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Implementation of a Food Science and Nutrition Module in a Dental Undergraduate Curriculum

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Implementation of a food science and nutrition module in a dental undergraduate curriculum

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Abstract

Introduction: To outline the development and implementation of a food science and nutrition module for dental undergraduate students that provides basic knowledge and clinical skills for improving oral health outcomes and understanding their importance for overall health.

Materials and methods: Interdisciplinary discussions with professionals with expertise in food science and nutrition, including dentists, dietitians and nutritionists, were held to agree on core subject areas in line with the evidence base. The module was delivered online to 2nd-year dental students due to COVID-19 restrictions. Students completed an online evaluation on completing the module. Final examination consisted of one essay question.

Results: Subject areas and learning outcomes were derived from current and previous approaches to curriculum development. A total of 14 prerecorded lectures, including healthy eating guidelines, dietary assessment, specific oral effects of diet and food constituents were delivered and tutorials provided. The evaluation survey had a 90% ($n = 39/43$) response rate. A majority indicated that the course was "interesting," "worth doing" (59%) and "provided a good evidence base to understand nutrition and oral health" (87%). Nearly all students (92%) agreed that the course was "sufficiently structured to allow understanding of the key topics" and that "a good understanding of nutrition is important for a dentist" (95%).

Conclusion: A food science and nutrition module developed by a multidisciplinary team enabled dental students to gain an understanding of the role of diet in oral and overall health. The module facilitated the development of skills that enable students to utilise dietary assessment techniques and promote dietary interventions beneficial to oral health. The approach taken may act as a template for other institutions.

KEYWORDS

curriculum development, dietary counselling, food science, interdisciplinary, nutrition, undergraduate dental education

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1 | INTRODUCTION

Although it is generally acknowledged that nutrition should be a core subject in curricula, most dental programmes do not specifically include nutrition education.¹⁻⁵ The rationale for improving the nutrition education of dental students is supported by the multidirectional and synergistic relationship between nutrition and oral health.^{6,7} As highlighted recently, achieving a population-wide reduction in free sugar consumption has now become a central tenet for public health authorities and professional healthcare workers globally.⁸ However, dentists do not have the confidence or competencies to assess or deliver appropriate dietary interventions.⁹⁻¹²

Advocates for nutrition education as a key component of dental training have regularly called for the discipline to be an integral subject since the early 1920s.¹³⁻¹⁶ While various disciplines have called for the inclusion of their particular subject interests,¹⁷ the lack of adequate nutrition education^{11,18} has left many dental (and medical) clinicians without the necessary skills to provide an evidence-based conservative-management approach to diet-related oral diseases.^{2,4,15,19,20} A worldwide dental caries epidemic has been largely attributed to our failure to address the primary single cause—dietary sugars.²¹ Yet, a disease-centred “surgical” approach has dominated dental education and, one could argue, that even dental undergraduates seem primed to take an interventionist, rather than a preventative-based approach to oral disease.⁸ Knowledge of nutrition, diet-related disease and the wider systemic implications are even more relevant now,^{3,4,7,11} with the emphasis on diet as a key contributing factor to many noncommunicable diseases.^{6,20,22-24} As is argued for medical curricula, an improvement in nutrition education can increase clinician awareness of when to refer to more knowledgeable health professionals and be confident in their role in addressing relevant dietary issues.^{15,25,26} Some patients with chronic disease conditions have prescribed therapeutic diets that may require a high frequency and content of free sugars.²⁷ The greatest efforts towards the integration of nutrition in dental science curricula have been advanced by dietitians and nutritionists.^{1,28,29} They have cogently and persistently argued for an interdisciplinary and collaborative approach for oral health promotion and disease prevention.^{3,10,15}

Public health awareness of the deleterious effects of the excessive consumption of free sugars has increased significantly in recent years and there is widespread support for a population-wide reduction in their consumption.^{11,30} Patients are generally more aware of diet-related health issues and there is an expectation that dentists should be knowledgeable about the effects on the oral health of topics as diverse as the effect of probiotics in caries prevention to the role of vitamins in periodontal disease.³¹ Furthermore, the role of pro-inflammatory dietary habits has also now been recognised as important in the aetiology of periodontal diseases.³² Apart from focusing on dietary factors associated with the two most prevalent oral diseases, dental caries and periodontal disease, there is a need to study the multidirectional relationship between nutrition, diet and oral health and malnutrition.^{3,6,33} This includes subjects as

diverse as oral manifestations of systemic disorders such as burning mouth syndrome, xerostomia, and candidiasis in uncontrolled diabetes, to the nutritional impact of reduced masticatory function and taste on food and the effect of nutrition on the development of the teeth and oral tissues.³¹ Additionally, the role of the whole diet versus single nutrient approaches is expanding our knowledge of the complex interactions between nutrients and their relationship with oral diseases such as periodontitis.^{34,35}

Specific training on how to assess dietary intake from an oral health perspective and provide appropriate advice based on current dietary guidelines are a minimum requirement.¹¹ An adequate education in nutrition would allow dental undergraduates to be able to fulfil their requirements as outlined by their professional and curriculum competencies.^{11,17,36} A sound knowledge of healthy eating and nutrition principles and how they apply to oral diseases enables students to assess, diagnose, and support patients to change dietary behaviours or patterns that may prevent or minimise the consequences of diet-related dental diseases.^{2,5} Concrete proposals for curriculum development have been suggested previously, including those published by one of the authors.^{1,11,19} However, while recommendations for nutrition curriculum themes are often included, details on lecture content and curriculum implementation are rarely available. This paper that outlines the introduction of a new, succinct nutrition module for dental undergraduates includes details on themes such as dietary assessment and nutrient analysis that can provide a basis for meaningful clinical interventions. The main aims were to (1) outline the development and implementation of the module with input from experts and literature and (2) obtain feedback from students on the module in terms of their appreciation of the course content.

2 | METHODS

2.1 | Interdisciplinary discussions

Previous research collaborators and active teachers in dental health-related food science and nutrition were contacted to form a working group composed of two dietitians, two nutritionists and four dentists. Learning outcomes and key topics to be included were identified following a literature review to identify previously published material related to food science-nutrition and dental curricula. The initial reference documents for the literature review were publications by the European core curriculum group for undergraduate dental students¹⁷ and one of the authors.^{7,11}

2.2 | Course delivery

The course was exclusively delivered online to year 2 dental students, due to COVID-19 restrictions at the time of delivery (April 2020). Each core lecture was of approximately 1-hour duration, was delivered prerecorded using Panopto® and Blackboard®, and

the lecture slides were also made available. After the initial six lectures were completed Nutritics® nutrition software (Nutritics®, Swords, Co.)³⁷ was introduced through a training workshop that was delivered using Zoom® (Zoom® Video Communications). Nutritics® software can be used in the clinical assessment of patients to analyse dietary intake. This software is underpinned by multiple food composition databases and adjusts for energy requirements based on inputted physical activity levels and nutrient requirements. The appropriate dietary assessment instrument can be selected (e.g. 24 h recall or 3-day food diary), and food items recorded by selecting the food or recipe consumed from the Nutritics® database to build a “diet log.” A nutrient intake report can be generated from the dietary intake details inputted. This report indicates total macronutrient and micronutrient intakes and compares these to Reference Nutrient Intake values. Students were required to use Nutritics® to assess their own or a friend/family member's dietary intake using a 24-h recall and a 3-day food diary. The assignment required that they provide a nutrient intake report that compared the subject's target nutrient intake with the estimated intake. This was a training requirement for the module as they would be required to use Nutritics® for patient assessment in clinics the following year.

2.3 | Student evaluation

A student survey was devised to provide feedback at the final lecture of the module. An anonymous online survey was completed using Qualtrics® (Provo, <https://www.qualtrics.com>) and results analysed using R Studio®.³⁸ Ethical approval for the survey was approved by the Research Ethics Committee, Dublin Dental University Hospital, Trinity College Dublin.

Survey questions sought data on students' views on the evidence base to understand nutrition and oral and general health if they found the course interesting and worth doing and whether the Nutritics® assignment was useful and beneficial for dietary assessment. The remaining questions assessed: the degree to which respondents found the course sufficiently structured to understand key topics; whether respondents felt a good understanding of nutrition is important for dentistry; and, which lectures respondents found most interesting or informative. Tutorials were available at student request to discuss any topics. The undergraduate dental students will receive further exposure to the materials covered in this course through problem-based learning, case-based learning and final year dissertation topics to reinforce the central themes of nutrition.

3 | RESULTS

Following the literature review and identification of overlapping nutrition-related topics partially included in other disciplines such as Biochemistry and Physiology from year 1 and year 2 of the

curricula, the key topics were selected. The content was broadly aligned with the areas of competence and learning outcomes specified for the “Graduating European Dentist” that relate to the theme of Patient-Centred Care and “the complex interactions between oral health, nutrition, general health, medications, ageing and disease.”³⁶ Other topics included some previously suggested for dental nutrition education,^{1,11,19} especially those with potential applications in a preventive approach to dental care, such as behaviour change techniques, functional foods, and consumption of other carbohydrate sources including sugar alcohols.^{39,40} The lecture material was prepared and presented by lecturers from all of the disciplines involved.

The overarching learning outcomes (Table 1) for the students were to:

(1) understand the impact of food composition and nutrition on oral and general health, (2) be familiar with dietary guidelines and dietary reference values, (3) have the skill set to perform dietary assessment and analysis with an emphasis on oral health and; (4) understand how to deliver appropriate patient-focused dietary recommendations. The first six-module lectures focused on introducing the concepts of macro- and micronutrients, dietary assessment, healthy eating guidelines, dietary reference values, nutrition and oral health and dietary patterns at different stages of the life course. At this stage, students were introduced to the use of Nutritics® and completed their own dietary intake assessments. The remainder of the module included a further eight lectures with a greater focus on the role of specific nutrient deficiencies or excesses on oral health. The role of all nutrients and especially free sugars on selected disease conditions such as dental caries, periodontal disease, dental erosion, and obesity were emphasised. Other topics included dietary interventions and behaviour change, the determinants of sugar consumption and the effect of food constituents and products on oral health. Student examinations were modified in 2020 due to COVID-19 so that only one question was included in this module, a clinically case-based scenario with multiple short questions. All students passed the summative assessment.

A total of 39 out of 43 students (90%) completed the student feedback questionnaire. A majority of students responded “definitely yes” or “probably yes” to questions related to the course providing a good evidence base to understand nutrition and oral health (87%) and nutrition and general health (90%) (Figure 1A). Almost 60% of students responded “probably yes” or “definitely yes” when asked ‘did you find the project using the “Nutritics” app useful and beneficial for dietary assessment’ and when asked “do you think that the course content was interesting and worth doing?” Nearly all students (92%) agreed that the course was “sufficiently structured to allow understanding of the key topics” and that “a good understanding of nutrition is important for a dentist” (95%) (Figure 1B). Students were also asked to “select (at least 3) which lectures you found the most interesting/informative.” The three most commonly selected topics were: (1) Obesity, common risk factors and general/oral health, (2) Dental erosion, and (3) Periodontal disease and nutrition.

TABLE 1 Food science and nutrition lecture topics and content-year 2

Lecture No.	Title	Topics
1	Introduction to nutrition and health	Terminology and definitions, Historical context of the science of nutrition, Main classes of nutrients, Body composition and energy requirements, Research and study design, Sources of nutrition information
2	Healthy eating guidelines and dietary reference values	Healthy Eating Guidelines, Dietary Reference Values
3	Measuring food intake, dietary assessment	Dietary intake assessment methods (application and limitations), Food composition tables and databases
4	Nutrition effects on oral health and disease	General aspects of the role of diet in health and disease, Impact of nutrition (pre-eruptive) on dental tissues, Role of diet in dental caries, Cariogenic food and drink, Dental erosion, Nutrition and oral mucosal conditions, Nutrition and periodontal health and disease
5	Micronutrients: (vitamins, minerals and trace elements)	Overview of vitamins, Dietary Reference Values and food labelling; Vitamins: classification, sources, role and oral lesions related to deficiencies; Minerals, Trace elements/ antioxidant systems, Micronutrient requirements/Deficiencies, Vitamin supplements
6	Dietary patterns	Children and Adolescents, Growth and malnutrition, Energy and Nutrient Requirements Ageing/older people, Nutritional status, Compromised dentition, Ageing and oral health
7	Sugars and oral health	General chemistry and digestion of carbohydrates, Dental caries and sugars Classification and guidelines on intake. Consumption of sugars and starches, Dietary behaviour and snacking, Dietary risk reduction
8	Periodontal disease and nutrition	The role of oxidative stress in the association between nutrition and periodontal disease. Association between specific macro- and micronutrients and periodontal disease— theory and evidence
9	Dental erosion	Epidemiology of Dental Erosion, Diagnosis, Biological Factors, Behavioural Factors, Chemical Factors, Prevention of Erosion, Eating Disorders
10	Obesity, common risk factors and general/oral health	Current prevalence and trends of obesity in Ireland, Factors (including genetics, environmental) that influence obesity, Altered adipose tissue function in obesity, Evidence for an impact of obesity on oral health in adults and children, Underlying reasons why obesity is associated with poor oral health, Role of oral health care professionals in tackling obesity
11	Determinants of sugar consumption	Upstream versus downstream determinants, Sugar production and marketing, Sugars consumption and sweetness (including processed starches), The evidence for sugars as a risk factor for systemic diseases; Obesity, cardiovascular, diabetes. Determinants and changing dietary behaviour
12	Dietary interventions to improve oral (and general) health	Dietary recommendations and dental health, Communication skills, Behavioural change techniques and goal setting with patients
13	Food: constituents, processing and products that affect oral health-1	Food processing, Functional foods for prevention of oral disease. Probiotics, Beverages and oral health, Sweeteners, Food additives
14	Food: constituents, processing and products that affect oral health-2	Nutritional anthropology, Nutrigenomics and precision dentistry, Food labelling and health claims, Mastication, taste and food oral processing

4 | DISCUSSION

A food science and nutrition module was developed and delivered to undergraduate dental students who provided feedback indicating that the course was broadly well-received. That 95% of students acknowledged the importance of a good understanding of nutrition for a dentist suggests that they appreciate why it is required and is broadly in agreement with the previous opinion.^{1,11,15} Similarly, a large majority (87%–90%) felt that the course provided a good evidence base to understand the role of nutrition in oral and general health issues, and this is important given the potential for dentists to play a key role in promoting healthy food choices.^{11,41}

The sequence of lecture topics was devised to provide a logical development of basic knowledge before introducing the practical dietary assessment workshop and the more clinically oriented topics. While the decision to deliver a strong course fully online was a consequence of the COVID-19 restrictions, the overall response to the course content and delivery was positive with only a small minority of students indicating an unfavourable evaluation (Figure 1). That 92% “agreed” that the course was structured sufficiently to understand the key topics suggested that the students understood what was expected of them to achieve the desired learning outcomes (Table 1).

Given the early stage of their education, it can be difficult for undergraduates to appreciate the clinical relevance of some subjects.

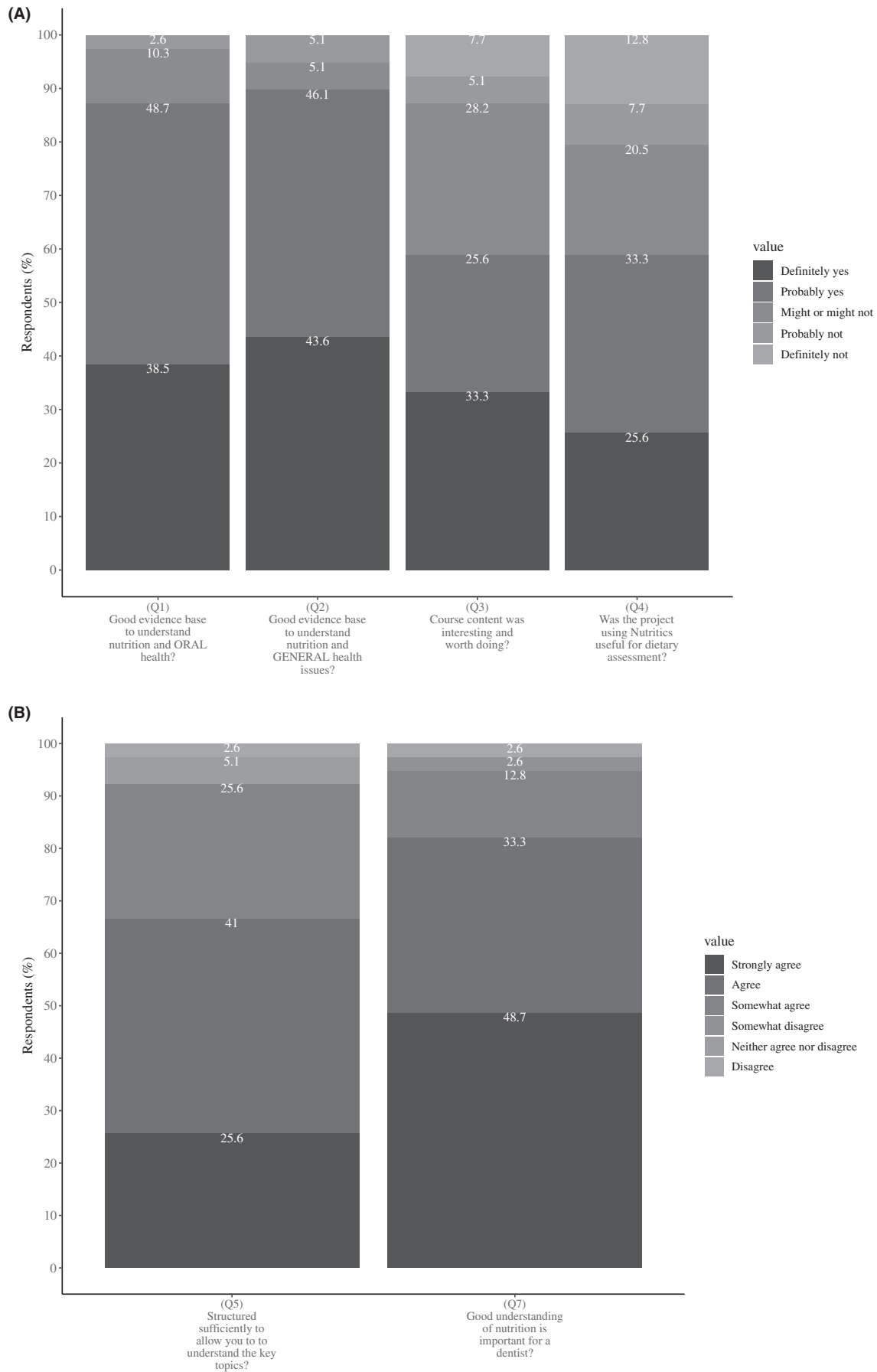


FIGURE 1 (A,B) Survey response by students to nutrition module

In general, the students appeared to rate the lectures with the most clinical content as the “most interesting/informative” suggesting that lectures with less obvious clinical application are not as interesting. However, the basic content of lecture 2 (healthy eating guidelines/dietary reference values) and lecture 3 (dietary assessment) provides sufficient knowledge to begin the task of assessing dietary risk before considering personalised dietary advice. As this is the first clinical academic year for these students the content for the subsequent year was adjusted to emphasise the need for nutrition skills to encourage a preventive approach to dentistry.^{11,20} Implicit in the requirement for this change in dental practice is the re-focusing of nutrition in the education of practitioners. It is hoped that the introduction of this food science and nutrition module may help guide dental students to a more preventive-orientated and evidence-based approach to clinical dentistry and increase their awareness of the wider importance and relevance for public oral and general health. Dental students are taught biochemical and physiological aspects of metabolism that require a detailed understanding of the role of nutrients. Yet nutritional analysis is a skill that has been largely ignored by the dental profession and, in our view, needs to be updated and emphasised as an important tool for prevention-orientated dental care. A lack of adequate training and confidence to carry out a dietary assessment, nutrition analysis and provide appropriate dietary advice has been highlighted as a key obstacle for dental practitioners to engage with nutrition in patient care.^{9,10,15,42} Current software for nutrient analysis not only provides the student with an opportunity to assess the patient's diet and easily generate a nutrient profile but also provides features that can help promote a healthy diet and assist with dietary counselling relevant to oral health. It is essential for students to appreciate the advantages and limitations of dietary assessment techniques if they are to be competent at assessing and offering dietary interventions and the course provided material through lecture content and dietary assessment software to address this.^{1-3,19} Changes in digital technologies have yet to be fully embraced in minimal intervention and preventive dentistry and many dental hospitals still use paper-based diaries for dietary assessment.^{20,42} Nutritics® was chosen as the group had already collaborated with dietitians and nutritionists who had successfully used this software for patients in a hospital environment and it provides quantitative nutrient profiling and dietary education tools for patients. It is generally acknowledged that there is insufficient research on dietary assessment in the dental environment and further studies into nutritional intervention and behavioural science are needed.^{12,17,33,42} Generally, the students in this study seemed to be interested in their own dietary assessment or nutrient screening as was found in the previous studies.¹⁹ As the course had to be delivered online due to COVID-19 restrictions, the teaching of Nutritics® software, often more suited to a face-to-face laboratory workshop, was more challenging. Direct teaching by demonstrators and simulation of dietary assessment exercises by students can help with more one-to-one interactions and direct demonstration or assistance with initial software difficulties. Following student feedback, future lectures will be modified to increase case-based scenarios to highlight the importance of diet-related oral and systemic effects. This should add more clinical context to illustrate why nutrition and dietary assessment are

important for dentists in the identification and management of nutrient deficiencies/masticatory problems related to chronic conditions such as Crohn's disease, diabetes and cancer. To act on this feedback, for example, lecture 14 will be replaced (for the subsequent academic year) with “Clinical conditions and diseases: case-based assessment, diagnosis and intervention.”

There are some limitations to this descriptive study. While it is generally acknowledged that student evaluation is useful, there is no universal standard in reporting tools. All areas of the course that could benefit from improvement may not have been identified due to reliance on student survey data and subsequent informal feedback. The course content was delivered by multiple instructors while there was only a single retrospective evaluation of the overall course module. Future research could include individual class evaluations, a more detailed assessment on how the design of rating scales may impact evaluation, assessing the impact on nutrition knowledge and attitudes towards providing preventive advice in practice and extending the course to include other members of the dental team.

5 | CONCLUSION

A multidisciplinary team implemented a food science and nutrition module to assist dental undergraduate students to gain a wider understanding of the role of diet in both oral and general health and a skill set that enables appropriate dietary assessment and interventions. Student feedback suggests that the module was well-received and was successful in achieving the desired learning outcomes, and as such, the approach taken may serve as a useful guide for other undergraduate programmes in dentistry.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

Ethical approval for the survey was granted by the Dental Science Research Ethics Committee, Trinity College, Dublin. Reference code DSREC2021-05.

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