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NUTRITION AND ORAL HEALTH

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NUTRITION AND ORAL HEALTH

INFORMATION FOR DENTAL PRACTITIONERS

Nutrition is a complex process that involves ingestion, digestion, absorption, transportation, utilisation, storage and excretion of food or drink to maintain health and wellbeing.^{1,2} Carbohydrates, lipids, proteins, vitamins, minerals and water are the six main nutrients that are obtained from food and are essential for proper functioning of the body.^{1,2}

Investigations into the effects of nutrition on health have been carried out over a long period of time.³⁻⁷

Accordingly, poor diet and nutritional deficiencies have been implicated in increasing the risk of contracting both systemic diseases/conditions such as type 2 diabetes, cardiovascular diseases, cancers, osteoporosis, gastrointestinal disorders, overweight/obesity, hypertension and dyslipidaemia as well as oral diseases including dental caries, periodontal disease and oral cancer.³⁻⁸ Apart from these major oral diseases, a variety of other oral diseases and conditions have been associated with nutritional status.^{4,9}

This information sheet focuses mainly on the impact of nutrition on three major oral diseases including dental caries, periodontal disease and oral cancer while briefly addressing nutritional implications on other oral diseases/conditions as well.

Nutrition and dental caries

Dental caries has been considered as both the most common oral disease, as well as the most prevalent chronic systemic disease, worldwide.⁸ It is well established that microorganisms of dental biofilm metabolize fermentable carbohydrates in the diet, in particular sugars, making acidic by-products. Subsequently, these acidic by-products can demineralise the tooth structure and initiate dental caries development. In this context, it is apparent that nutrition plays a key role in the initiation and progression of dental caries, and consequently, it is worthwhile discussing briefly the impact of sugars, which are considered as the main cause of dental caries.

Sugars and their impact on dental caries

All monosaccharides (e.g. glucose, fructose) and disaccharides (e.g. sucrose, lactose), other than polyols, including sugar-free sweeteners, are regarded as total sugars.¹⁰ Sugars are generally classified as *intrinsic* and *extrinsic* sugars.¹⁰

Intrinsic sugars have sugar molecules held within the cell structure. For example, whole fruits, vegetables and grains have naturally present intrinsic sugars. On the other hand, extrinsic sugars have sugar molecules that are outside the cell structure of the food or added to the food. Accordingly, extrinsic sugars can be further categorised as milk sugars and non-milk extrinsic sugars. Milk sugars, including lactose and galactose, are naturally present in milk and milk products such as cheese and plain yoghurt, which are rich in essential nutrients. Naturally present sugars, including intrinsic sugars of whole fruits, vegetables and grains, as well as milk sugars (extrinsic) are less cariogenic and have health benefits.¹¹ This has been attributed to their inherent features including the presence of protective factors such as polyphenolic compounds and/or calcium as well as unique fibre and water content.¹² Non-milk extrinsic sugars are also known as added sugars, free sugars or hidden sugars. Of these terms, the currently preferred term is free or added sugars and they include all monosaccharides (e.g., glucose, fructose) and disaccharides (e.g., sucrose or table sugar) added to foods by the manufacturer, cook or consumer, and sugars that are naturally present in honey, syrups and fruit juices.^{7,12} While being highly cariogenic, these sugars add to unnecessary calories, as they have no nutritional value and hence are not beneficial for health.¹²

Several studies have evaluated the impact of sugar consumption of a variety of food such as snacks (e.g., cakes, cookies and chocolates)¹³, sweet drinks and 100% fruit juice¹⁴⁻¹⁶, sugar sweetened beverages (SSB)¹⁷⁻¹⁹ and free sugars^{20,21} on dental caries. While highlighting the impact of free sugars on dental caries all these studies reported that sugar consumption has significantly increased the risk of dental caries in both children and adults. The overall time that the teeth are exposed to sugars increases with high frequency of sugar consumption while the retention time of sugary food and drinks augments the cariogenic process.²² As such, sticky foods such as lollies and sweet biscuits have a high retention leading to greater exposure of sugar on tooth surfaces and thereby increase caries risk.²² Evidence also suggests a dose-response relationship where dental caries risk increases with increasing amount of sugars consumed.²³ A systematic review restricted to children aged 3-16 years suggested with very low quality evidence that restricting free sugars around bedtime may reduce the risk of caries in children, in line with the existing recommendations.²⁴

Restricting free sugar intake to <10% of energy and <5% of energy has moderate and very low quality of evidence, respectively, according to

a systematic review that attempted to evaluate sugar-dental caries relationships involving all age groups.²⁵ This evidence, however, has prompted the WHO to update their guidelines on sugars intake, for both children and adults, and to endorse that free sugar consumption should be less than 10% of total dietary energy intake and that restricting free sugar intake to less than 5% of total dietary energy intake has additional oral health benefits.²⁶ The WHO further recommends that free sugars consumption should be reduced right through the life course. Interestingly, only 48% of Australians²⁷ and 42% of New Zealanders²⁸ comply with the 10% limit set by the WHO while the corresponding figures for the 5% limit are 10% for Australians²⁷ and 12% for New Zealanders.²⁸

Current guidelines for sugar consumption in Australia and New Zealand

Australians are recommended to limit foods and drinks containing added sugars such as confectionery, sugar-sweetened beverages including soft drinks and cordials, fruit drinks, vitamin waters and sports drinks²⁹ whereas New Zealanders are advised to prepare foods or choose pre-prepared foods, drinks and snacks, with little added sugar and to limit intake of high-sugar foods.³⁰ Accordingly, confining added sugar intake in the diet has been the key message to both Australians and New Zealanders.

Impact of other nutrients/food on dental caries

It has been shown in a recent systematic review that consumption of rapidly digestible starch (RDS) has significantly increased the risk of dental caries across all age groups whilst there was no association of total starch consumption with caries risk.³¹ The findings further suggested that while endorsing the intake of slowly digestible starch (SDS) containing food, including whole grains, fruits and vegetables, oral health professionals should promote limiting the consumption of RDS only, particularly when it is combined with free sugars. More relevantly, the authors have reiterated the importance of conducting further research with well-designed studies.

In a six-year longitudinal study of Japanese elderly, a negative relationship between the quantity of milk and milk products intake and root caries was observed.³² Accordingly, the authors suggested that adequate daily intake of milk and dairy products such as yoghurt and cheese have a protective effect against root caries, which was mainly attributed to the remineralisation effect of these food.

Drinking plenty of tap water is a main requirement to maintain health according to both Australian and New Zealand dietary guidelines.^{29,30} The anti-cariogenic effect of fluoride is well established and hence drinking fluoridated tap water provides an additional oral health benefit. While helping to reduce the intake of sugar added soft drinks and acidic drinks, drinking plenty of water augments the protective effect of saliva on oral health. Consequently, it provides extra protection against oral conditions such as dental erosion, abrasion and attrition in addition to dental caries.²⁹

Nutrition and periodontal disease

Several studies have assessed the impact of a range of foods such as dietary saturated fatty acids (SFA), antioxidants, lipids and vitamins^{33-37,40-43}, dietary fibre including fruits and vegetables^{38,39} on periodontal disease. The findings of these studies indicated that high SFA consumption was significantly associated with more periodontal disease events.³⁶ Both vitamin C and D deficiencies, in diet^{40,41} and serum^{42,43}, have been implicated in increasing the risk of gingivitis as well as periodontitis. It has been shown that vitamin C is essential in synthesis of collagen, which is an important constituent of periodontium, whereas vitamin D helps in maintaining alveolar bone mineral density.⁴⁰⁻⁴³ These biological pathways may explain the associations between these vitamins and periodontal disease. Furthermore, it has been shown that diets rich in antioxidants such as vitamin C, vitamin D and polyunsaturated fatty acids, as well as high fibre food including fruits and vegetables,^{33-35,37-43} may have protective effects on initiation and progression of periodontal disease. Such effects could be potentially mediated through the antioxidant and immunomodulatory properties of these ingredients that might act via reducing oxidative stress and shortening the duration of inflammatory processes.³⁹

There is limited evidence to suggest that slowly digestible starch (SDS) including whole grain starches have a protective effect on periodontal disease, which was attributed to the antioxidant components of SDS/whole grain.³¹ A longitudinal study has also shown that dark green and yellow vegetable consumption was associated with reducing the risk of periodontal disease in elderly persons although this relationship could have been confounded by supplements intake including vitamins and minerals by the participants.³² Importantly, almost all these studies pointed to the value of conducting further research to confirm such findings.

Nutrition and oral cancer

Consumption of vegetables and fruits is associated with a reduced risk of oral cancers whereas intake of preserved vegetables (salted, dried, fermented or pickled) is associated with increasing the risk of oral cancers (Grade C evidence for suggestive association).²⁹ A recent

systematic review that included publications up to March 2017 on humans of all age groups has evaluated the impact of total starch consumption and the effect of replacing rapidly digestible starch (RDS) with slowly digestible starch (SDS) on oral cancer.³¹ After extensively reviewing two cohort studies, one ecological study and nine case-control studies, the authors found that there was no association between total starch intake and oral cancer as supported by very low-quality of evidence. Interestingly, there was low-quality evidence for a protective effect of SDS on oral cancer. However, they have emphasised the importance of implementing well-designed studies to affirm these findings.

Nutrition and other oral health outcomes

Nutrition has been implicated in a range of other oral diseases/conditions, in addition to the major oral diseases, which have been discussed hitherto. For example, dietary acids have caused dental erosion whereas deficiencies in micronutrients such as iron, folate, and vitamins A, C, D and B12 have been associated with the following diseases/conditions^{4,5,9}:

- Developmental anomalies of teeth such as enamel hypoplasia and salivary gland atrophy
- Oral candidiasis
- Cleft lip and palate
- Potentially malignant oral diseases including oral lichen planus and leukoplakia
- Mucosal diseases/conditions such as glossitis (Figure 1), recurrent oral ulcers (Figure 2), angular cheilitis (Figure 3) and mucositis



Figure 1. Glossitis of the lateral boarder of tongue (circled)



Figure 2. Ulcers on lower lip (circled)



Figure 3. Angular cheilitis (circled)

The elderly, mentally-ill, alcohol/drug addicts, Indigenous and homeless people, and those who consume fad diets (e.g., low-carb, vegan and ketogenic diets that exclude or restrict food groups) are at a high risk of developing micronutrient deficiencies, mainly because they consume a limited variety of food.⁴⁴ On the other hand, children, pregnant and lactating women are also at an increased risk of micronutrient deficiencies as they not only have higher requirements but generally their intake of food rich in micronutrients is poor.⁴⁴ Given that most of the clinical features of micronutrient deficiencies may manifest initially in the oral/perioral region a dental practitioner could potentially be the first healthcare provider to detect such disorders related to micronutrient deficiencies. Accordingly, dental practitioners can play an important role in early detection of such diseases/disorders, particularly among abovementioned high-risk groups, and making appropriate referral of these patients for further management.⁹

Implications for dental practitioners

- The existing body of evidence on nutrition and oral health, in line with both global and national dietary guidelines, suggests that dental practitioners have an obligation in educating and providing appropriate dietary advice to their patients.
- Based on an array of emerging evidence on the relationship between oral health and general health, as well as to align with common risk factor approach, such advice should be customised individually and directed at promoting oral health as well as general health while highlighting on the following:
 - > Limiting the intake of foods and drinks containing added (free) sugars such as confectionary, sugar-sweetened beverages including soft drinks and cordials, fruit drinks, vitamin waters, energy and sport drinks.
 - > Encouraging the consumption of all types of fruits and vegetables (unpreserved), nuts, seeds and whole grain starch rich foods.
 - > Encouraging the intake of water, particularly fluoridated tap water, milk and other dairy products (mostly reduced fat except for children under the age of 2 years) without added sugars.
 - > Discouraging the consumption of preserved vegetables (salted, dried, fermented or pickled).

- > Discouraging consumption of foods high in fats, particularly saturated fat and salts.
- > Potentially being the first healthcare providers to detect, particularly the mucosal diseases/conditions associated with micronutrient deficiencies, dental practitioners can play an important role in early detection of such diseases/conditions and appropriate referral of these patients for further management.

Summary

- Nutrition is associated with oral diseases/conditions and it particularly plays a pivotal role in the initiation and progression of dental caries via sugars in the diet. Sugar consumption is considered the main contributor to dental caries.
- Naturally present sugars including intrinsic sugars of whole fruits, vegetables and grains as well as milk sugars (extrinsic) are shown to be less cariogenic and have health benefits.

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- Added (free) sugars, which are highly cariogenic, consist of all monosaccharide and disaccharides added to foods by the manufacturer, cook or consumer, and sugars that are naturally present in honey, syrups and fruit juices.
- Amount as well as frequency of sugar consumption and form of sugar (sticky versus non-sticky) are all associated with risk of dental caries.
- WHO recommends restricting intake of free sugars to <10% and <5% of total dietary energy to achieve overall health benefits and additional oral health benefits, respectively.
- There is limited evidence to suggest that vitamins A and D, polyunsaturated fatty acids, slowly digestible starch and, high-fibre containing fruits and vegetables may have a protective effect on periodontal disease.
- Whilst a protective effect of slowly digestible starch on oral cancer is supported by low-quality evidence there is some evidence for suggestive associations between:

- > Intake of vegetables and fruits, and reduced oral cancer risk
- > Consumption of preserved vegetables and increased oral cancer risk.
- Dental erosion and micronutrient deficiencies-related oral diseases/conditions are the other oral health outcomes associated with nutrition.
- Dental practitioners could be the first healthcare providers to detect particularly the mucosal diseases/conditions associated with micronutrient deficiencies and consequently they can play an important role in appropriate referral of these patients for further management.
- Dental practitioners have an obligation in educating and providing appropriate dietary advice to their patients. Such advice should be customised individually and directed at promoting oral health as well as general health.

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