socket firmly, root first. If the tooth is very dirty, it can first be cleaned gently by rinsing with milk**
- **After reinsertion, the patient should bite on a clean handkerchief for 15–20 minutes, as they make their way to the dentist**
- **If the tooth cannot be re-inserted, it should be stored in milk possible, and the patient brought to a dentist immediately**

Tooth Wear

Our understanding of tooth wear has evolved considerably over the last three decades. In the adult population, the amount of tooth wear seen currently is considerably greater than in the past decades. There are a number of reasons associated with this; many individuals are retaining more of their permanent teeth with less tooth decay, and lifespan has increased. Dietary patterns and food choices have changed considerably, with increased consumption of foods with a higher acidic content causing the loss of tooth surface.[62] It is also worth mentioning that tooth grinding (bruxism and attrition) may be increasing in association with modern society's high pressure and fast paced lifestyle.[63] Tooth wear increases with age, in epidemiological studies tooth wear is frequently recorded when there has been enamel loss from the tooth surface to the extent that the underlying dentine is visible. This is obviously a late stage in the process and hence the reason for increasing focus on preventive

Tooth wear: The cumulative surface loss of mineralised tooth substance due to physical or chemo-physical processes (dental erosion, attrition, abrasion). Tooth wear is not considered to be the result of dental caries, resorption, or trauma.

Figure 24: Example of tooth wear.

Dental erosion: Dental erosion is the chemical loss of mineralized tooth substance caused by the exposure to acids not derived from oral bacteria.

Figure 25: Example of dental erosion in the primary teeth.

Dental attrition: Dental attrition is the physical loss of mineralized tooth substance caused by tooth-to-tooth contact. It will also tend to be more pronounced in people who eat a particularly fibrous diet. Wear, due to attrition, can be considerably increased in people who habitually clench or grind their teeth (bruxism).[49]

Figure 26: Example of dental erosion in the primary teeth.

Dental abrasion: Dental abrasion is the physical loss of mineralized tooth substance caused by objects other than teeth.

strategies. Research indicates that tooth wear in the primary (baby) teeth is predictive of tooth wear in the permanent teeth, and that males have a higher prevalence than females.[64,65] Although, we can define the various causes, it is more common to have a combination of risk factors operating at the same time. For example, a tooth surface that has lost mineral due to acidic foods/drinks will be more easily worn if an individual is grinding their teeth together or scrubbing too vigorously during brushing. It is therefore common to see terms like erosive tooth wear, meaning that there is an important acid contribution: acids and thus erosion may be dominant, but also there are contributions from abrasion and attrition. The rise in popularity of oral piercings may result in wear of the tooth surface due to abrasion, and recession of the gum from around the tooth. A recent study carried out in Italy shows that there is a significant lack of awareness of the potential for damage caused by lip and tongue piercings.[66]

Prevention

Reducing the frequency of drinking carbonated drinks and fruit juices which are acidic is the key to preventing erosive tooth wear. Attrition is often a slow–progressing condition and many people will only be made aware of the damage to their teeth on visiting the dentist. In the case of bruxism or tooth grinding, treatment may require the wearing of a bite/night guard during sleep. A night guard (protective acrylic splint) provides a protective, replaceable barrier between the upper and lower teeth to prevent them grinding together.

Figure 27: Night guard.

A common cause of abrasion is the habit of vigorous toothbrushing and the use of abrasive toothpastes. Abrasion can be reduced by adopting an appropriate toothbrushing technique, which may involve time spent with your dental professional establishing the most suitable method.

Toothpastes vary in their level of abrasiveness; whilst abrasives help to remove tooth stain, they may also contribute to tooth wear. Those concerned about tooth wear could seek a less abrasive toothpaste and an oral health assessment/dental visit. As an individual is at risk of tooth decay throughout life, it is wise to check with your dental professional that the toothpaste selected also contains fluoride.

Tooth Sensitivity

Some people suffer sharp bouts of pain especially when they take cold food or drinks into their mouth. The condition giving rise to this pain is termed cervical dentine hypersensitivity and is a result of exposure of the root surface at the gum margin and transfer of the stimulus through the exposed dentinal tubules. This can be due to gingival recession, gum disease or abrasion from over-vigorous toothbrushing. The condition can be quite distressing and uncomfortable.

Prevention

Precautions outlined above to promote periodontal health and prevent gingivitis and periodontitis and tooth abrasion will also help reduce the occurrence of cervical dentine hypersensitivity. It is important to consult with a dentist and have the cause established. To alleviate the sensitivity, the dentist may decide to apply a high concentration fluoride varnish on the site. It is worth noting that tooth sensitivity can also be due to other reasons such as a loose or cracked filling, hence the importance of seeking dental advice.

The oral healthcare industry has responded to the increased prevalence of cervical dentine sensitivity and a number of "sensitivity" toothpastes are currently on the market. There is growing clinical evidence that use of these toothpastes can help alleviate the pain from cervical dentine sensitivity. Further information on toothpastes is available in Chapter 5: Oral Healthcare Products.

Dry Mouth

Most people have experienced the temporary sensation of "drying up" when nervous, for example when giving one's first public speech. This is a normal reaction. Common causes of an ongoing dry mouth include medications (e.g., those used to control high blood pressure, anti-Parkinson drugs, anti-anxiety agents, antihistamines, diuretics and sedatives), disease, and radiotherapy. Radiotherapy to treat cancer in the head and neck area may cause salivary flow to stop altogether, either long term (permanent) or for periods of up to three months (temporary). It is essential that people about to undergo radiotherapy treatment are informed of the increased oral health risks associated with the reduced saliva flow that may result from their treatment. Some systemic diseases and conditions can also cause dry mouth (e.g., Sjögren's syndrome, systemic lupus erythematosus (SLE), rheumatoid arthritis, diabetes mellitus, nutritional deficiencies, and depression).

Though dry mouth is not directly age-related,

Dry mouth is a result of reduced or absent saliva flow. Unstimulated saliva* normally flows at a rate of 0.3 ml per minute. A flow rate of less than 0.1 ml per minute is an objective measure of a 'dry' mouth "dry"; Stimulated saliva^ flows at a rate of 1–2 ml per minute, and less than 0.7 ml per minute is considered reduced saliva flow. These rates are average values but there is a wide range of normal salivary flow rates. Individuals can generally tolerate a 50% reduction in their own normal salivary flow rate before any impact is felt.

***Unstimulated saliva flow is the flow rate recorded when an individual is sitting quietly at rest.**

^Stimulated saliva flow is the flow rate recorded when an individual is sitting quietly and chewing on a piece of unflavoured gum.

it is more commonly a complaint of older people, as older people may be taking multiple medications which have the effect of reducing saliva flow.

The feeling of a dry mouth is a particularly uncomfortable one and often gives rise to difficulty in speaking and eating, and can have a major negative impact on a person's quality of life. A reduced saliva flow can give rise to an increased incidence of tooth decay, gum disease and oral infection (e.g., candida albicans). Individuals with a dry mouth or feeling of a dry mouth should attend their health professionals so that they can be advised of the management measures they can take to minimise the damaging effects of dry mouth.

Management

People with dry mouth lose the protective effect of saliva in preventing tooth decay, tooth wear and trauma to the oral mucosa. Where dry mouth is medication-induced, the prescribing doctor should be consulted about possible alternative drugs which may not have the same xerogenic side effect, or strategies to minimise the discomfort. For many people, the underlying cause of dry mouth cannot be prevented, and management of the problem is the best option. Management involves making the person comfortable by providing oral lubricants (saliva substitutes) and preventing disease using fluoride mouth rinses and plaque control mouth rinses. People with dry mouth should be careful not to regularly suck sweets (e.g., mints, boiled sweets). Although sucking sweets may give temporary relief, it will cause severe tooth decay in the absence of saliva. Frequent consumption of drinks sweetened with sugar (e.g., soft drinks) should also be avoided. Even sugar free sweets and drinks can be problematic due to their acid content, which is erosive to the teeth, especially in the absence of saliva. The frequent sipping of iced water may provide some relief and can be recommended. Acupuncture is an alternative therapy that may also bring relief to those with dry mouth.

Nowadays there are many saliva substitutes or oral lubricants on the market, generally available through pharmacy outlets; these can be effective in reducing the unpleasant side effects of reduced flow of saliva. Saliva stimulants have also been developed for those with some remaining salivary gland function; these are available on prescription but do have some side effects which should be discussed prior to use. There are now well-defined methods for assessing the flow of saliva and it

Strategies to minimise discomfort of dry mouth:

- **Carry a bottle of still water or tap water with you and sip frequently**
- **Saliva substitutes are available from the dental practice or pharmacy**
- **Discuss dietary choices with the dentist, dietician or nutritionist**
- **Discuss use of toothpaste with a dental professional**

is important to seek the advice of a dentist as soon as symptoms of dry mouth appear.

Halitosis (Bad Breath)

Halitosis – bad breath or oral malodour – is considered to be socially unacceptable. Self-diagnosis is, however, difficult as it is not possible to easily detect an odour from one's own breath. Those who have halitosis are often unaware of it until they have been informed by friends or relatives. People who have been told that they suffer from bad breath may continually worry that an offensive smell can be detected from their breath.

Halitosis is mainly caused by excessive amounts of volatile sulphur compounds (VSCs) being produced by bacteria in the mouth. The amount of VSCs in a person's breath can vary greatly during the day and is influenced by factors such as eating, drinking, sleeping, oral hygiene practices, and the effect these activities have on saliva flow and the effective bathing of the oral cavity with saliva.
Studies have shown that up to 50% of adults suffer from objectionable mouth odour in early morning before breakfast or toothbrushing. The reason for this is that saliva incubates bacteria in the mouth during sleep when saliva flow is reduced. People with periodontal disease exhibit raised odour intensity due to the incubation of micro-organisms in periodontal pockets. A number of systemic diseases and conditions such as diabetes mellitus, chronic renal failure and cirrhosis of the liver can also give rise to bad odours in the breath.

There is increasing interest in the development of a reliable system that will measure the level of volatile sulphur compounds in one's breath. This technology is making rapid progress, though the cost of a reliable system remains problematic.

While tobacco and certain foods and drinks (e.g., garlic, onions, coffee, alcohol) also influence breath odour, their effect comes from the lungs rather than from the mouth itself.

Prevention

Reduction of halitosis is achieved in several ways. The oral hygiene products and practices used to control dental caries and periodontal disease will also help prevent, control and mask halitosis. Periodontal treatment that results in reduced periodontal pocketing will also minimise halitosis.

The majority of studies on volatile sulphur compounds concentrate on the effects which commercially available mouthwashes have on the reduction of halitosis. Reduction in mouth odour is caused by the anti-microbial influence

Figure 28: Tongue scraper.

of the mouthwash. Some products however, mask halitosis rather than deal with the cause of the problem. Toothbrushing, eating, chewing gum and tongue cleaning (with a toothbrush or specific tongue-cleaning devices) can be effective in controlling oral halitosis to an acceptable level, though their effect is not as long lasting as the effect of antimicrobial mouth rinses.

Cold Sores

Cold sores are contagious, and strict hygiene measures should be adopted when one is infected. Primary oral infection with the virus responsible for cold sores (herpes simplex virus (HSV) typically occurs at a young age and may be asymptomatic. Some children develop a symptomatic primary infection, presenting with inflammation and ulceration of the mouth and gums. The skin around the mouth may be affected and there may be swollen lymph glands, an elevated temperature and loss of appetite. After the primary oral infection, HSV may remain inactive, only to be re-activated later as the more common herpes labialis, or 'cold sores'. Triggers for reactivation are well known and include sunlight, trauma, tiredness, stress, and menstruation. An episode of 'cold sores' usually begins with a burning sensation on the affected area of the lips, which is usually followed by the development of painful blisters. The appearance of 'cold sores' is a well-localised cluster of small vesicles along the red border of the lip or adjacent skin. The vesicles rupture, ulcerate, and crust within one to two days and heal within seven to 10 days.

Figure 29: Cold sore present on upper lip.

Prevention

Prevention is difficult, although the use of SPF Lip balm will help reduce attacks in those holidaying in the sun. Also, a well-established product on the market (containing 5% w/w acyclovir), if applied during the early burning phase of cold sores, has been shown to be effective in reducing the duration of the episode.

Mouth Ulcers

Many people suffer from recurrent mouth ulcers, which can be extremely painful. The most common form is called Minor Aphthous Ulceration (MIAU). Teenagers are most frequently affected, though many experience their first lesions well outside this age range. Usually one to five small ulcers (less than 1 mm in diameter) appear on the inside of lips or cheeks and floor of the mouth or tongue. The ulcers tend to be concentrated towards the front of the mouth. Prior to the ulcers appearing, the

patient may experience a burning or prickling sensation. The ulcers are painful, particularly if the tongue is involved, and may make speaking and eating difficult. The course of these ulcers varies from a few days to a little over two weeks, but most commonly they last for about 10 days. Some minor trauma such as vigorous toothbrushing or an irregular filling can be precipitating factors. Mouth ulcers can also be precipitated by stress, illness, hormonal changes, menstruation, and deficiencies in vitamin B12, iron and folic acid. Other more serious causes of mouth ulcers include herpes infection, inflammatory bowel disease (IBD) and other immune disorders.

A more severe form of oral ulceration, called Major Aphthous Ulceration (MJAU) can affect any part of the oral mucosa, including the soft palate and the tonsillar area, and can extend into the oropharynx. The ulcers are larger than those seen in MIAU and last longer, up to periods of months in some cases. There are other forms of oral ulceration, where, for example, the ulceration may be part of a syndrome involving ulceration of the eyes, genitalia, the nervous system and joints.

Figure 30: Mouth ulcer present on lower lip.

Prevention

Successful prevention of mouth ulcers requires identification and treatment of their underlying cause or causes. It is important to seek the advice of a dentist or health professional, who may decide to refer the more severe cases to a specialist in oral medicine for a more thorough investigation. Maintenance of a high level of oral hygiene will reduce the likelihood of secondary infection when mouth ulcers are present. This of course can prove difficult since patients may find toothbrushing too painful due to the presence of ulcers. Covering agents, some containing choline salicylate, are available though they can be difficult to apply. They may also be difficult to keep in place, for example inside the lips and on the tongue, due to constant movement. Use of antiseptics (e.g., chlorhexidine mouth rinse) is reported by some patients to be helpful. Topical steroids can also provide relief. In some females there is complete remission from aphthous ulcers during pregnancy. Hence, hormonal therapy has been tried with varied success. Lozenges containing local anaesthesia have been used as a last resort to give the patient some relief, for example when eating.

Mouth, Head and Neck Cancer

Mouth, head and neck cancer includes cancer of the lips, tongue, base of the tongue and tonsillar area, gums, cheeks and roof of the mouth, the back and side walls of the throat, nose, ear, salivary glands, eye, larynx (voice box) and thyroid. A cancer starts when cells grow in an abnormal way. As they grow, the cancer cells can form a tumour, which can affect how the organ or tissue normally works. Global

Figure 31: Oral lichen on side of tongue (lesion has the potential to turn malignant).

Figure 32: Squamous cell carcinoma present on the side of tongue.

Figure 33: Squamous cell present on lower lip.

estimates indicate that lip and oral cavity cancer cancer (tongue, base of the tongue and tonsillar area, gums, cheeks and roof of the mouth) collectively represent the 16th most common malignant neoplasm worldwide, with almost 355,000 new cases per year.[53] The risk of developing lip and oral cavity cancer increases with age, and most cases occur in people over the age of 50 years.[67-69]

There is an increasing incidence of oral cancer in younger adults (non-smokers) thought to be associated with exposure to the human papilloma virus (HPV), and the increasing incidence of oral cancer in females is associated with the increased acceptability of tobacco and alcohol use among women.[70]

Both smoking and alcohol are important independent risk factors for oral cancer, and there is convincing evidence that their combined effect is synergistically greater than the sum of the risks associated with either. There is also evidence of a dose response with tobacco smoking: The more cigarettes consumed daily and the more years one has smoked, the greater the risk of oral cancer.[71]

A key risk factor for non-smokers is viral exposure (i.e., HPV).[72] Other risk factors include a diet low in fresh fruit and vegetables. A recent systematic review also found evidence that low socioeconomic status per se is significantly associated with increased oral cancer risk in both high- and low-income countries worldwide.[73]

Although oral cancer can occur without any pre-cancer signs, several recognised precancerous lesions are also linked with smoking and alcohol consumption. Many of these have a whitish colour and may not be painful. While the number of these lesions (such as leukoplakia) which will become cancerous is extremely low, a considerably higher proportion of people with these lesions develop oral cancer than among the general population.

There is also a link between oral cancer and several strains of oral bacteria (such as *Porphyromonas gingivalis*, *Fusobacterium nucleatum*, and *Capnocytophaga gingivalis*) and

the incidence of cancers of the gastro-intestinal tract.[74]

Prevention

The key to the prevention of oral cancer is to not smoke tobacco (or to give up smoking if already smoking), and to adopt a sensible approach to the consumption of alcohol. Tobacco smoking and alcohol consumption account for at least three-quarters of all oral cancers. A healthy diet with at least five servings of fresh fruit and vegetables may also reduce the risk of oral cancer.

Early diagnosis has been clearly established as important for a successful outcome; hence, an oral health assessment at least once a year for adults is important – whether you have your own natural teeth or dentures. Oral cancer detected early has a good prognosis; despite this, the survival rate in Ireland is quite low (<50%) as over half of the cases present at an already advanced stage.[68]

Medication-related Osteonecrosis of the Jaw (MRONJ)

Medication-related osteonecrosis of the jaw (MRONJ) is a condition first documented in 2003 by Marx et al., which can develop following the administration of a bone modifying agent (antiresorptive and antiangiogenic).[75] They are used widely across medicine predominantly in cancer care (oncology), rheumatology and in patients with structural and metabolic bone changes (hypercalcemia, skeletal-related events and osteoporosis).[75]

MRONJ follows a clinical path of exposed bone in the maxillofacial region, present for at least 8 weeks in a patient exposed to a bone modifying agent.[75] The prevalence of MRONJ in cancer patients ranges from 0 to 12% and 0.04 to 1.9% in the osteoporotic patient.[75,76] The half-life of the commonly used medication is 11.2 years which has longstanding implications particularly when used in the curative cancer setting.[76]

Local dental risk factors include the presence of oral disease in particular severe periodontal diseases and/or the necessity for invasive dental procedures.[76] MRONJ is a painful condition that shows a variable response to conservative and surgical procedures.[76] Factors such as steroid therapy or chemotherapy at the same time, smoking and poor oral hygiene and infrequent dental attendance can play a role in the development of MRONJ.[75, 76] MRONJ can give rise to significant impacts on quality of life, inability to each, chew or enjoy food.[76]

Attending for a dental visit prior to undergoing treatment with bone modifying agents and the maintenance of good oral hygiene and preventative dental measures reduce the burden of oral disease and the requirement for extensive dental procedures[76]. Thus, there is a need to ensure that oral health, for cancer patients particularly, is considered prior to the prescription of a bone modifying agent. It is important to always let dental professionals know of medications that are being taken and to ask other health professionals about personal, oral and dental health before treatment to minimise the development of MRONJ.[76]

Possible warning signs of oral cancer should not be ignored and should be brought to the attention of a medical or dental professional. These include:

- **A sore or lesion in the mouth that does not heal within two weeks**
- **A lump or thickening in the cheek**
- **A white or red patch on the gums, tongue, tonsil or lining of the mouth**
- **A sore throat or a feeling that something is caught in the throat**
- **Difficulty chewing or swallowing**
- **Difficulty moving the jaw or tongue**
- **Numbness of the tongue or other area of the mouth**
- **Swelling of the jaw that causes dentures to fit poorly or become uncomfortable**

For further information, visit *www.dentalhealth.ie/adult-oral-health/older-people/oral-cancer/*

Chapter 3
Oral Health & General Health: The Common Risk Factor Approach

The mouth serves as a "window" to the rest of the body, providing signals of general health disorders. This chapter will emphasise the importance of general health to oral health and vice versa.

The non-communicable diseases such as cancer, respiratory diseases and diabetes and the oral diseases of tooth decay, gum disease and oral cancer share the risk factors of diet, alcohol and tobacco use. Therefore, if these risk factors are controlled we can reduce a number of diseases. This is often referred to as a common risk factor approach.

The Mouth-Body Connection

Oral health is an integral part of general health and well-being at every stage of life. A healthy mouth enables not only nutrition of the physical body, but also enhances social interaction and promotes self-esteem and feelings of well-being. The mouth serves as a "window" to the rest of the body, providing signals of general health disorders. For example, mouth lesions may be the first signs of HIV infection, aphthous ulcers are occasionally a manifestation of coeliac disease or Crohn's disease,[77] pale and bleeding gums can be a marker for blood disorders, and bone loss in the lower jaw can be an early indicator of skeletal osteoporosis. Saliva samples can be used to aid diagnosis for a number of diseases/conditions and have the advantage of being non-invasive (e.g., alcohol, nicotine, opiates, drugs, hormones, environmental toxins, antigens including Sars Cov-2 detection).[78,79,80]

Oral conditions have an impact on overall health and disease. Bacteria from the mouth can cause infection in other parts of the body when the immune system has been compromised by disease or medical treatments (e.g., infective endocarditis). Systemic conditions and their treatment are also known to impact on oral health (e.g., reduced saliva flow, altered balance of oral microorganisms). Periodontal disease has been associated with a number of systemic conditions such as diabetes mellitus, Down syndrome, heart disease, stroke, metabolic syndrome, bacterial pneumonia, and low-birth weight babies. Though the biological interactions between oral conditions and other

medical conditions are still not fully understood, it is clear that major chronic diseases – namely cancer and heart disease – share common risk factors, such as alcohol consumption, tobacco and smoking and a poor diet, with oral disease.[80] Furthermore, there is a need for further research regarding the microbiome, to understand why dissemination of oral bacteria into the gastro-intestinal tract can potentially exacerbate gastrointestinal diseases.[81]

Recognition that oral health and general health are interlinked is essential for determining appropriate oral healthcare programmes and strategies at both individual and population or group levels. This recognition underscores the importance of the integration of oral health into general health policies that are holistic and patient centred, and the necessity to adopt a collaborative "Common Risk Factor Approach" for health promotion, both general and oral.[29,82, 83]

The Common Risk Factor Approach

Traditionally, oral health promotion has focused on care of the teeth and gums, in isolation from other health programmes. The Common Risk Factor Approach (CRFA) to health promotion takes a broader perspective, and targets risk factors common to many chronic conditions and their underlying social determinants. The key concept of this approach is that concerted action against common health risks and their underlying social determinants will achieve improvements in a range of chronic health conditions more effectively and efficiently than isolated, disease-specific approaches.[83]

Adoption of a common risk factor approach is more resource-efficient than a targeted disease-specific approach because:

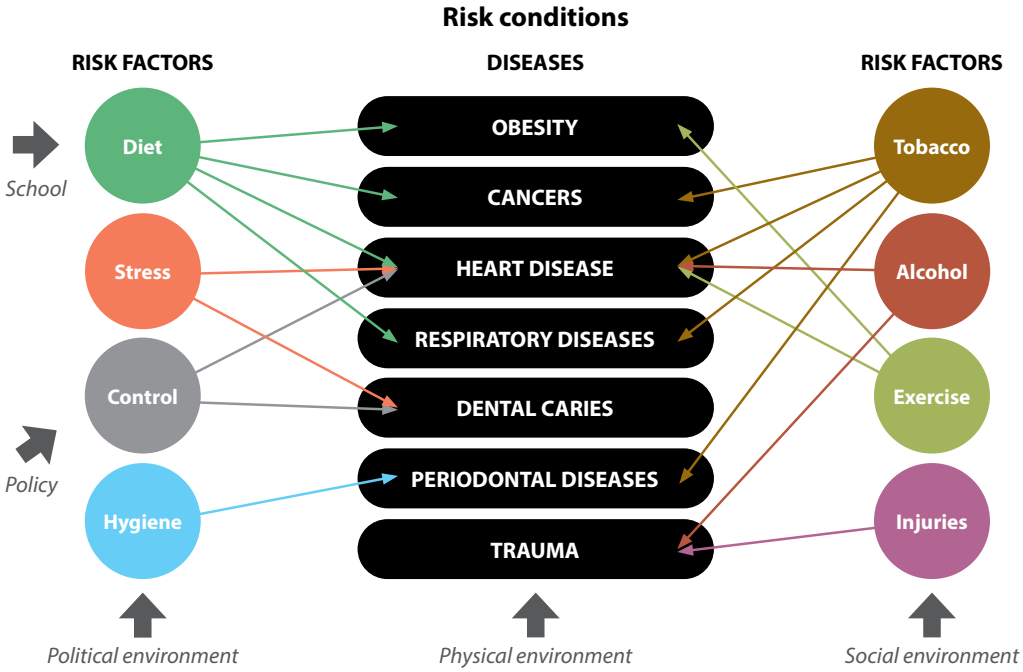


Figure 34: Common Risk Factor Approach.

- Most chronic diseases have multiple risk factors
- One risk factor can impact on several diseases
- Some risk factors cluster in groups of people
- Risk factors can interact – in some instances synergistically with each other - for example alcohol and smoking.

The common risk factor approach provides a rationale for developing multi-sectoral alliances between health professionals; statutory, voluntary, and commercial bodies and the general public. It recognises that engendering lasting changes in individual "lifestyle" behaviours requires supportive social, economic, and political environments.

Common Risk Factors for Oral Health

The common risk factors that oral diseases share with other chronic diseases/conditions are:

Poor diet – Risk factor for tooth decay/dental caries; diseases of the cardiovascular system; diabetes; cancer; and obesity.

Tobacco consumption/smoking – Risk factor for periodontal disease; mouth, head and neck cancer; lung cancer; cardiovascular disease; respiratory disease; and diabetes.

Alcohol consumption – Risk factor for mouth, head and neck cancer; lung cancer; cardiovascular disease; liver cirrhosis; traumatic injuries, including oro-facial and dental injuries.

Poor hygiene measures – Risk factor for periodontal diseases and other bacterial and inflammatory conditions.

Stress – Risk factor for periodontal diseases and cardiovascular disease.

Socio-economic status – Low socio-economic status is an independent risk factor for many diseases/conditions, as well as increasing the likelihood of other risk factors.

Diet

Poor diet is a risk factor for tooth decay/dental caries, cardiovascular disease, diabetes, cancers and obesity.

Diet – the foods and drinks we consume to nourish our body – and our eating habits have an important influence on our health and wellbeing. A good diet provides the body with the appropriate quantity and quality of nutrients it requires to sustain health. Deficiency diseases such as anaemia and osteoporosis result from the inadequate intake of essential specific nutrients (undernutrition). Overeating or excessive intake of nutrients (over nutrition) leads to obesity, a recognised major risk to good health. Obesity is a serious problem in Ireland: in the 2022 Healthy Ireland survey, 35% of those surveyed self-reported being overweight, with a further 21% self-reporting obesity.[84] For Irish adolescents the prevalence of overweight/obesity has increased significantly in recent years, with 24% of adolescents living with overweight/obesity in 2020 compared to 18% in 2006 and 13% in 1990. The prevalence of obesity has increased considerably between 1990 and 2020 with 8% of adolescents in 2020 living with obesity compared to 3% in

2006 and 0.5% in 1990.[85] There may be some evidence that overweight and obesity levels are plateauing in children (5–12-year-olds) in Ireland. However, despite this, levels remain high, with the highest prevalence in 2019 observed in girls and in those from the lowest socio-economic group.[86] Thus, overweight/obesity prevention and intervention policies are necessary and must be continued. Being overweight and obese increases the risk of cardiovascular disease and Type 2 diabetes.

Dietary guidelines in Ireland are currently based on the Food Pyramid published by the Department of Health. The Food Pyramid is designed to help people to eat a balanced diet by combining different types of food in the right amounts. The "top shelf" of the pyramid represents processed foods high in fats, salt and sugar (HFSS) (e.g., ultra-processed foods, such as biscuits and cakes): these should be consumed sparingly (i.e., up to two servings per week, and avoiding daily intake). The "bottom shelf" represents fruit and vegetables which should constitute a large proportion of our daily diet (i.e., 5-7 daily servings). There is also a mention of the importance of keeping active and having a regular intake of fluids; up to 8 cups per day with an emphasis on water and on limiting intake of sugary drinks.

Figure 35

The top shelf of the Food Pyramid is of particular relevance to oral health as high consumption of foods/drinks containing sugars is a direct cause of dental caries.[88] The oral health message to restrict consumption of foods/drinks containing sugars to mealtimes complements the healthy heart message to reduce consumption of foods high in oils and fats,[87] and the WHO Guideline: sugars intake for adults and children.[42,89,90]

Reports show 36% of those interviewed, report they consume multiple unhealthy snacks daily, with 24% consuming at least one unhealthy snack daily, which has only marginally changed since surveyed in 2016.[88]

Sixty-five percent of people report eating fruit on a daily basis, and a surprisingly higher percentage (75%) report consuming vegetables daily.[88] Studies show that eating more fruits and vegetables can have a protective influence against cancers and systemic inflammatory (including periodontal) diseases.[89, 90] The relatively good compliance rate of 65% (59% of men; 71% of women) for the "Fruit and vegetables" shelf is likely reflective of a widespread acceptance of the health benefits provided by this food group. This would suggest that the nationwide promotion of the message to have five or more daily servings of fruit and

vegetable has had an impact.
The impact of dietary habits and practices on oral health will be discussed in greater detail in Chapter 4 – Nutrition and Oral Health.

Tobacco use

Tobacco chewing/smoking is a risk factor for oral and other cancers, periodontal diseases, cardiovascular disease, respiratory diseases and diabetes.

Tobacco contains chemicals that are harmful to the human body, and the smoking or chewing of tobacco is the cause of 80–90% of oral cancers.[91] Other oral consequences of tobacco consumption include: increased risk of periodontal diseases, halitosis/bad breath, tooth discolouration; an increased build-up of dental plaque; and delayed healing following tooth extraction, periodontal treatments and oral surgery. Use of tobacco products also affects one's sense of taste and smell.
Smoking is also bad for general health. It increases the risk of several types of cancers (lung cancer, pancreatic cancer, cervical cancer, cancer of the kidney, liver cancer, cancers of the mouth, lip, throat, bladder cancer, stomach cancer and leukaemia); emphysema and other respiratory diseases; cardiovascular disease; diabetes and ulcers. Smoking is also associated with adverse pregnancy outcomes.

The perils of smoking extend beyond active smokers to include those who are in their environment (i.e., passive smokers): second-hand smoke contains at least 50 known carcinogens and other harmful chemicals.
Smoking is the single most important preventable cause of illness and death. Compared to those who have never smoked, smokers are almost twice as likely to have a heart attack. Smokers shorten their life expectancy by 10–15 years on average. By simply quitting smoking, however, smokers can, over time, reduce their risk levels.

According to the 2017 WHO report on the Global Tobacco Epidemic, during 2016 it was estimated that approximately 5,950 deaths in Ireland were directly linked with smoking. While there has been some modest reduction in smoking since the introduction of the Smoking Ban in March 2004, there is still a high rate of smoking among Irish adults, namely 20% of men and 17% of women, with a considerable cost to society.[92-94] The Healthy Ireland Survey for 2022 indicated that: 18% of the population currently smoke, with a reduction in the 25-34 age group, declining by 6% since the 2019 survey. In the 15-17-years age group, the survey indicated that 5.5% were smokers. Overall 29% of those who smoke are actively trying to quit.[95] When smoking is accompanied by alcohol consumption or cannabis use, their ill-effects act synergistically, and the consequences are amplified: smokers who are also alcohol drinkers have a risk of oral cancer greater than the combined risk of those who only smoke and those who only drink alcohol.[93]

Electronic cigarettes / vapes

Electronic cigarettes (e-cigarettes) or vapes are battery operated devices containing a mixture of nicotine, solvent carriers such as propylene glycol, concentrated flavourings and water, among other additives that are delivered to the lungs in aerosol form. Due to the increasing use of these devices, there is a high potential for acute and chronic adverse health effects. Early

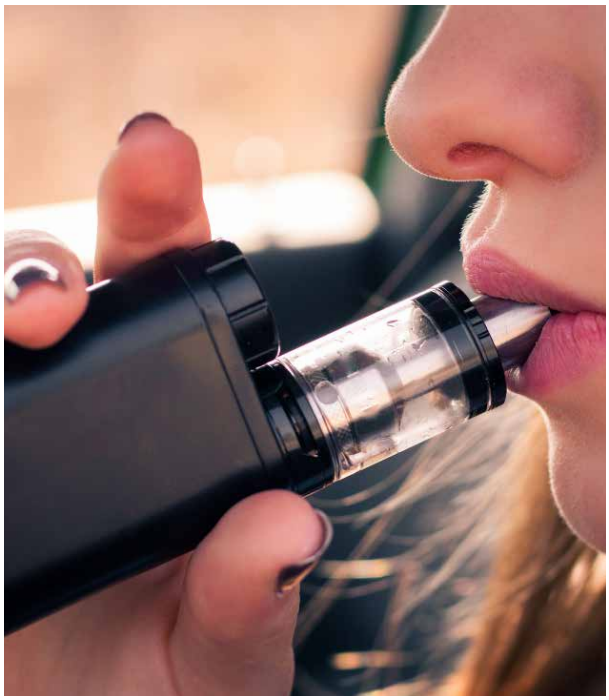


Figure 35: Vaping.

studies have shown that the use of e-cigarettes has resulted in an increase in the abundance of both Porphyromonas and Veillonella bacteria in the mouth, leading to increased gingival inflammation. However further research is needed to assemble a more robust verification.[96] It is estimated that 6% of the population use e-cigarettes on a regular basis.

Of those in the under 25 years old age bracket, 11% report using e-cigarettes regularly.[84] There is a worrying trend amongst young adults; according to a 2018 study by HBSC Ireland, 26% of boys and 18% of girls aged 15-17 have tried e-cigarettes.[97] A review undertaken by the Health Research Board of Ireland on the available studies on e-cigarettes has indicated that (i) E-cigarettes are no more effective than medically approved and regulated nicotine replacement therapies to help people stop smoking. (ii) Adolescents who use e-cigarettes are three to five times more likely to start smoking tobacco cigarettes compared to those who never used e-cigarettes and (iii) E-cigarettes can lead to poisonings, burns, lung injury and asthmatic attacks. Some of the chemicals in e-cigarettes are thought to cause tissue and cell damage and are linked to cancer. The long-term health effects beyond 24 months are not researched and both oral and general health could be affected.[98-101]

Alcohol

Alcohol is a risk factor for oral and other cancers, cardiovascular disease, liver cirhossis and trauma as well as increased incidence of dental caries.
The risk of oral cancer is six times higher in those who drink alcohol compared to non-drinkers. Alcohol is the primary cause of liver cancer and is also a risk factor for breast cancer and colorectal cancer.

Alcohol is absorbed from the stomach into the blood stream and affects the central nervous system. Alcohol is a depressant and, in some individuals, can give rise to violent and irrational behaviour. Excessive alcohol consumption leads to liver damage, alcohol dependency, memory loss, cardiovascular disease, stomach ulcers, impotence, low birth weight babies, impaired motor skills, wrinkles and early ageing.

Frequent intake of alcoholic beverages can lead to increased risk of caries, both short term, because many alcoholic beverages contain sugar syrups[102] or are consumed with carbonated mixers, and long term because alcohol dependency has a strong correlation with a decrease in general and oral hygiene. There is also an increased risk of traumatic injury due to accidents.[102]

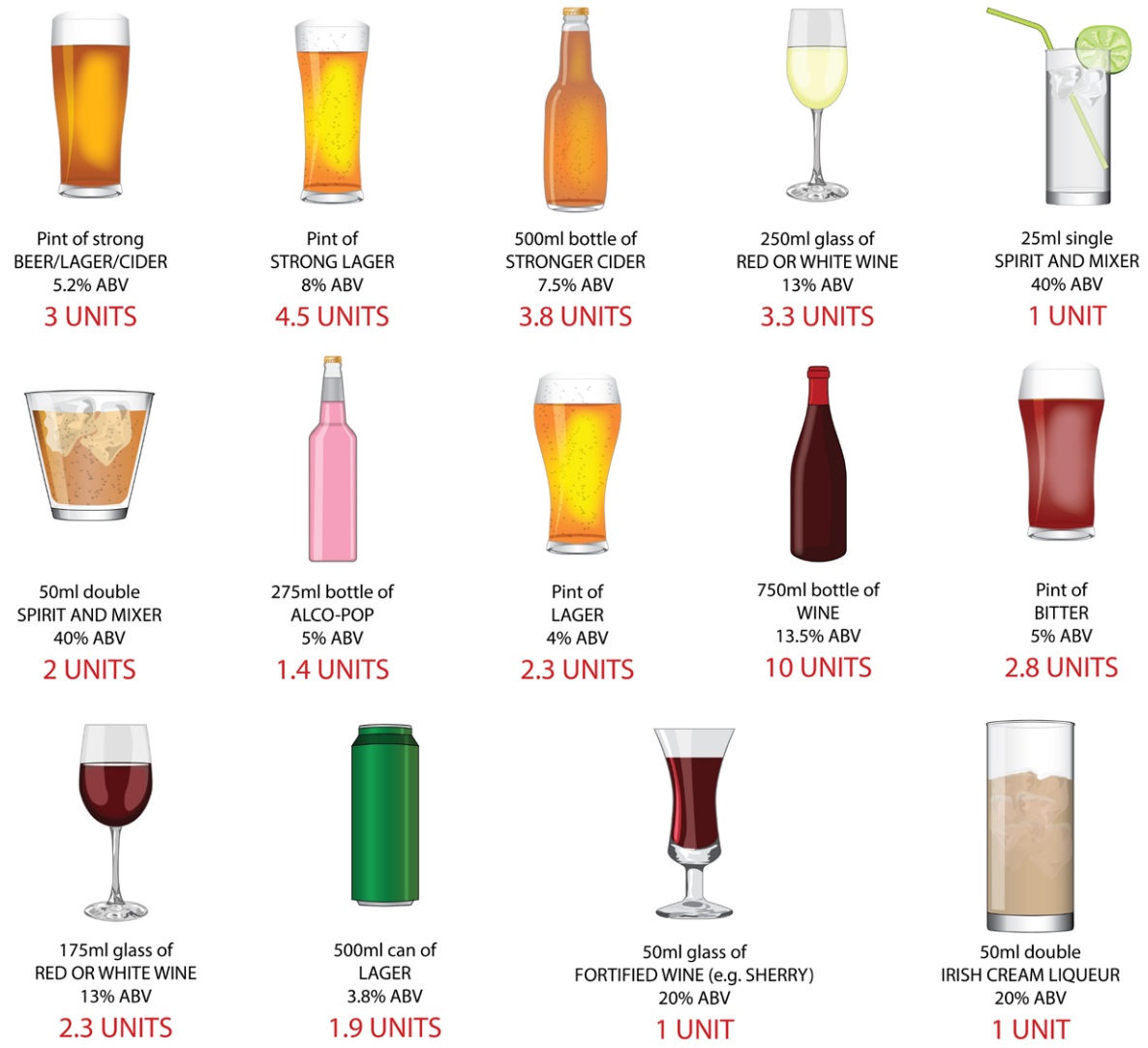


Figure 36

A standard drink in Ireland contains about 10 grams of pure alcohol. For adults, the recommended upper limits for alcohol intake are:

- Up to 11 standard drinks per week for women, ideally spread out during the week and with 2 alcohol-free days
- Up to 17 standard drinks per week for men, according to alcoholireland.ie

The following is a useful link for further information from the HSE: https://shorturl.at/ahAE0

The risk of oral and pharyngeal cancers tend to increase with the amount of alcohol consumed and with binge drinking.[103,104]

Hygiene

Poor oral hygiene is a risk factor for periodontal diseases and other bacterial and inflammatory conditions.

Hygiene in general refers to the practices used to ensure good health and cleanliness. Poor personal hygiene leads to inflammatory skin

conditions and bacterial or other infections. Oral hygiene refers to individual habits and professional methods used to control the bacterial biofilm (dental plaque) that grows on tooth surfaces. If not removed regularly, dental plaque can lead to tooth decay and periodontal diseases. Tooth brushing as a daily routine is the most important method of plaque control.
Early assimilation of good oral hygiene into general hygiene practices promotes better overall oral health and general health. Oral hygiene practices should be included in guidelines for personal hygiene taught in schools, and in guidelines used for the care of the chronically ill, those with special needs, and older people in residential care.
Risk of bacterial pneumonia in older people in residential care, especially ventilation associated pneumonia (VAP), has been associated with poor oral hygiene. A systematic review of randomised controlled trials and other clinical studies estimated that one in ten cases of death from pneumonia among older people in nursing homes may be prevented by improving oral hygiene.[105]

Stress

Stress is a risk factor for periodontal diseases and cardiovascular diseases.
Stress is the body's reaction to external forces or events that cause physical, emotional or mental tension. When an individual feels stressed, adrenaline and stress hormones (e.g., cortisol) are released to prepare the body for the "fight-or-flight" response. While stress is a normal part of life, excessive stress can lead to health problems and lifestyle behavioural changes (e.g., take up smoking or increase smoking, increase alcohol intake, change dietary habits, become physically inactive, loose interest in personal hygiene) which further increase health risks.[106]

How individuals react to stress depends to a large extent on their personality type. Studies have shown, however, that even people with the most easy-going and adaptable personalities can suffer from stress if they lack a sense of control over aspects of their daily lives.

Chronic stress (e.g., low social support, low socioeconomic status, work stress, marital stress, caregiver strain) is a known risk factor for cardiovascular diseases and periodontal diseases. It has been theorised that chronic stress speeds up the process of atherosclerosis in the coronary arteries and that the stress hormone cortisol plays a role in increased destruction of the periodontium. Cortisol also acts to suppress the immune system, allowing microorganism to flourish in the mouth.

Exercise and stress management techniques provide individuals with tools to cope with the anxieties in their lives. The most effective way to deal with stress, however, is by correcting or modifying its underlying causes (e.g., low socio-economic status), which may be beyond the control of the individual.[106]

Socio-Economic Status

The link between general health and socio-economic status is well established. There is also a body of evidence showing that poor oral health is associated with low socio-economic status or deprivation. In both high and lower income countries around the world, low socio-economic status was significantly associated with

increased oral cancer risk, even after adjusting for potential behavioural confounders.[73] Socio-economic status per se is an important risk factor for oral cancer. Social disadvantage causes health disadvantage: those in the lower social class groups were more likely to smoke than those in the higher social class groups, and those in the higher social class groups were more likely to have tried to quit smoking in the previous year. In Ireland, being unemployed or not having completed the Leaving Certificate examination are often used as indicators of lower socioeconomic status. The Healthy Ireland Survey (2022), indicated that smoking rates were higher for those who are unemployed (39%) than those in employment (19%) and they also remain higher among those who have not completed the Leaving Certificate (21%) than those with a Leaving Certificate or higher educational attainment (17%).[84]

Acknowledging that personal lifestyle behavioural "choices" may, for certain segments of society, be limited by socio-economic, cultural, political and other environmental conditions beyond their control is essential for developing effective public health strategies.[73, 83]

Adopting a common risk factor approach enables targeting of risk factors for many diseases/conditions, rather than focussing singularly on the individual diseases/conditions.

The Dahlgren and Whitehead Determinants of Health[107] model first produced in 1991 remains an effective illustration of the determinants of health and factors influencing health and economic status. The individual is at the centre and the various layers of influence on health surround them.

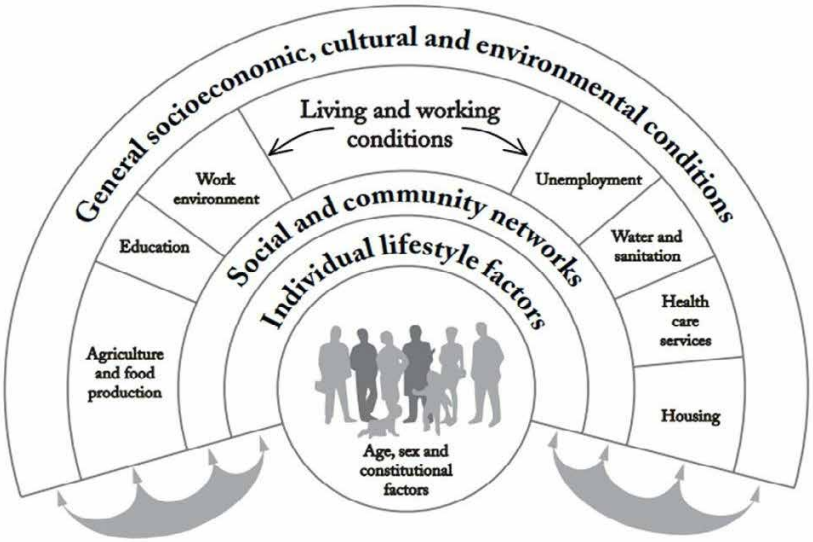


Figure 38: Dahlgren and Whitehead Determinants of Health.

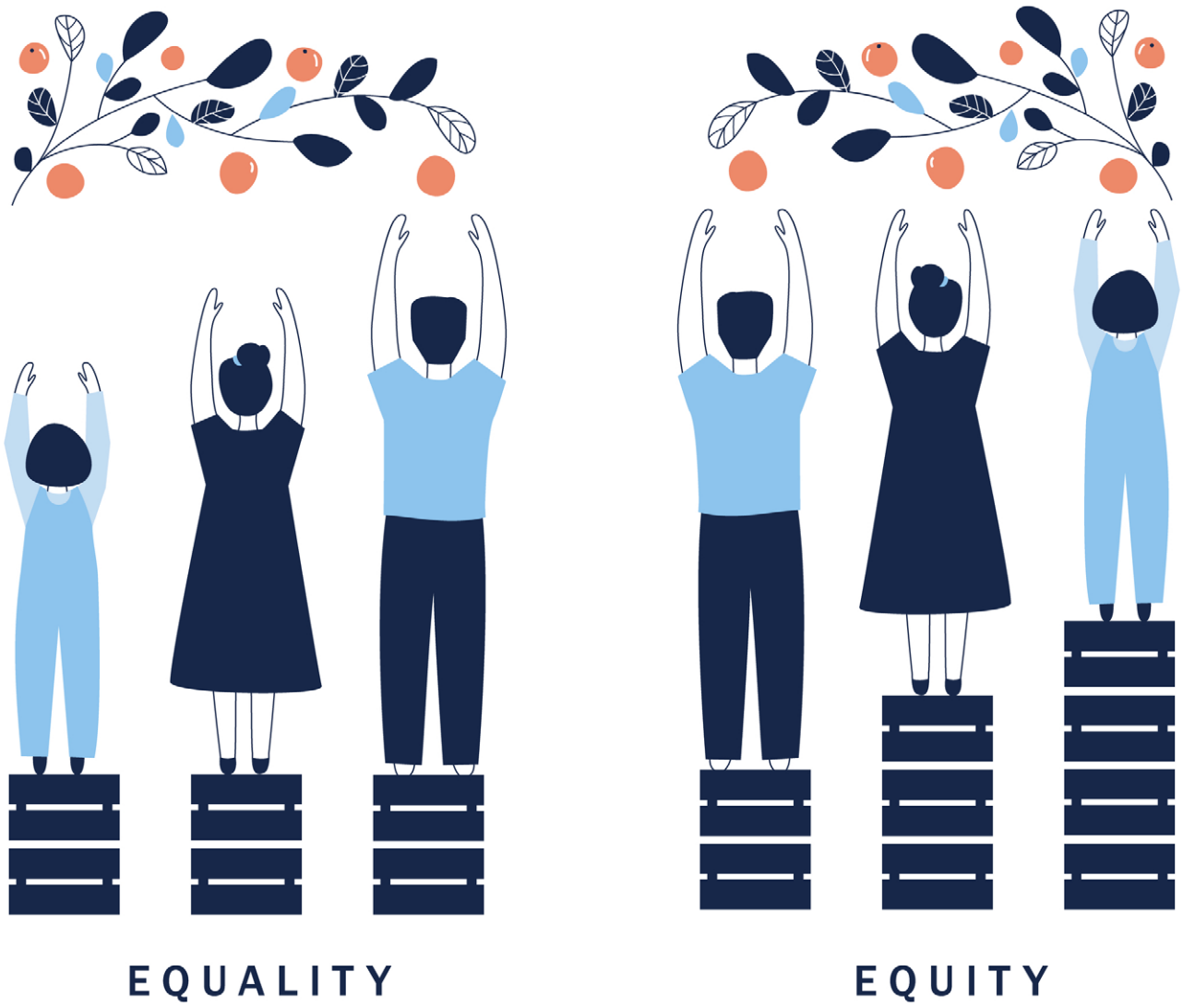


Figure 39

Chapter 4
Diet, Nutrition and Oral Health

Diet is the sum total of all food and drink consumed by an individual, the impact of which is dependent on when foods and drinks are consumed, how they are consumed, why they are consumed, how much is consumed and the frequency with which they are consumed. Nutrition focusses on the materials that are required to support the body and also involves the study of the ingestion and absorption of foods, drinks, minerals and vitamins.

The single most important cause of dental caries is the frequency with which sugar-containing foods and drinks are consumed. The nutritional advice offered in relation to oral health should be based on the reduction of between-meal snacking as well as a conscious reduction in the intake of sugary foods and drinks.[42,43,44]

The 2019 healthy eating, food safety and food legislation guide affirms that frequent consumption throughout the day of foods containing sugar should be avoided, especially by children.[42] While a high energy intake is required for growth by adolescents (and this increases meal frequency), this should not include frequent consumption of foods/drinks high in sugars throughout the day. The WHO recommendation regarding the intake of "free sugars" is multifaceted in its objectives.[42]

The Dental Health Foundation Ireland website has information on health promotion, nutrition, and oral health. The website also hosts a number of excellent resources such as the Sugar Clock poster and the Sugar Risk animation.

Summary of Key Points

- **The most significant cause of tooth decay is frequent consumption of sugar-containing foods and drinks throughout the day**
- **36% of those surveyed by Healthy Ireland in 2022 stated they consume two or more unhealthy snacks each day**
- **A further 29% of the group reported consuming sugar-containing drinks weekly**
- **Poor nutrition is a 'shared common risk factor' for cardiovascular diseases, cancer, obesity, and oral diseases**
- **A healthy diet should be promoted for better oral and general health and wellbeing**

Getting the Balance Right

A variety of foods that provide important nutrients also contain sugars, whether naturally present or added. Sugars naturally present in whole fruits, vegetables and milk are not harmful to the teeth. Foods which contain "free sugars"[42] ("free sugars include monosaccharides and disaccharides added to foods and beverages by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates") when consumed as part of a main meal may have little or no effect on dental caries.

The biggest threat to both oral and general health comes from snack foods that have been allocated to the top shelf of the Food Pyramid: foods high in sugars, salt and fat, such as cakes, biscuits, chocolate sweets, fizzy drinks, and chips/crisps, in addition to take away foods high in fats. The frequency and quantity with which these foods are consumed should be reduced: they should not be taken every day.

The Food Pyramid is essentially a guide to the components of a well-balanced healthy diet, and recommended serving sizes should be adjusted to an individual's requirements as determined, among other variables, by their age, physical size and activity levels. It is also important, within the guideline of the Food Pyramid, to eat a varied diet, as this helps to ensure intake of essential nutrients.[108,109]

ADULTS

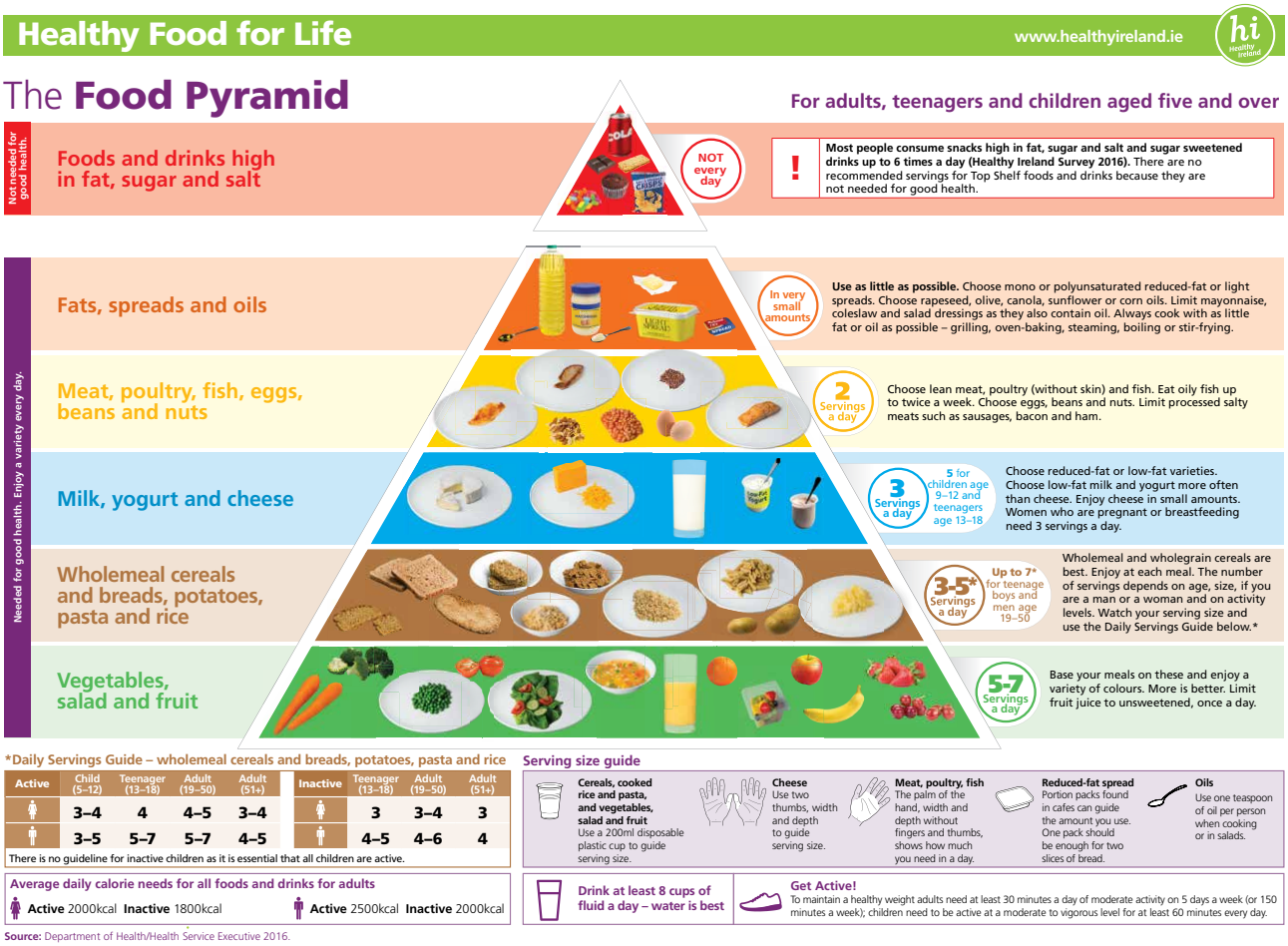


Figure 40: Adult, teenagers and children aged 5 and over food pyramid.

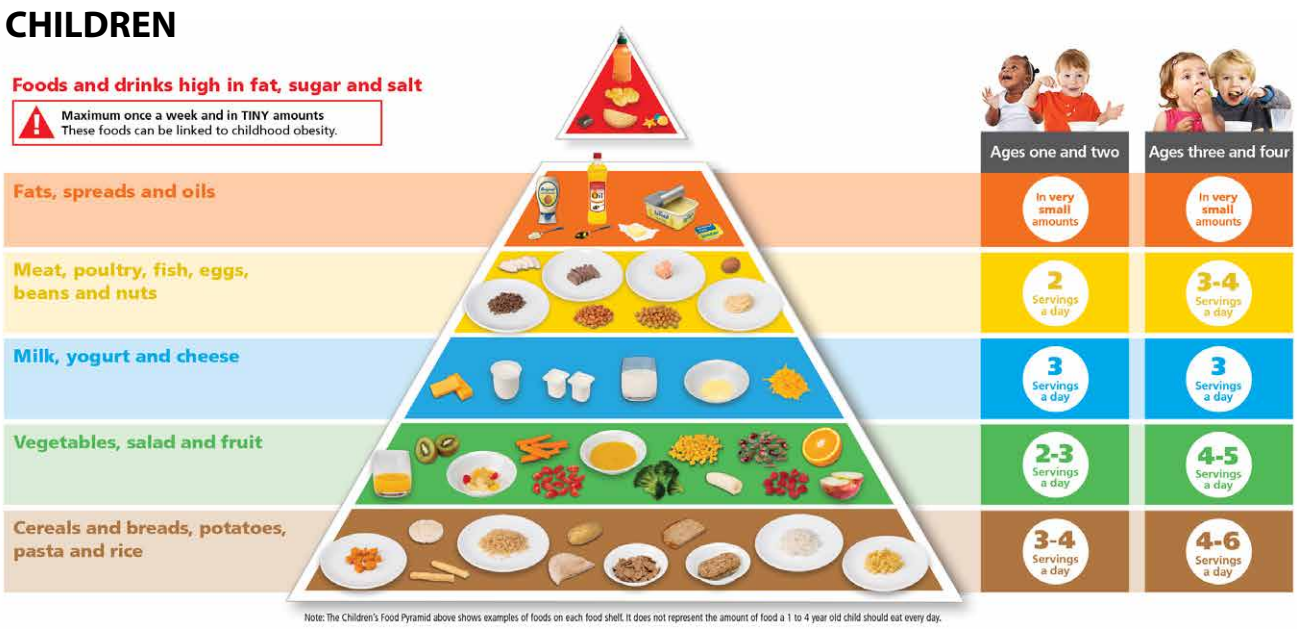


Figure 41: Healthy Eating for 1 to 4-year-olds.

The number of servings shown on this Food Pyramid is suitable for adults, teenagers and children over 5 years of age; there is also a Food Pyramid available for children 1-4 years of age, with additional advice on portion sizes and healthy snack suggestions.[109]

Children, as well as adults, are advised to drink plenty of water and to get physically active.[108,109]

The Get Ireland Active! National Physical Activity Plan for Ireland is an initiative by Healthy Ireland to help the public plan and achieve goals in living a more active and healthier lifestyle. It is recommended to aim for a target of at least 60 minutes of moderate to vigorous activity every day for children and a target of at least 30 minutes of moderate activity five days a week for adults. To support the key message that "physical activity is for everyone and any level of activity is better for your health than none", the Guidelines and associated webpage (www.gov.ie/en/publication/16d3c-keeping-active/) provide examples of activities suitable for people of all ages and ability level – including older people and those with disabilities.[110]

Good Food for all Stages of Life

Dietary Advice for Parents/Carers of Infants

Breast milk provides the best source of nourishment for the early months of life. Mothers should be encouraged and supported in breast-feeding and may choose to continue to breast-feed as the weaning diet becomes increasingly varied.

Children have high energy needs for growth and development. It is important that from the age of six months, children are introduced to energy-rich foods that are nutritious, such as

cereals, breads, dairy foods, meats, chicken and eggs. Foods from the first four shelves of the Food Pyramid should be used in preference to foods from the very top shelf that are high in added sugars/fats, such as chocolate, cakes and sweets.[109]

Practical tips:

Foods

Do not add sugar or salt to home prepared weaning foods.

Limit baby foods sweetened with free sugars.

Drinks

Breast milk is the best form of nourishment for young infants. If it is not possible to breast feed, a suitable iron-fortified infant formula should be used. Cow's milk is not advisable for infants under 12-months but is a suitable drink for older infants. Milk is a good source of calcium which is necessary for the development of teeth and bones.

For children allergic to cow's milk, unflavoured, unsweetened fortified soy milk (also called soya milk, soybean milk or soy juice) is the recommended alternative.[111] Soy milk may contain sugar and can cause tooth decay if children are allowed drink when they wish from a feeding bottle. Soy milk should be used as a "feed" and not as a drink.

Plain tap water is a suitable drink for all ages but should be boiled and cooled for infants less than 12 months. Natural mineral/bottled waters are not suitable for infants because some contain high levels of sodium or other minerals. Fruit juices should be unsweetened, well diluted (1 measure to 4 or 5 measures of water) and given only at mealtimes from a cup. Baby juices and herbal drinks, which are often high in sugars content are not necessary. If given, they should be used sparingly and only at mealtimes from a cup.

Colas, squashes, fizzy drinks and diet drinks are unsuitable for infants as they are acidic and cause erosive tooth wear. Such drinks have no nutritional value.

Foods should never be added to the baby bottle as babies can choke on the added food.[112]

Early Childhood Caries (ECC)

Parents/carers of infants should be advised about the dangers of putting fruit juices and sugar-sweetened drinks into feeding bottles or reservoir feeders and giving these to the baby/toddler, especially when they are being put to bed. Such practices result in almost continuous bathing of the teeth with sugars and lead to severe and rapid tooth destruction – a condition described as Early Childhood Caries (ECC). Any sign of tooth decay in a child under the age of 3 years is described as Severe Early Childhood Caries (S-ECC) and should be brought to the attention of a dentist.[113, 114]

School Children/Adolescents

Children aged 5 and over should eat like the rest of the family. As children grow they can have big appetites and it is important to ensure that they are eating as recommended from the shelves of the food pyramid, along with keeping up their water intake as recommended.[115] The Safefood website provides extremely helpful

Free sugars are simple sugars added by the manufacturer or consumer. They are also sugars that are naturally present in honey, syrups, and fruit juices. These are different to those found in natural foods such as milk-sugar lactose, found naturally in milk, milk products and fructose (fruit sugar) found naturally in whole fruits.

www.diabetes.ie/what-are-free-sugars

Children should be fed and put to bed — NOT put to bed and fed"

Figure 42

suggestions on choice of food snacks and fluid intake.[115]

Adults and Older people

Loss of natural teeth is associated with poor nutritional status in older people. Consumption of sugars seems to be higher in older adults than in younger adults. A tendency towards reduced salivary flow among older people (because of many prescription medicines which

have the side effect of a reduced salivary flow rate), together with a higher sugar intake and gum recession, places the older person with natural teeth at high risk of developing tooth decay, particularly decay of the roots of the tooth. In addition, many over-the-counter medicines, e.g., cough drops, laxatives, antacids and various tonics, which are generally high in sugar, may be used in the older population. Use of alternatives, free of sugars,, which are now available for many of these over-the-counter remedies, is recommended to help reduce the risk of tooth decay. Dietary and nutritional advice on oral and general health for adults with natural teeth should be consistent, ensuring that each individual has the opportunity for optimal general/systemic and oral health.

Practical tips:

Foods

Older people should be encouraged to snack on a wide variety of healthy foods with high nutrient density (e.g., bananas, berries, yoghurt, nuts, seeds, eggs, vegetable soup, wholegrain sandwiches), and limit foods from the top level of the Food Pyramid that are high in sugar and fats but low in nutrients, such as cakes, sweet biscuits and soft drinks.[108, 116]

Drinks

The consumption of 8–10 cups/glasses or about 2–2.5 litres of fluid a day is important for older people, as the body is less able to sense dehydration with advanced age.[117]

Nutritional Advice

Oral Health vs Heart Health

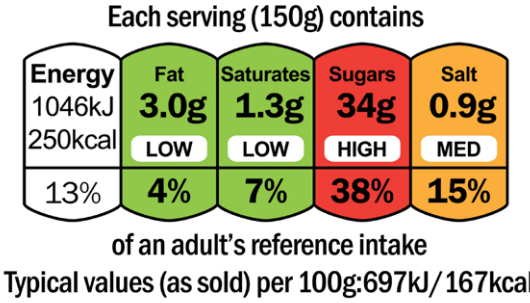
One of the key issues in nutritional advice relating to good oral health is that the oral health message focuses on limiting the intake of sugar-containing foods, whereas for heart health the focus is on lowering fat intake. There is no evidence that nutrition advice promotes heart health at the expense of oral health or vice-versa.[116, 117]

Food and Drink Labels

Food and drink labels are intended to enable consumers to make informed nutritional choices between different products, and should not carry misleading or false claims. By law in Ireland, food labels should be clear, legible, written in English (or both English and Irish), easy to understand, and without confusing or misleading information. Irish legislation follows the European Union (Provision of Food Information to Consumers) Regulations of 2014.[118] The basic information required on food labels include: name of the product, list of ingredients, quantity of certain ingredients, net quantity, use by or best before dates, place of origin, special storage instructions, instructions for use, name and address of the manufacturer, packer or seller in the European Union, alcoholic strength of beverage with more than 1.2% alcohol. Information on the legislations that govern food labelling in Ireland may be found on the Food and Safety Authority of Ireland website.[119]

Health professionals also have a role to play in raising people's understanding of the nutritional claims on food labels, which can be ambiguous, selective, or prone to misinterpretation. For oral health, it is particularly important to educate the public on how to read and interpret the sugar content of products and to be aware of hidden forms of sugar. Safefood have some very helpful resources available to support the public.[120]

Some products may display a colour coded traffic light label, which indicates green is low in a particular nutrient, amber means medium and red is high in a nutrient. The more green lights a label displays, the healthier the food is.



Low (green) - the best choice
Medium (amber) - okay most of the time
High (red) - only choose occasionally

Figure 43: Colour-coded traffic light label.

The terms "sugarless", "sugar free", "low sugar", and "no added sugar" may only mean that there is no added sucrose in a product. The product may already contain sugars that can be listed as fructose, maltose, dextrose, glucose syrup, molasses, treacle, invert sugar, maltodextrins, maple syrup and honey – these can be cariogenic (have the possibility to cause tooth decay).

An example list of ingredients on a confectionery dessert label

Ingredients: water, fructose, milk chocolate, inulin – vegetable fibre, skimmed milk powder, fat reduced cocoa powder, dried whey, gelatine, hydrogenated vegetable oil, glucose syrup.

Fructose is the second ingredient in the list and immediately signals that this product has a high sugar content. Sugar in the form of glucose syrup is also listed. What is not so evident is that milk chocolate and inulin also contain sugar. Thus, this product has a higher sugar content than is evident at first glance.

Did you know that a carbonated Cola drink contains 50g of sugar per 500 mls (0.5 litres of Cola)?
50g of sugar is equivalent to 12.5 teaspoons (the estimated number of grams of sugars in a teaspoon is 4 grams.
A typical blackcurrant juice drink contains 40g of sugar per 228mls – 40g of sugar is equivalent to 10 teaspoons (40/4 = 10 teaspoons of sugar).
One fromage frais small pot (54g) contains 7gms of sugar – 7gms of sugar is equivalent to 1.75 teaspoons (7/4 = 1.75 teaspoons of sugar).

Nutrition information usually takes the form of a table which provides the amount of energy, protein, carbohydrate and fat per 100g of product, and sometimes also per serving or pack. The information per serving is the most useful when comparing two foods. The sugar content of a product may be assessed by looking at the list of ingredients: the sooner sugar is mentioned on the list, the higher the sugar content of the product.

The WHO recommends reducing the intake of 'free sugars' to below 10% of energy intake at all stages of life. For an average adult (with a calorie intake of 2,000 kcal), 10% is equivalent to no more than 50 grams of sugar per day (about 10 teaspoons). For children, the maximum recommended intake of 'free sugars' – depending on age and gender – is lower. For one- to three-year-old children, 10% of energy intake is equivalent to about 30 grams of sugar a day (about 6 teaspoons). In addition, the WHO considers a further reduction of 'free sugars' intake to below 5% of energy intake (no more than 5 teaspoons of sugar per day for adults) to be a reasonable long-term health policy goal.

Due to growing concern regarding the prevalence of obesity globally, a Food Environment Policy Index (Food EPI) has been created by the INFORMAS group- International Network for Food and Obesity/ NCDs Research, Monitoring and Action Support. This ambitious endeavour has been implemented by creating policies and infrastructure support to drive change in a set list of domains in a number of EU member states. One example which has already been significantly successful is the reformulation of certain own-brand products by some retailers, to reduce added sugar by 20%.[121]

Different names for sugars

- **Dextrose**
- **Fructose**
- **Glucose**
- **Dextrin**
- **Maltodextrin**
- **Maltose**
- **Malt Syrup**
- **High fructose corn syrup**
- **Molasses**
- **Saccharose**
- **Sucrose**
- **Treacle**
- **Saccharin**
- **Agave syrup**
- **Cane juice**
- **Lactose**

Medicines

Traditionally, sugar (sucrose) and sugars have been added to oral medications to help counteract their bitter and unpleasant taste. This can pose a risk of developing tooth decay (caries). Some illnesses may require liquid medication for a long time. Frequent liquid medications can also be taken for common conditions including pain relief, infections, coughs and colds. Sugar-free medicines, where available, may play an important role in the long-term care of such patients. Products that do not contain fructose, glucose or sucrose are listed

as being sugar-free. Preparations containing sweeteners such as hydrogenated glucose syrup, lycasin, maltitol, sorbitol or xylitol are also listed as sugar-free, since there is evidence that they are non-cariogenic. Prescription of long-term medications should be consistently reviewed as the individual ages.

It is more widely recognised that certain medications can cause a reduction in salivary flow which further increases the risk of tooth decay. For patients on medications with such side effects, or older adult patients on a high number of medications, the patient should be asked about symptoms of xerostomia (dry mouth), and advised concordantly following consultation with relevant health professionals.[122]

Chapter 5
Oral Health Products

A wide variety of oral healthcare products are available to consumers for over-the-counter (OTC) sale, and include:

- Toothpastes
- Toothbrushes
- Mouth rinses
- Interdental cleaning tools
- Denture cleansers and fixatives
- Saliva substitutes

Both toothpaste and mouth rinse products contain therapeutic agents designed to control various diseases and conditions of the mouth such as dental decay, gum diseases, erosive tooth wear, tartar, and tooth hypersensitivity. Toothbrushes and the different interdental cleaning accessories are primarily designed for the mechanical removal of plaque. Despite a decline in the number of people having teeth extracted, there is still a sizeable market for denture cleansers and denture fixatives. A dry mouth or the feeling of a dry mouth is a problem for many people, particularly those in the older age bracket, or those taking multiple medications – hence the increasing market for saliva substitutes.

Toothpastes

What is in Toothpaste?

Toothpastes are the most widely used oral healthcare product, and there is considerable choice available to the consumer. Toothpaste type ranges from products for all the family that are designed to prevent tooth decay, remove plaque and prevent tartar build-up, to specific formulations for sensitive teeth, products for smokers, special children's formulations and tooth whitening pastes. Toothpaste ingredients are usually shown on packs as 'w/w' (weight for weight) or grams per 100 grams. Under new European cosmetics legislation, toothpastes are required to list all ingredients.[123,124] The following list provides the ingredients and proportion typically present in toothpaste:

- Abrasives (30-33%)
- Detergent (1–2%)
- Binding agents (1%)
- Humectants (10–30%)
- Flavouring, sweetening and colouring agents (1–5%)
- Preservatives (0.05–0.50%)
- Fluoride
- Therapeutic agents
- Water

Abrasives

These cleaning and polishing agents account for about a third of toothpaste by weight. Most of the abrasives used are chalk or silica based. Examples are dicalcium phosphate, sodium metaphosphate, sodium bicarbonate, calcium carbonate, silica, zirconium silicate or calcium pyrophosphate. Abrasives differ. An international standard defines a test paste against which toothpaste abrasivity can be assessed, but there is no system for ensuring that all toothpastes sold in the Republic of Ireland are at or below the maximum recommended abrasivity level. The unit of measurement is known as the Relative Dentine Abrasivity (RDA) or the Relative Enamel Abrasivity (REA). The RDA is measured on a scale from 0 to 250. Toothpaste in the range 0 to 70 is considered to be of low abrasivity. Individuals who are advised by their dental professional that they have erosive tooth wear should consider using a toothpaste with a low relative dentine abrasitivity.

Detergents (1–2%)

This makes toothpaste foam and helps to distribute it around the mouth. Detergents lower surface tension and loosen plaque and other debris from the tooth surface. Principal examples are sodium lauryl sulphate (SLS) and sodium N-lauroyl sarcosinate. Some individuals may have a contact irritation to SLS in toothpaste, reporting a burning or spicy sensation. Toothpaste without SLS can be purchased when this is the case.

Binding agents (1%)

These agents prevent separation of solid and liquid ingredients during storage. They are usually derived from cellulose, sodium carboxy-methyl cellulose being the most commonly used. Carrageenins (seaweed derived), xantham gums, and alginates are also used.

Humectants (10–30%)

Humectants act to retain moisture and prevent the toothpaste from hardening on exposure to air. Glycerol, sorbitol and propylene glycol are commonly used. Glycerol and sorbitol also sweeten the toothpaste, though this is not their main function.

Flavouring, sweetening and colouring agents (1–5%)

Xylitol is a sugar alcohol which has both sweetening and anti-cariogenic properties. Peppermint, spearmint, cinnamon, wintergreen and menthol are among the many different flavourings added to toothpastes. While mucosal irritations from toothpaste are rare, such irritations (i.e., ulceration, gingivitis, angular cheilitis, perioral dermatitis) are usually linked to flavourings, preservatives, or SLS. Unflavoured toothpastes are now available, which may appeal to individuals identified with Autism Spectrum Disorder (ASD).

Homeopathic toothpastes tend to avoid mint because of interactions with other homeopathic remedies; however, they also often exclude fluoride, which means the caries preventive effect is lost.

Preservatives (0.05–0.5%)

Alcohols, benzoates, formaldehyde and dichlorinated phenols are added to prevent bacterial growth on the organic binders and humectants.

Fluoride and other therapeutic agents: Active ingredients may have antibacterial, biomimetic or anti-cariogenic properties and are added to enhance the efficacy of toothpastes. Examples of which include Hydroxyapatite Ca5(PO4)3(OH), allantoin, hyaluronic acid, bisabolol, zinc and lactoferrin. The majority of toothpastes combine the caries preventive effect of fluoride with other agents to control plaque, tartar and periodontal diseases. The inclusion of antibacterial agents can help individuals improve their plaque control. Many toothpastes include triclosan, which has been shown to offer a clinically useful improvement in gum health. Other pastes specifically target 'tartar' (hardened plaque) and use pyrosphosphate to inhibit the mineralisation of dental plaque and hence the build-up of tartar (calculus).[125]

Fluoride Toothpastes

Fluoride toothpastes make up more than 95% of all toothpaste sales.[28] It is well recognised that the decline in the prevalence of tooth decay recorded in most industrialised countries over the past 50 years can be attributed mainly to the widespread use of toothpastes that contain fluoride. Investigations into the effectiveness of adding fluoride to toothpaste have been carried out since 1945 and cover a wide range of active ingredients in various abrasive formulations. Fluoride compounds and their combinations which have been tested for the control of tooth decay include sodium fluoride, stannous fluoride, sodium monofluorophosphate and amine fluoride. The most widely used fluoride compounds in the Republic of Ireland are sodium fluoride and sodium monofluorophosphate.

Amount of fluoride in toothpaste

The amount of fluoride contained in fluoride toothpaste should be indicated on the toothpaste tube, although this information may sometimes be hard to locate. It may appear under "Active ingredient" or as a component under "Ingredients" on the toothpaste tube. Whereas previously fluoride content was given as a percent of volume (% w/v) or weight (% w/w), it is now accepted that the best method is to quote the amount of fluoride as "parts per million" fluoride (ppm F). Most manufacturers now indicate fluoride content in ppm F.

Under EU Directive 76/768/EEC and updated New EU Cosmetic Products Regulation (EC) No 1223/2009, toothpastes are classified as cosmetic products.[123,124] These EU Directives prohibit the marketing of cosmetic products (including toothpastes) with over-the-counter levels of fluoride greater than 1500 ppm F.

At present, most toothpastes in Ireland contain 1000–1500 ppm F (0,1 to 0,15 % fluoride). By regulation toothpaste that contains between 0,1 to 0,15 % fluoride, unless already labelled as contra-indicated for children (e.g. 'for adult use only'), must include the following labelling 'Children of 6 years and younger: Use a pea sized amount for supervised brushing to minimize swallowing. In case of intake of fluoride from other sources consult a dentist or doctor'.[124] There are some newer toothpastes being trialed that contain hydroxyapatite the mineral present in enamel, dentine and cementum, the inclusion is to support tooth remineralisation.[126]

For patients with high caries risk, toothpaste with higher fluoride concentrations of 2500 or 5000 ppm F may be prescribed for daily or weekly use. This should be reviewed at recall appointments and prescription refilled, as necessary.[127]

The Dental Health Foundation has recognised and promoted the benefits of "spit don't rinse" in the understanding that leaving a residual amount of fluoride toothpaste in the mouth following brushing allows the fluoride to have a longer lasting effect in caries prevention.
Fluoride toothpaste use in children: Infants and young children up to approximately age 7-years swallow most – if not all – of the toothpaste when brushing, therefore there has been concern that using toothpastes containing more than 1000 ppm F could give rise to dental fluorosis of the front permanent incisors. Under EU Directive 76/768/EEC, it is a legal requirement (effective 19 January 2009) for any toothpaste containing 1000–1500 ppm F sold in Ireland, unless already labeled as contra-indicated for children (e.g., "for adult use only"), to carry the following labelling: "Children of 6 years and younger: Use a pea sized amount for supervised brushing to minimize swallowing. In case of intake of fluoride from other sources consult a dentist or doctor."[124]

Enamel fluorosis is a condition which can vary from minor white spots to unsightly yellow/brown discolouration of the enamel. Recent survey results in the Republic of Ireland suggest that the majority of cases involve very slight changes, and are not a source of concern. Nevertheless, some manufacturers have begun marketing low fluoride "children's" or "paediatric" toothpastes containing less than 600 ppm fluoride. A number of systematic reviews have shown that low fluoride toothpastes (containing 250 ppm F) are less effective than toothpastes with the standard 1000–1500 ppm F at preventing caries in permanent teeth.[128] The effectiveness of these low fluoride toothpastes in preventing caries has not been established.

Recommendations on fluoride toothpaste use in children were produced by the Expert Body on Fluorides and Health (2004-2022). These recommendations aim to minimise the risk of fluorosis from fluoride toothpaste while maximising its caries-preventive benefits. These recommendations can be found in Chapter 2 – Oral Health & Disease Prevention.
It is of note that in October 2021, the World Health Organisation added fluoride toothpaste (1000-1500 ppm) to its list of Essential Medicines. This designation emphasises the importance of fluoride in the prevention of tooth decay, and the importance of oral health to general health.[129, 130]

Types of Toothpaste

The 'all in one' toothpaste (often referred to as 'family' toothpaste) usually contains a combination of agents to reduce tartar formation, improve gum health and prevent tooth decay. It is important to verify that the effectiveness of toothpastes advertising improved or new formulations have been 'clinically proven', by seeking information from dental public health personnel engaged in research and appraisal of the literature.

Toothpaste advertised for Smokers

People who smoke often suffer stained teeth

because of tar deposits. Some brands have marketed "smokers' toothpaste" which uses stronger abrasives to remove these stains. Vigorous brushing with more abrasive pastes may abrade and wear away the enamel and dentine of the tooth.

Toothpaste and Tooth Hyper-Sensitivity

One of the consequences of ageing or long-term vigorous brushing with a firm toothbrush is that gum margins may recede, exposing the root surface of certain teeth, which in some instances result in hypersensitivity and pain – for example, when eating an ice cream or drinking cold drinks. Toothpaste specifically formulated for sensitive teeth can be effective in relieving the pain. Toothpastes to manage dental hypersensitivity act in different ways: some occlude the exposed tubules in dentine with active ingredients such as hydroxyapatite, arginine, strontium and calcium sodium phosphosilicate, while others contain potassium compounds to alter the pulpal nerve response to stimuli and thereby reduce symptoms. However further research is needed to confirm their efficacy.[131]

Whitening toothpaste

These pastes are promoted mainly for cosmetic benefit. The market for these pastes is likely to continue growing due to heightened societal awareness of and emphasis on presenting a positive and flawless self-image. Rising standards in population oral health and expectations, along with a rise in population numbers retaining their natural teeth into later life is also a driver for the rise in use of whitening toothpaste.

Some whitening toothpastes use fluoride and an enzyme system, while others rely on abrasives to remove staining. A relatively new ingredient which has been shown to aid the appearance of whiter teeth is blue covarine- this is a silica-based product which deposits onto the tooth surface, with little to no risk of abrasion or damage, and alters the appearance of tooth shade due to its optical properties.[132]

Whitening toothpastes are not to be confused with professional hydrogen (or carbamide) peroxide whitening systems designed for application by a dentist or initiated by a dentist.[133]

Natural/ herbal/ vegan toothpaste

There is a growing range of 'natural' or 'herbal' toothpaste products available nowadays. These may contain essential oils, seaweed extract, propolis and much else. It is important to check if these contain fluoride. Another problem with some 'natural' toothpastes is that their abrasive agents may have a low or high Relative Dentine Abrasion (RDA) leading to insufficient or excessive abrasiveness. Studies have shown a reduction in the removal of dental plaque following brushing with herbal toothpastes, compared with mainstream fluoridated toothpastes, and results of many trials of alternative or herbal versions are conflicting.[134]

With the rising trend of veganism, companies are looking to create products for this demand. Some commercial toothpaste companies now offer 'natural' toothpastes in some countries exhibiting flavours such as aloe vera, hemp seed oil, and charcoal. Products are now available in tubes that can be recycled or refilled. During COVID-19 lockdown periods, it became fashionable to attempt at-home toothpaste recipes using household ingredients such as

coconut oil, bicarbonate of soda and essential oils, an activity not to be recommended.[135] Toothpaste powder has had a resurgence in use and can also be found in toothpaste tablet form, although most of these products available do not contain fluoride and have little supporting evidence to prove effectiveness in maintaining oral health.

Health professionals must be aware of changing trends in toothpaste composition, so that they can advise patients on usage, estimated efficacy and potential risks of new or homemade products.

Toothbrushes

Manufacturers are producing a greater variety of both manual and electric toothbrushes incorporating different designs for handles, heads and bristles.

For manual brushes, the dental profession currently recommends the following: for children, a small toothbrush head, approximately 20mm X 10mm seems most suitable; for adults, the toothbrush head can be slightly larger, approximately 22–28mm x 10–13mm. Small-headed toothbrushes give better access to the back of the mouth. Nylon filaments are recommended because of their better physical properties and standardisation; the recommended diameter is 0.15–0.20 mm to give a soft to medium texture. Multi-tufted brushes are best. A general guide is that the size of the brush should be selected to suit mouth size, with smaller brushes being more suited to smaller mouths. Whether straight handles or angled handles are used is a matter of personal preference. People who find difficulty cleaning their back teeth may find it easier using an angled brush; in any case the best brush is the one that enables the user to clean their teeth thoroughly without causing trauma. Soft bristles are recommended for all patients.

A comprehensive assessment of systematic reviews and clinical trials has shown that electric (circular oscillating) and ultrasonic (vibrating) toothbrushes are superior at removing dental plaque in the short term than manual toothbrushes. The clinical meaning of this is not yet clear.[60] Benefits may be associated with the generation of more efficient brushing motions. Additional features to help the user improve their technique by highlighting areas missed, guiding the amount of pressure (pressure sensors), and aiding time allocation for brushing, may also convey a benefit. These toothbrushes may be re-chargeable or battery operated and can be particularly useful for people who have difficulty holding and manouvering an ordinary toothbrush, such as persons with poor motor control or a physical disability.

While studies to show causality of gingival recession from overbrushing remain inconclusive, signs for this should be monitored at regular oral health assessment and check-up visits.

The environmental impact of toothbrushes is now an area in which research is focussed.[136] Toothbrushes made of sustainable or biodegradable materials are becoming more widely available.

Figure 44: Specialised Toothbrushes.

The frequency with which toothbrushes or toothbrush heads are replaced has yet to be correlated with oral health. The most helpful guide is to replace a toothbrush when the bristles begin to show signs of wear. Toothbrush handles can also be adapted to improve the grip by the user in case of disability or reduced dexterity.

- **Toothbrushes should be replaced when bristles show signs of wearing**
- **Brushing is more effective with multi-tufted, small-headed toothbrushes with soft nylon filaments and a comfortable handle**
- **Powered brushes with an oscillating/rotating action are more effective at removing plaque than conventional brushes**

Mouth Rinses

Over the past three decades there has been a dramatic increase in over-the-counter sales of mouth rinse. In particular, teenagers and young adults are purchasing these products, as mouth rinsing has become part of the normal grooming process. From a health promotion point of view, this is a welcome trend since most of the mouth rinses sold contain therapeutic agents to control various oral health conditions such as amount of dental plaque, gum disease, tooth decay, bad breath, and tooth stain.

Mouth Rinse Containing Fluoride to Control Dental Caries

Fluoride mouth rinse has been used for many decades for the control of dental caries. Initially, these were used mainly within dental public health programmes, such as daily, weekly or fortnightly mouth rinse programmes using 0.05% or 0.2% sodium fluoride. Over the last three decades, over-the-counter sales of mouth rinses containing fluoride (usually 0.05% NaF) have increased. This is a welcome development since a high proportion of sales are to teenagers and young adults, who are the most prone to frequent snacking on sweet foods and drinks between meals and are also the group often wearing orthodontic appliances (braces).

Some school-based mouth rinse programmes continue in the Republic of Ireland. Indeed, one of the longest running school-based programmes in the world is conducted in non-fluoridated areas of Co. Waterford. This programme commenced in the late 1960s and has been shown to be effective in the control of dental caries.[137] There is support for the reintroduction of targeted fluoride mouth rinse

programmes for children over 6 years of age.[20] Again, echoing the ethos of "spit don't rinse", it is advised to use mouth rinse at a different time to brushing to retain the benefits of each.

- **Mouth rinse containing fluoride is effective in the control of dental caries/tooth decay and is particularly useful for those wearing orthodontic appliances**
- **Fluoride mouth rinse should be used at a different time to brushing with a fluoride toothpaste, to increase the frequency and maximise the benefits of fluoride use**
- **Mouth rinse is available for the control of gum disease/ gingivitis**
- **Many choose a mouth rinse to freshen their breath**

Mouth Rinse to Control Plaque and Gingivitis

Toothbrushing alone does not sufficiently control plaque and gingivitis, but adjunctive use of mouthrinse specifically formulated for this purpose can be advantageous. The most effective rinses contain chlorhexidine. This type of rinse is generally recommended for people who have acute gum problems. Long term use (more than 3–4 weeks) is not advised because it affects the oral flora and can alter the sense of taste. Also, the teeth may develop a brownish stain, although this can be easily removed with ultrasonic scaling. The modes of action and effectiveness of mouth rinse in general are continually being reviewed. Mouth rinse containing essential oils and other ingredients can control plaque and improve gum health. In general, these are not as effective as rinses with chlorhexidine, but they have the benefit of not staining the teeth and can be used on a regular basis.

Mouth Rinse containing Alcohol

Some mouth rinses contain a significant amount, up to 27% by volume of alcohol. Alcohol provides an antibacterial effect, acts as a carrier of flavour and adds "zing" to the mouth rinse. Alcohol consumption is a well-known risk factor for oral cancer. Due to concerns regarding the possible carcinogenic effect of alcohol in mouth rinse, sporadic studies have been carried out over the last three decades to investigate the issue. While it remains difficult to prove individual causality, there has been an indication that use of alcohol containing mouthrinse can increase the risk of malignancy in combination with other carcinogenic risk factors.[138]

Many alcohol-free mouth rinses are available on the market: the available research, although limited, suggests their efficacy and effectiveness.[139, 140]

Casein Phosphopeptide Amorphous Calcium Phosphate CPP-ACP

Casein phosphopeptide amorphous calcium phosphate CPP-ACP is a group of naturally

occurring milk peptides which has transformational properties in fighting tooth decay. Used in toothpastes, mouth rinse, chewing gum and sprays, it facilitates the remineralisation of white spot enamel lesions, and can inhibit demineralisation while also enhancing the actions of fluoride. Further studies are required to evaluate its long-term benefits.[141]

Interdental Cleaning Aids

Even the most efficient toothbrushing technique would not result in removal of all plaque deposits. Whilst use of a mouth rinse will help in further plaque control, use of dental floss and interdental brushes (shaped like tiny bottle-brushes) are recommended by oral health professionals. These cleaning aids are particularly important for patients where plaque accumulation may be a problem, e.g., patients with dental overcrowding, extensive fillings, crowns or bridges, orthodontic patients, or patients with periodontal problems. Interdental cleaning aids are not generally recommended for children as they may damage their gums by incorrect usage.

Enthusiasm for the use of dental floss has been limited, thankfully a modern alternative which has been positively received by many patients is the water flosser. This is a rechargeable or battery-operated device which shoots a stream of water/diluted mouth rinse between the teeth to remove food debris and plaque. Some studies have demonstrated its effectiveness in reducing gingivitis.[142] A member of the dental team can help the patient choose the best product suitable for their oral health needs.

Sugar-free Chewing Gum

Sugar-free chewing gum, for example gum containing xylitol, can be of benefit as an in-between-meals cleanser of food particles, particularly when brushing is not possible. There are studies to show the benefits of chewing sugar-free gum between meals to help increase salivary flow, thereby allowing clearance of food particles; facilitate a faster return to neutral oral pH; and even boost remineralsiation.[32,143] A discussion with your oral health professional about the use of sugar free gums can assist.

Disclosing Tablets

It is important to encourage people to monitor the effectiveness of their plaque control practices. Disclosing tablets stain the dental plaque which remains on teeth after oral hygiene activities such as toothbrushing and flossing. They are a straightforward way of highlighting deficiencies in plaque removal techniques.

Denture Cleaners and Fixatives/Adhesives

Many people used to think that once they lost all their natural teeth their dental worries were over. This is not the case. When teeth are extracted, the bone that held them in the jaw resorbs (shrinks), so that the bony support for dentures constantly changes. This is a problem particularly in the lower jaw, where extensive bone loss can occur, making it difficult for some people to control their lower denture. Hence, dentures should be checked approximately every five years. As bone in the

Figure 45: Interdental cleaning brushes.

mouth constantly changes in shape, individuals cannot expect a set of dentures to last for life. Home-use denture repair kits and relining kits to make dentures fit more comfortably are not recommended. Temporary repair kits are sometimes useful to mend fractured dentures in an emergency, but broken dentures are best mended by the dentist, or dental technician working in association with a dentist or clinical dental technician.

Dentures should be cleaned at least once a day with a non-abrasive denture cleansing product. A soft nail brush is a useful alternative for people whose manual dexterity is compromised, if a manual denture cleaning brush cannot used. Soaking the dentures once or twice a week in a diluted 2% sodium hypochlorite solution will help keep them clean, but they must not be soaked in hot water. Disinfectants containing bleach should not be used on dentures with any metal components.

Dentures should be removed before sleeping and kept out of the mouth for six to eight hours each day to give the gums a chance to rest.

Figure 46: Teeth with plaque before using a disclosing tablet.

Figure 47: Teeth with plaque after using a disclosing tablet.

Saliva Substitutes

One of the side effects of many drugs and a problem encountered by many older adults is xerostomia or dry mouth. Medical treatments such as chemotherapy and radiotherapy can cause long term or even irreversible dry mouth. People with dry mouth can experience severe discomfort and considerable difficulty with eating and speaking. Those with a reduced natural dentition are hampered by unsuccessful wearing of dentures due to lack of cohesion for the denture, or increased sensitivity of the gums. Some people get relief by keeping a bottle of water at hand to sip as required. This can be beneficial in the prevention of dental caries if fluoridated water is used. If drinks containing sugar are used, tooth decay will

occur very quickly. The acidic nature of lemon juice can stimulate saliva flow, but the acid can result in erosive tooth wear for those who still have natural teeth present. In more mild cases, regular use of sugar-free chewing gum can give considerable relief by stimulating salivary flow.[143]

Another useful way to help with the discomfort of xerostomia or a dry mouth is to recommend one of the artificial saliva preparations or oral lubricants. One example of a product range suitable for those with dry mouth contains mouthrinse, toothpaste, and an oral lubricant. Saliva substitutes can be useful if used just before eating, at night if a person wakes because of dry mouth, or first thing in the morning. A saliva substitute or oral lubricant that has a neutral pH is best for use by people with teeth as an acidic product could lead to erosive tooth wear. Inclusion of fluoride could also have potential benefits.

- **Dry mouth results from a number of diseases and is a side effect of many drugs, it can give rise to considerable discomfort**
- **Various saliva substitutes or oral lubricants are now available and can give considerable relief**
- **Sugar-free gum can be useful to stimulate salivary flow where there is some residual gland function**
- **See also the Sections on Saliva (page 18) and the section on Dry mouth (page 38)**

Chapter 6
Sustainability in Dentistry

Sustainability and the protection of the environment are topical in all aspects of life and living and very much play a significant role in dentistry. Dentistry must also consider its impact on planetary health. For example, the practice of modern dentistry and the protection of patients from infection and cross-infection results in an unfortunate, but essential and significant generation of single-use products.

For several decades, single-use instruments and materials have been the norm. Single use instruments ensure patient safety, the reduction of cross-contamination risk, and save both time and costs associated with cleaning, decontaminating, sterilising, and reprocessing instruments. Regrettably, the use of single-use instruments results in the generation of substantial amounts of packaging and instruments for disposal. That said, the practice of sterilisation also has a toll on the global environment. Measures to mitigate the high energy usage, voluminous consumption of water, rapid generation of waste matter including hazardous chemicals and pollutants, must be to the fore.[144] This impact on the environment is now an area of growing research interest, examining opportunities to protect populations, and the planet. [145] As the burden of climate change has become better acknowledged and understood, populations in developed countries are demanding change, the medical and dental professions are making an effort to embrace sustainability with practices that in addition to being ethical, of high quality and safe, endeavour to be environmentally sustainable.[144] There is an optimism in the scope in which efforts can be made to move towards sustainability in dentistry, from small-scale practices like reduce-reuse-recycle and in considering public transport for commuting to the dental clinic,[146] to more significant actions such as how dental materials are created, used and disposed of. Change at every level is necessary. [147] Addressing the burden of climate change and promoting sustainable practices will require collaboration and innovation – not only in knowledge but also in education, research, and care systems.

In dentistry, environmental sustainability can be broadly considered under the headings of Prevention, Travel, Energy, Procurement (purchasing and acquisitions), Waste Management and Decontamination (infection prevention and control in the dental clinic).

Prevention

The prevention of oral diseases, including tooth decay, gum diseases and oral cancer, is more sustainable than their treatment , emphasising once again the importance of the 'Common Risk Factor Approach' [29, 83] and 'Making Every Contact Count'.[28]

Travel

Patient and staff travel contribute to the carbon footprint of dentistry and may also negatively impact health, through particulate matter inhalation.[146] The 'Cycle to Work' scheme which is available across Ireland could be an adoption to be considered.[148] The use of virtual meeting tools for consultations, staff training or meetings are opportunities to reduce travel.[146] Further research is needed to increase the ability to monitor patient's oral health virtually.[146]

Energy

When aiming to reduce energy footprint it is important to measure current consumption (e.g. using energy monitoring devices) and develop minimisation strategies. This may include using insulation, double/triple glazing, installing timers and thermostats and investigating alternatives to air conditioning.[146] When purchasing new equipment, the energy use should be evaluated as should the use of renewable energy from solar panels or wind energy.[146] Whilst some of these changes require investment, many can result in both environmental and financial savings.[146]

Procurement

The products and equipment used daily in the delivery of dental care contribute to the environmental impact of dentistry and sustainable strategies include buying less, buying better, patient education and collaboration with suppliers and industry.[146] Buying less may involve the use of less single use items, and improved stock control with expiry dates checked regularly. Buying better could involve identifying suppliers with sustainable policies and practices, consideration of suppliers packaging, and purchasing products made with renewed energy.[146] The way that goods are procured, and the emissions associated with their transportation should be prioritised, as should using local dental suppliers and laboratories.[146]

Waste

Like all areas of healthcare, dentistry must transition to a circular economy, embracing zero waste lower environmental impact concepts.[146] Reducing clinical waste should be prioritised; this may necessitate a waste management strategy (appropriate waste segregation) and undertaking a waste audit. Recycling of healthcare waste can help minimise environmental impact, as can the use and maintenance of reusable and durable equipment.[146]

Decontamination

To ensure patient safety, infection prevention and control is paramount in dentistry, and involves cleaning, disinfection, and sterilisation.[146] However, it is important to balance the safety of patients within the healthcare setting, whilst minimising the environmental impact. To facilitate this a common-sense approach is needed, with appropriate research to ensure activities being undertaken are maximised and efficient.

Figure 49

Figure 48: United Nations 17 Sustainable Goals.

The United Nations Sustainable Development Goals (UN SDG)

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are 17 Sustainable Development Goals (SDGs). [10] These goals with their associated targets are an urgent call for action by all countries – developed and developing through global partnership. [10] The UN SDGs recognise that ending poverty and other deprivations must go together with strategies that improve health and education, reduce inequality, and spur economic growth, while also tackling climate change and working to preserve the oceans and forests. [10] Of the 17 goals identified, seven can be applied within dentistry, namely: 3. Good health and well-being, 4. Quality education, 6. Clean Water and Sanitation, 9. Industry, innovation, and infrastructure, 10. Reduced inequalities, 12. Responsible consumption and production, 13. Climate action, and 17. Partnerships for the goals.[10]

The World Dental Federation (FDI) has also outlined its ambitions for sustainability in the dental industry with three goals: increased awareness on the importance of sustainability in dentistry, creation of a guide for dental professionals on actions that can be taken, and a review process to assess current directives and any gaps in progress.[147] Documents such as Standard Practice for Managing Sustainability in Practice are available to support the Dental Industry.[149]

One eco-conscious shift which is evident in the dental surgery is the significant reduction in usage of dental amalgam as a material in the last number of years. Historically, dental amalgam was used by dentists for over one hundred years as the material of choice for dental fillings in back teeth and in the preparation of a core to hold a dental crown. The durability, ease of use, and bacteriostatic properties made it a popular choice globally.[150] Following the 2013 establishment of the Minamata Convention on Mercury, there is recognition of its detrimental

effects on the environment. [35] There are now 137 member states which have committed to a phase down in usage of mercury a constituent of dental amalgam.[35] Studies have been conducted on alternative materials which can be used in place of amalgam, and while some show less success with respect to longevity than dental amalgam, further progress is underway.[150,151] The European Union (Mercury) Regulations 33, were adopted, by Ireland to uphold the goals of the Convention, and it provides an ambitious roadmap towards the phase-out of industrial mercury.[33] Article 10 of the Regulations sets out the rules relating to dental amalgam and includes an obligation to produce a National Plan by 1 July 2019, on the phase down of dental amalgam.[36]

In Ireland, 71% of the population receive community water fluoridation (CWF) as a caries preventive effect.[152] This has been demonstrated as not only cost-effective,[153] it has also performed well in a Life Cycle Analysis (LCA) study in all measures of environmental sustainability when compared with other community-level interventions for the prevention of dental caries in children (such as fluoride varnish in schools, supervised toothbrushing in schools, the provision of toothbrushes and toothpaste).[154] Sustainability is increasingly important in Dentistry and as the agenda moves forward so too should all aspects of Dentistry to ensure that achieving optimal oral health for all is aligned with protecting the planet and its people and activities identified against the UNSDG and targets.[10]

Conclusion

The preceding chapters of this handbook on oral health in Ireland for health professionals have updated editions one and two. In each chapter the reader is provided with the most current and appropriate information with respect to oral health. The intention of the handbook is to emphasise how oral health is integral to general health and vice versa and that health professionals can work together to support each other in their respective roles. Opportunities throughout the handbook are provided to demonstrate the overlap and common risk factors for both oral and general health diseases/conditions. Recent publications such as the WHO global oral health action plan and EU platform for better oral health are indicative of opportunities on the horizon for shared knowledge and work practices. We acknowledge the sharing of resources that contributes to better general and oral health such as those provided by the Health Service Executive and the Dental Health Foundation Ireland.

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Glossary of Terms

Abscess	Acute or long-term localised inflammation resulting in the collection of pus under pressure. A dental abscess may be caused by severe tooth decay, dental trauma, or gum disease and will be characterised by swelling and often pain.
Amalgam	Amalgam is a mixture of metals used to fill holes in teeth caused by tooth decay. Often referred to as a 'silver filling'.
Amelogenesis Imperfecta	A congenital disorder which presents with a rare abnormal formation of the enamel or external layer of the teeth, unrelated to any systemic or generalised conditions.
Anaesthesia	A state of controlled, temporary loss of sensation or awareness that is induced for medical or dental purposes.
Bridge	A fixed appliance (prosthesis) that replaces missing teeth. A bridge is a series of crowns (abutments and pontics).
Bruxism	Clenching or grinding of the teeth.
Bone modifying agents (BMA)	A variety of medications and therapeutic agents that prevent or treat damage from the spread of cancer to bones in patients with cancer or in the early stages of osteoporosis.
Canal	The narrow chamber inside the root of the tooth that contains the nerve and blood vessels.
Canker Sore	Also called aphthous ulcers, are small, shallow lesions that develop on the soft tissues in your mouth or at the base of your gums.
Canine	The third tooth from the centre of the mouth to the back of the mouth. Also known as the 'eye tooth'; These are the front teeth that have one rounded or pointed edge used for biting.
Caries	The clinical name for tooth decay.
Carious lesion	A cavity/hole caused by caries.
Chlorhexidine	An antiseptic and disinfectant. It helps reduce the number of germs (bacteria) in the mouth or on the skin.
Composite (resin) Restoration	A dental restorative material. Also referred to as a "white filling".

Cortisol	Cortisol is a steroid hormone produced by the adrenal glands, which are the endocrine glands on top of your kidneys. Cortisol affects several aspects of your body and mainly helps regulate your body's response to stress.
Crown	A porcelain, gold or metal cover for a decayed, damaged, brittle, or discoloured tooth that has a strong base and roots.
Deciduous Teeth	The baby teeth or primary teeth.
Demineralisation	A process where essential minerals, including calcium and phosphate are removed from the hard, protective layer of tooth enamel or dentine. This process is typically caused by acids produced by bacteria in the mouth, feeding on sugars and carbohydrates from food particles. These acids attack the enamel or dentine, weakening it and leading to the formation of cavities or dental caries. It can also occur with the acids present in some foods and drinks or with reflux from the stomach.
Dental biofilm	Is the presence of bacteria in a sticky white mass on the surface of the teeth. It has the ability to accumulate on the surface of a tooth. Dental biofilm is also known as dental plaque, microbial plaque, oral biofilm, plaque biofilm or bacterial plaque biofilm. It has the potential to cause both tooth decay and gum diseases.
Dental calculus	Dental calculus is calcified dental biofilm, it is composed mostly of calcium phosphate mineral salts that are deposited between and within the microorganisms of dental biofilm.
Dental fluorosis	Presence of milky white lines or spots on the enamel due to the ingestion of fluoride when the teeth are forming.
Dental plaque	Is the presence of bacteria in a sticky white mass on the surface of the teeth. It has the ability to accumulate on the surface of a tooth. Dental plaque is also known as dental biofilm, microbial plaque, oral biofilm, plaque biofilm or bacterial plaque biofilm. It has the potential to cause both tooth decay and gum diseases.
Dental professional / Oral health professional	A health worker and expert who provides care and treatment to promote and restore oral health. These include dentists, dental surgeons, dental assistants, dental auxiliaries, dental hygienists, dental nurses, dental technicians, dental therapists or oral health therapists, and related professionals.

Dental Team	Those who work with the dentist make-up the dental team and include dental nurses, dental hygienists, orthodontic therapists, dental technicians and clinical dental technicians.
Dentinal tubules	Small, hollow microscopic channels that travel from the inside of the tooth out through the dentine, ending right beneath the enamel.
Dentinogenesis Imperfecta	A genetic disorder of tooth development. This condition can cause teeth to be discoloured (most often a blue-grey or yellow-brown colour) and translucent, giving teeth an opalescent sheen.
Denture	A removable appliance (prosthesis) that replaces missing teeth in either the upper or the lower jaw. Usually made of plastic or metal.
Dry Mouth	Dry mouth, also called xerostomia, is the sensation of a dry mouth, with a drop in saliva flow at rest of about 50%.
Enamel	Hard calcified tissue covering dentine of the crown of tooth.
Extraction	The removal of teeth that are severely decayed, broken, lose, or causing crowding.
Floss	To clean between your teeth using a thin thread (Dental Floss) made specifically for this purpose.
Fluoride	Fluoride is a substance that naturally occurs in water sources. It is derived from fluorine, the thirteenth most common element on earth, and is known to help prevent dental caries.
General Anaesthetic	A drug-induced loss of consciousness during which patients are not arousable, even by painful stimulation.
Gingiva	The clinical term used to describe the gums.
Gingivitis	Inflammation of the gums characterised by redness, bleeding and swelling. Also see Gum Disease.
Glass Ionomer	A restorative material that can be used to restore teeth, fill pits and fissures, and cavities.
Gum diseases	Where the gums become red, swollen and sore, and bleed. It is caused by buildup of plaque on the teeth and around the gums or dental implants. The two most common types of gum disease around teeth are gingivitis and periodontitis, around implants it is peri-implant mucositis or peri-implantitis.

Herpes	A viral infection caused by the herpes simplex virus. Herpes infections are categorised by the area of the body that is infected. The two major types of herpes are oral herpes and genital herpes, though other forms also exist.
HPV (Human papillomavirus)	The name of a very common group of viruses, which commonly cause skin or mucous membrane growths (warts).
Implant	A post that is implanted in the jawbone. A crown, bridge or denture may then be retained by the implant.
Incisors	The first and second teeth from the centre of the mouth to the back of the mouth. These are the front teeth with the flat edges for biting and cutting.
Interdental	Between the teeth or for use between the teeth.
Lesion	An injury or wound; area of diseased tissue.
Local Anaesthesia	Relieves the sensation of pain in a localised area.
mg/l (Milligram per litre)	A unit of measurement used to express concentration of a substance in water.
Molar Incisor Hypomineralisation	A type of enamel defect affecting at least one and up to the four first molars often with incisors in the permanent dentition also affected. This condition occurs when the teeth are forming and before they erupt.
Molar Tooth	The back teeth used for grinding food. They have large crowns and broad chewing surfaces.
Mouth Head and Neck Cancer	Cancers that start in the head and neck area. The most common types of head and neck cancer occur on the lips, in the mouth and larynx.
Mouth Ulcer	Breaks or lesions in the tissue lining of mouth, base of gums, inside cheeks or lips, or on the tongue.
Microorganism	An organism of microscopic size, which may exist in its single-celled form or as a colony of cells.
Night Guard	A removable acrylic appliance worn at night to minimise the effects of grinding the teeth (bruxism) or joint problems (T.M.J.).
Oral cancer	Cancer that develops in any of the parts that make up the mouth (oral cavity).

Oral health assessment	A process of examining the head, neck, mouth, teeth and gums to identify any problems or risks.
Oral Surgery	Surgery that takes place in the mouth.
Orthodontic appliance	Devices that help to correct malocclusions, which are problems with the alignment of teeth and jaws.
Over the counter (OTC)	Medication that can be bought without prescription or authorisation from a doctor or other authority.
Palate	Roof of the mouth.
Partial Denture	A removable appliance (prosthesis) that replaces some of the teeth in either the upper or lower jaw.
Periodontal diseases	Gum inflammation and/or bone loss of the soft tissue and bone supporting the tooth.
Periodontium	The periodontium is the specialised tissues that both surround and support the teeth, maintaining them in the maxillary and mandibular bones.
Periodontology	The treatment of diseases of the gum or bone (supporting the tooth).
Periodontal Pocketing	The pocket that forms when the gums detach from the side of the tooth.
Permanent Molars	The adult first, second and third molars, they are the sixth, seventh and eight teeth from the centre of the mouth to the back of the mouth. They have large crowns and broad chewing surfaces.
Plaque	See Dental Plaque.
Pit and Fissure Sealant	A layer of dental material that is professionally applied by the dentist or dental hygienist to the pit and fissure surfaces which provides a mechanical barrier to the accumulation of plaque biofilm in the pits and fissures of the tooth.
ppm	parts per million. A unit used to describe very small concentrations of a substance in a larger solution.
Premolars	The first and second bicuspids, those are the fourth and fifth teeth from the centre of the mouth to the back of the mouth. These are the back teeth that are used for chewing, they only have two points (cusps).
Quadrant	One of the four equal sections of the mouth. The upper right, upper left, lower right and the lower left. Each quadrant has eight teeth.

Republic of Ireland	26 of the 32 counties of the island of Ireland.
Remineralisation	The process by which lost minerals, primarily calcium and phosphate, are restored to the tooth enamel or dentine, helping to repair and strengthen them. This natural process occurs when the pH level in the mouth becomes less acidic and the conditions become favourable for mineral to be replaced.
Restorative	Procedures performed to restore the missing part of the teeth.
Root Canal Treatment (RCT)	Treatment where the nerve of the tooth is removed from the canal inside the root and replaced with a filling material.
Saliva	Watery liquid secreted into the mouth by glands, providing lubrication for chewing and swallowing, and aiding digestion.
Salivary gland	Exocrine glands that produce saliva and empty it into the mouth; these include the parotid glands, the submandibular glands and the sublingual glands and numerous minor salivary glands.
Special needs	Any of various difficulties (such as a physical, emotional, behavioural, learning disability or impairment) that causes an individual to require additional or specialised services or accommodations.
Sugars	Any of numerous sweet, colourless, water-soluble compounds present in the sap of seed plants and the milk of mammals and make up the simplest group of carbohydrates (monosaccharides or disaccharides). The most common of the sugars is sugar also called sucrose, a crystalline tabletop and industrial sweetener used in foods and beverages.
Tartar	Tartar is also referred to as calculus and is calcified dental biofilm, it is composed mostly of calcium phosphate mineral salts that are deposited between and within the microorganisms of dental biofilm.
Tooth decay	Tooth decay, also known as dental decay or dental caries or tooth cavity, is a bacterial infection that causes demineralisation and destruction of the hard tissues (enamel and dentine) of the teeth.
Tooth wear	The progressive loss of a tooth's surface due to actions other than those which cause tooth decay or dental trauma.
Vape	An electronic cigarette (e-cigarette) or vape is a device that simulates tobacco smoking.
Wisdom Teeth	The third molar, this is the eighth tooth from the centre of mouth to the back of the mouth.

WHO	World Health Organisation
WHO Essential Medicine	A group of medicines that are deemed to be of critical importance in any health system.
WHO definition of Free sugars	Free sugars are monosaccharides and disaccharides added to foods and drinks by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates.
Xerogenic	Denotes that which causes dry mouth.

References

https://www.dentalhealth.ie/resources/publications/oral-health-in-ireland-3rd-edition/

Dental Health Foundation Ireland

The Dental Health Foundation Ireland (DHF) is Ireland's only independent charity focused on enhancing oral health and well-being in Ireland. Established by dentists in 1977, the DHF has led the way in promoting oral health and wellbeing, collaborating with the Department of Health, the Health Service Executive, education institutions, the dental sector, and stakeholder and community groups nationwide. www.dentalhealth.ie

The Oral Health Services Research Centre, University College Cork

The Oral Health Services Research Centre, University College Cork is a multidisciplinary team of researchers interested in the promotion of oral health and well-being in Ireland and internationally. Our group represents a wide range of skills and expertise including, but not limited to; Research, Clinical Trials, Oral Health Guidelines, Postgraduate Education, and Publications. These strands are synergistic and provide a stimulating research environment. www.ucc.ie/en/ohsrc

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