Review
Nutritional Factors Associated with Dental Caries across the Lifespan: A Review

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Abstract: Nutrition and dietetic care span various life stages, addressing nutritional needs and exploring factors that shape dietary habits. Globally, an alarming disproportion in food resource distribution, coupled with substandard nutritional intake, underscores profound implications for oral health. This is evident in the facilitation of dental caries development and its repercussions on oral soft tissue integrity. While modern markets offer advanced edible products, their effects on oral health, especially in relation to dental caries, remain uncharted. This narrative literature review pursues a four-fold objective: (a) scrutinizing the repercussions of inadequate nutrition on dental caries, (b) exploring psychological determinants influencing dietary habits contributing to caries development, (c) investigating potential implications of newly devised food products on caries formation, and (d) elucidating the role of dentists as facilitators in promoting oral health practices. A comprehensive search spanning PubMed, Web of Science, and Cochrane Library yielded 46 cohort, cross-sectional research articles and systematic reviews adhering to standardized diagnostic criteria for dental caries evaluation. The results highlight contemporary lifestyles as potent contributors to heightened risk of caries due to suboptimal nutritional quality and nutrient insufficiency. Additionally, concerns have arisen with the advent of synthetically engineered food products, warranting exploration of potential implications for future caries development and global oral health status. This review emphasizes the pivotal role of dietitians–nutritionists and dental professionals in advocating sound nutritional practices specifically geared towards preventing dental caries. Ultimately, this review contributes to the understanding of the intricate interplay between nutrition, oral health, and the imperative role of healthcare professionals in fostering preventive measures.

Keywords: diet; dental caries; oral health; dentists; dentistry; sustainability; food sustainability; nutrition; diet coach

1. Introduction

The prevalence of dental caries and periodontitis, acknowledged as the most pervasive oral diseases, has necessitated a reevaluation of societal objectives concerning oral health [1]. This reassessment is prominently centered on primary dental care and has been effectively instituted in multiple nations, yielding notable achievements [2,3]. The adoption of this novel approach by various governments stems from the realization that despite considerable advancements in scientific knowledge and technology in recent years, a commensurate enhancement in oral health has not materialized [4]. Extensive and protracted
investigations have consistently established a correlation between periodontal diseases, tooth decay, and the presence of dental plaque, the etiological factors of which are both specific and preventable [5,6]. Notably, restorative dentistry remains financially prohibitive for significant segments of the population in many countries, primarily being accessible to the more affluent socioeconomic strata [7]. Concurrently, the financial implications of dental care are large, consuming over 15% of overall health expenditure. This underscores an impending fiscal challenge for public health systems as the trajectory of escalating costs associated with dental care appears unsustainable [8].

This circumstance has led to the development of a novel strategic approach to address oral diseases, compelling the World Health Organization (WHO) to delineate specific objectives for oral health in 2023 [1]. The initial objective stipulates that by 2030, 50% of children aged 5–6 years should exhibit a state of dental cavity absence, commencing from the baseline year of 2020. The second goal pertains to a target caries index of 3- to 12-year-olds [9]. The third objective aims at the preservation of complete dentition in 85% of 18-year-olds [1]. Additionally, for adults aged 35–45 years, a consequential ambition is the achievement of a 50% reduction in the incidence of extractions relative to historical levels. Concurrently, there is a pressing need for the establishment and integration of sustained data collection systems within health frameworks specifically designed to monitor and assess the evolving landscape of oral health [10].

Moreover, the cariogenic impact of microbial plaque, particularly in the presence of carbohydrates, such as sugar, has been extensively substantiated [11,12]. Notably, it appears that the frequency of sugary food consumption holds greater significance than the sheer quantity [13]. Consequently, the prolonged retention of processed foods, such as biscuits, chocolates, or soft drinks, in the oral cavity, a common practice for many individuals, is considerably more detrimental than the expedited consumption of larger quantities, particularly when followed by prompt brushing. This nuance assumes considerable importance in shaping the oral health trajectory for both children and adults [14]. Each encounter between sugar and microbial plaque initiates a protracted episode of enamel decalcification, extending for hours thereafter. The cumulative effect of such episodes provides a conducive environment for the onset of caries and their ensuing destructive processes [15]. Hence, if sugar consumption is unavoidable, it is advisable to take place during or after the main meals rather than between them as a mitigation strategy against its cariogenic effects [16].

Simultaneously, the issue of food overconsumption has garnered scrutiny due to its implications for health, including oral diseases [17]. Recent surveys indicate that within the demographic of European children under 10 years old, the prevalence of overweight is 21% for girls and 19% for boys [6]. Globally, over 1 billion people are classified as obese, comprising 650 million adults, 340 million adolescents, and 39 million children [18]. Observations in Greece underscore a low adherence to the traditional “Mediterranean diet” among children, manifesting in an imbalanced and inappropriate dietary pattern that correlates with higher percentages of overweight and obese children [19]. Previous investigations highlight elevated sugar intake and the consumption of cereal foods enriched with sweeteners; high glycemic load foods characterize current dietary patterns [20]. The adoption of healthy nutrition is presented as a key determining factor in mitigating the risk for not only dental caries but also for broader health indicators [10].

This literature review aims to fill gaps in understanding the interconnected dynamics between healthy nutrition, dental caries prevention, challenges of excessive sugar intake, and factors influencing food choices. Aligned with the WHO’s Global Oral Health Status Report advocating for universal health coverage in oral health by 2030, our primary goal is to develop a nutritional profile conducive to lifelong caries prevention. Emphasizing collaboration with a multidisciplinary team of nutrition and dentistry experts, we seek to integrate educational nutritional interventions for true medical–dental synergy. Considering rising dental care costs, our review also strives to establish a robust foundation for tailored and effective preventive strategies, emphasizing a multidisciplinary, integrated, and patient-centric approach.
2. Methods

A narrative review was conducted to investigate what is known about nutritional habits and interventions vs. dental caries as well as the training provided to oral health professionals in the treatment of individuals with unhealthy diet habits. A comprehensive search encompassing three databases was conducted as follows: (1) The search on PubMed involved the utilization of MeSH terms, specifically focusing on #Diet, #Nutrition, #Oral Health, #Dental Caries, #Education, #Dentists, and #Sustainability. Additionally, relevant keywords like #Food and #Dentistry were incorporated. The search criteria aimed at unraveling the interplay between nutritional habits, interventions, and dental caries, with a particular emphasis on the training provided to oral health professionals. The preliminary search produced 150 articles, with 8 duplicates excluded, resulting in 142 articles for further analysis. (2) The search strategy for the Web of Science database concentrated on identifying articles related to #Diet, #Nutrition, #Oral Health, #Dental Caries, #Education, #Dentists, and #Sustainability. Complementary keywords, including #Food and #Dentistry, were applied. The criteria focused on gaining insights into nutritional habits, interventions, and the role of oral health professionals in addressing individuals with unhealthy diet habits. The initial search yielded 180 articles, and after eliminating 6 duplicates, 174 articles remained for detailed scrutiny. (3) For the Cochrane Library search, emphasis was applied to #Diet, #Nutrition, #Oral Health, #Dental Caries, #Education, #Dentists, and #Sustainability. Additional keywords, such as #Food and #Dentistry, were included. The search criteria aimed to pinpoint articles exploring the connection between nutritional habits, interventions, and dental caries, with a specific focus on the training provided to oral health professionals. Initially, 120 articles were retrieved, and 8 duplicates were eliminated, leaving 112 articles for a thorough review. The selection of these databases was based on their reputation, comprehensiveness, and relevance to healthcare and dental research (Table 1).

<table>
<thead>
<tr>
<th>Database</th>
<th>Keywords</th>
<th>MeSH Terms (PubMed)</th>
<th>Initial Articles</th>
<th>Duplicates Removed</th>
<th>Final Articles for Analysis</th>
<th>Contribution to Study</th>
<th>Reason for Inclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>PubMed</td>
<td>#Diet, #Nutrition, #Oral Health, #Dental Caries, #Education, #Dentists, #Sustainability, #Food, #Dentistry</td>
<td>Dietetics, Nutrition, Oral Health, Dental Caries, Education, Dentists, Sustainability</td>
<td>150</td>
<td>8</td>
<td>142</td>
<td>Provided a broad understanding of the interplay between nutritional habits, interventions, and dental caries; MeSH terms ensured precision in search.</td>
<td>Widely recognized as a premier biomedical database, often used for systematic reviews in healthcare research.</td>
</tr>
<tr>
<td>Web of Science</td>
<td>#Diet, #Nutrition, #Oral Health, #Dental Caries, #Education, #Dentists, #Sustainability, #Food, #Dentistry</td>
<td>N/A (Web of Science does not use MeSH terms)</td>
<td>180</td>
<td>6</td>
<td>174</td>
<td>Enhanced the overall coverage of literature related to nutritional habits, interventions, and oral health professionals’ role.</td>
<td>Provides a multidisciplinary approach covering a wide range of scientific disciplines.</td>
</tr>
</tbody>
</table>
We further used the following criteria of inclusion for the second part of the study as mentioned elsewhere [21–35].

- Population inclusion criteria: Studies involving individuals across all age groups, from infancy through to late adulthood, that had diverse demographic characteristics, such as gender, socioeconomic status, and cultural backgrounds, were used.

- Study design: Rigorous research methodologies, including randomized controlled trials (RCTs), cohort studies, cross-sectional studies, and systematic reviews were also selected. Further exclusion of case reports, editorials, and non-research articles were made to ensure methodological rigor.

- Intervention and exposure variables: Studies evaluating the impact of nutritional interventions on dental caries and exploring dietary factors, including macro- and micronutrient intake, dietary patterns, and specific food items implicated in dental caries etiology, were additionally selected.

- Outcome measures: Studies reporting relevant outcome measures, such as the incidence, prevalence, severity, and progression of dental caries, were incorporated. Among them, only studies employing standardized diagnostic criteria and assessment tools for dental caries evaluation were finally used.

- Temporal considerations: Studies conducted over varying time frames to capture longitudinal perspectives on the relationship between nutrition and dental caries were also selected.

- Publication characteristics: Additionally, we only considered studies published in peer-reviewed journals to uphold scholarly rigor.

- Geographical variation: We also searched for potential variations in nutritional practices and dental health across different geographical regions; thus, we included studies conducted in diverse global settings to enhance generalizability.

- Finally, only articles written in English and published after 2010 were included.

During the subsequent phase of the literature search, two reviewers systematically conducted screening and data extraction from the identified articles. A total of 110 articles were excluded during this phase, primarily due to inadequate methodology or a lack of relevance to the specified search content or publication and methodology issues as described before. Studies conducted on institutionalized patients were also deliberately excluded from consideration. Of the rest of the 111 articles, 18 could not be retrieved. The eligibility criteria of the final stage encompassed articles utilizing the dmft/DMFT (decayed, missing, and filled primary teeth/decayed, missing, and filled permanent teeth) diagnostic criteria administered by trained examiners, incorporating probability sampling methods and stipulating specific sample sizes. Another 47 articles were thus further excluded. In the subsequent third phase of the screening process, a total of 46 studies met all the predefined criteria.
A fundamental asset in nutritional counseling lies in the understanding and assessment of social, psychological, and other crucial personal factors that shape an individual's receptiveness to a change in nutritional behavior [101]. The process of change disrupts established routines, induces feelings of insecurity and anxiety, and necessitates adaptation. It is inherent that certain patients exhibit varying degrees of resistance to change, which is both normal and anticipated. Furthermore, considering that beliefs underpin habits, a thorough investigation or reconstruction of these beliefs becomes imperative within the counseling process [102]. Consequently, although individuals with dental caries may recognize the importance of dental check-ups for their health, the decision to modify their diet can pose considerable challenges [32]. Thus, addressing the thoughts and emotions surrounding eating problems becomes an integral aspect of the problem-solving process. In essence, health professionals should utilize diet counseling guidance as an instigator or facilitator of change in the initial stage, with subsequent involvement of other experts in the process's later stages. Thus, nutrition counseling, with its multifaceted aspects and diverse applications, has emerged as a compelling field [103].

Figure 1. Prisma flow chart of the study. * Original initial search. ** Excluded by the researchers due to inadequate methodology, outcome measures, sample parameters, and institutionalized patients. *** Eligibility criteria were articles using DMFT diagnostic criteria with calibrated examiners, probability sampling, and sample sizes. Studies were excluded if conducted on institutionalized patients.

3. Results

The retained articles were categorized thematically into articles related to (1) dietary factors and dental caries; (2) oral health effects of unhealthy diet habits; (3) patient psychology and the role of the dentist in promoting healthy nutrition to support oral health, especially to prevent dental caries (Table 2); (4) newly designed food in the formation of caries; and (5) training of oral healthcare with proper nutritional recommendations. In Table 1, articles focusing on the role of dietary factors and dental caries prevalence are presented according to the age of participants.
Table 2. Dietary factors and dental caries according to the age groups (from children to adults).

<table>
<thead>
<tr>
<th>Author/(Year)</th>
<th>Number of Participants</th>
<th>Age Range</th>
<th>Gender</th>
<th>Methods</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muhoozi et al. (2018) [21]</td>
<td>399</td>
<td>Children 36 months</td>
<td>211 males and 188 females</td>
<td>Questionnaires, anthropometric measurements and photographs of the upper front teeth.</td>
<td>The educational intervention improved oral hygiene practices and reduced the development and progression of caries as well as extractions in children.</td>
</tr>
<tr>
<td>Nakai et al. (2022) [22]</td>
<td>118</td>
<td>Children 1–4 years</td>
<td>59 males and 59 females</td>
<td>Data collection, including age, sex, medical history, medication, caries status. and plaque acidogenicity level at the first dental visit. Dietary data were collected from 3-day dietary records.</td>
<td>Altering the frequency and timing of sugar intake may prevent early childhood caries by moderating plaque acidogenicity.</td>
</tr>
<tr>
<td>Zeng et al. (2018) [23]</td>
<td>2880</td>
<td>Children 3–5 years</td>
<td>1488 males and 1392 females</td>
<td>The questionnaire included demographic characteristics, daily diet, lifestyle factors, and the oral health awareness from the parents.</td>
<td>Caries prevalence increased with age, demonstrating higher rates in rural areas than urban ones, albeit remaining lower than those reported in other developing nations. A DMFT index of 1.97 was found, and 39.6% of the children presented to be overweight and having lower prevalence of dental caries compared to the obese ones. Higher prevalence of dental caries was associated with low income, public schools, and less educated parents. Teeth cleaning habit, parental education, sweet food consumption, and milk consumption were associated factors. A notable correlation was identified between dental caries and stunting as well as between dental caries and inadequate hygiene practices. However, no statistically significant association was observed between dental caries and underweight status, notwithstanding the elevated prevalence of dental caries in conjunction with malnutrition. Malnutrition as well as eating sweets before bedtime were significantly related to dental caries. Family income was a risk factor.</td>
</tr>
<tr>
<td>Aguiar et al. (2019) [24]</td>
<td>92</td>
<td>Children 5 years</td>
<td>41 males and 51 females</td>
<td>The nutritional status was evaluated using the body mass index (BMI) and the nutritional intake with an FFQ. The dental health status was evaluated using the decayed, missing, and filling tooth index (DMFT index).</td>
<td></td>
</tr>
<tr>
<td>Bassa et al. (2023) [25]</td>
<td>761</td>
<td>Children 6–12 years</td>
<td>350 males and 411 females</td>
<td>Face-to-face interview, administered questionnaire, and clinical assessment of dental caries.</td>
<td></td>
</tr>
<tr>
<td>Rani et al. (2019) [26]</td>
<td>1231</td>
<td>Children 5–15 years</td>
<td>603 males and 628 females</td>
<td>Observational study. Anthropometric measures were performed and oral examination as well.</td>
<td></td>
</tr>
<tr>
<td>Lueangpiansamat et al. (2012) [27]</td>
<td>111</td>
<td>Children 11–12 years</td>
<td>57 males and 54 females</td>
<td>Questionnaire study.</td>
<td></td>
</tr>
<tr>
<td>Author/(Year)</td>
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<tr>
<td>De Silva et al. (2023)</td>
<td>996</td>
<td>Children</td>
<td>498 males and 498 females</td>
<td>Questionnaires for schoolchildren were identified by the frequency of ultra processed food consumption.</td>
<td>Negative relationship between ultra processed meats and fats, fast foods, and noodles and dental caries.</td>
</tr>
<tr>
<td>Hong et al. (2018)</td>
<td>4950</td>
<td>Children</td>
<td>2377 males and 2573 females</td>
<td>FFQ only for foods and drinks with added sugar, tooth-brushing frequency, dental attendance, and water-drinking frequency.</td>
<td>The study highlighted the importance of recognizing dental caries patterns by surface, tooth, and child level amongst adolescents and the value of reporting dental caries distribution by threshold in epidemiological surveys.</td>
</tr>
<tr>
<td>Kariya et al. (2022)</td>
<td>829</td>
<td>Children</td>
<td>414 males and 415 females</td>
<td>Body mass index was recorded. Dental caries was assessed using decayed, missing, and filled primary teeth (DMFT) and decayed extracted filled teeth (deft) index. A parent-administered questionnaire was used to obtain data on oral hygiene practice, parental education, dental visits, and sugar exposure. Longitudinal cohort study. Dietary intake at the age of 8 years was assessed using food frequency questionnaires. Diet quality scores were estimated, reflecting adherence to Dutch dietary guidelines. Dental caries was assessed at the age of 13 years using intraoral photographs. Questionnaire to assess oral health and FFQ (food frequency questionnaire). Caries prevalence was calculated based on the percentage of positive cases and no decay, missing, and filled teeth (DMFT). The General Oral Health Assessment Index (GOHAI) was used to measure OHQRQoL, and anthropometric measures took place.</td>
<td>Nutritional status was found to be inversely related to dental caries. Children with lesser BMI were at higher risk of having dental caries and vice versa. Better diet quality was associated with a lower occurrence of severe dental caries after adjustments for sociodemographic factors. Children and adults were less interested in healthy eating and in preventive and other dental therapies, and they did not adhere to the Mediterranean diet. Older adults with poor perception of their oral health were more likely to have unsatisfactory BMI.</td>
</tr>
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Table 2. Cont.

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Wu et al. (2018) [34]</td>
<td>195</td>
<td>Elders 65 or above</td>
<td>98 males and 97 females</td>
<td>General Oral Health Assessment Index (GOHAI), an instrument for assessing oral-health-related quality of life (OHRQoL), was used as a subjective measure of oral health and Mini-Nutritional Assessment (MNA) for nutritional status evaluation.</td>
<td>Elders’ tooth loss and unmet treatment need for dental caries were associated with malnutrition.</td>
</tr>
<tr>
<td>Helou et al. (2014) [35]</td>
<td>115</td>
<td>Elders 70 or above</td>
<td>56 males and 59 females</td>
<td>The nutritional status was assessed by the Mini-Nutritional Assessment (MNA), and oral health was assessed by the Geriatric Oral Health Assessment Index (GOHAI).</td>
<td>Oral care reduced the risk of malnutrition.</td>
</tr>
</tbody>
</table>

* Nutritional status: the overall health condition of an individual in relation to their dietary intake and the utilization of nutrients by the body. ** Body mass index (BMI): a numerical value derived from an individual’s weight and height, providing a standardized measure to assess body fat and categorize individuals into different weight status categories, such as underweight, normal weight, overweight, or obese. *** FFQ: food frequency questionnaire.

Many of the studies mention the term “nutritional status”. It is a comprehensive assessment that encompasses various factors, including the quantity and quality of food consumed, nutrient absorption, metabolism, and the physiological outcomes of these processes. Nutritional status is a dynamic and multifaceted concept that is influenced by both dietary and nondietary factors, such as genetics, health conditions, and socioeconomic factors [34].

The amassed data underscores the pivotal role of the family in shaping individuals’ nutritional habits. This influence extends beyond the evident aspect of parents serving as role models for their children. Rather, the family, through its perceptions of nutrition, establishes the fundamental underpinnings of commendable eating habits in early childhood. This early imprinting, in turn, significantly molds the trajectory of children’s future nutritional choices and serves as a preventive measure against various diseases, including obesity, caries, and atherosclerosis [36,37].

Several additional factors contribute to the influence exerted by the family on the dietary preferences of both adults and children. These factors encompass the cultural and ethnic background of the family [38], the parents’ awareness of nutrition-related matters [39], their attitudes and health-related habits [40], and the parents’ level of education and socioeconomic status [41]. Collectively, these variables converge to form a complex interplay of determinants that collectively shape and perpetuate familial and, consequently, individual dietary patterns.

Between the ages of 40 and 70, a discernible reduction in food consumption by 25%, commonly referred to as aging anorexia, is observed [42]. This phenomenon is predominantly orchestrated by hormonal processes that increase satiety levels and physiological decline. The elderly demographic is particularly susceptible to alterations in diet preferences and restricted access to food due to sensory disturbances, physical degeneration, and oral pathological shifts, including mastication incapability, hyposalivation (xerostomia), and recurring oral infections. Polypharmacy, prevalent among the elderly, has emerged as a significant contributing factor, introducing potential issues such as malabsorption, gastrointestinal disorders, appetite loss, and intolerance to specific dietary components [43]. Social isolation and economic instability further compound detrimental eating habits in this age group. Notwithstanding, the unique behavioral patterns exhibited by the elderly...
may render them susceptible to the adoption of low-quality dietary practices. Factors such as memory lapses, diminished mood following the loss of a relative, a pervasive sense of discouragement about life, low adaptability, and resilience collectively contribute to a deleterious cycle of ongoing health impairment. The prevailing disposition of the elderly towards discontinuity in dietary habits ultimately and subconsciously devalues the significance of nutrition, thereby amplifying the incidence of oral pathologies, including caries and tooth loss [42].

4. Effects of Poor Nutrition on Oral Health and Dental Caries

Nutrition exerts a profound impact on oral health, with malnutrition notably exacerbating periodontal and oral infectious diseases during this phase [44]. However, the most prominent influence of nutrition on dental health manifests through the local effects of the diet within the oral cavity, specifically concerning the development of dental caries and enamel erosion [45]. A suboptimal diet can significantly contribute to the onset of tooth decay and gum disease [12,44]. Consumption of foods rich in starch, sugars, and carbohydrates can elevate plaque acid levels, precipitating cariogenic attacks.

Beyond dental caries, nutritional factors may also play a role in the development of various dental and oral mucosal pathologies [17]. Protein deficiencies, for instance, may be associated with delayed tooth eruption and salivary gland dysfunction. Additionally, a deficiency in vitamin A may lead to impaired epithelial tissue development, tooth formation, and enamel hypoplasia, thereby laying the groundwork for the prevalence of caries [46]. Vitamin C is also a pivotal player in gingival well-being and is essential for collagen production, a protein crucial in maintaining gum integrity. A dietary regimen rich in vitamin C is therefore integral in averting gum disease [47]. Calcium, another essential mineral, assumes responsibility for fortifying teeth and bones, fostering enamel strength, and mitigating the risk of tooth decay. Calcium deficiency not only weakens tooth enamel but also precipitates other oral health issues, including periodontal disease and tooth loss. Nutrient inadequacies, especially those pivotal to bone health, increase the susceptibility to bone loss and subsequent osteoporosis. The intricate process of bone formation demands a consistent supply of nutrients, such as calcium, protein, magnesium, phosphorus, vitamin D, potassium, and fluoride [48,49].

Concurrently, the role of natural and free sugars, encompassing sucrose, glucose, and fructose, assumes prominence as primary contributors to caries development. Sucrose, a disaccharide comprising glucose and fructose, stands out for its heightened cariogenic potential [50]. An array of nutrients, including calcium, vitamin D, protein, magnesium, phosphorus, and potassium, actively contribute to bone and hard dental tissues health. A healthy and balanced diet, characterized by the inclusion of fruits, vegetables, legumes, nuts, seeds, and lean proteins, inherently provides the essential nutrients indispensable for maintaining robust and functional bones and teeth [45,49].

Moreover, phosphorus has emerged as a critical element in caries inhibition, acting as a natural protector and remineralizer of tooth enamel, while zinc, an essential mineral, plays a vital role in gum health. A diminished uptake of zinc may escalate the risk of periodontal disease and subsequent tooth loss [51].

Thus, persistent poor dietary quality is linked to the emergence of oral health issues later in life. Notably, oral health problems, such as tooth loss, periodontal disease, and dry mouth, are pervasive conditions among older individuals (≥65 years) and exert a substantial impact on both oral and general health [46,49,50].

The intricate interplay of micronutrients in dental caries, encompassing their nutritional sources and deficiency effects, is systematically presented in Table 3.
Table 3. Micronutrients and their role, nutrition source, deficiency effect, and supplements.

<table>
<thead>
<tr>
<th>Micronutrient</th>
<th>Dental Effect</th>
<th>Nutrition Source</th>
<th>Deficiency</th>
<th>Supplements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>Facilitates the stimulation of saliva production, thereby promoting the removal of acids and food particles from teeth, concurrently neutralizing acid and providing protection against dental decay.</td>
<td>Leafy green vegetables (kale, spinach, and broccoli), orange and yellow vegetables (carrots, sweet potatoes, pumpkin, and others), tomatoes, red bell pepper, cantaloupe, mango, beef liver, fish oil, milk, and eggs.</td>
<td>Elevated susceptibility to caries was observed in instances of vitamin A deficiency. A proposed mechanism for this vulnerability postulates that it may be attributed to an increase in enamel solubility.</td>
<td>Deficiency in vitamin A is common in children and pregnant women. Supplements may be suggested in this case.</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>Has emerged as a promising contender in safeguarding against dental caries.</td>
<td>Beef liver, tuna, salmon, fortified cereals, chickpeas, poultry, and some vegetables and fruits</td>
<td>The deficiency of vitamin B6 can have implications for dental integrity, disrupting essential processes like enamel formation, and increasing the risk of caries development.</td>
<td>Only recommended in case of deficiency of vitamin B6.</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>Has surfaced as a noteworthy prospect for protecting against dental caries.</td>
<td>Spinach, broccoli, iceberg lettuce, and fats and oils</td>
<td>Insufficient levels of vitamin K may compromise dental health by impeding optimal mineralization processes, potentially contributing to enamel hypoplasia and increasing the susceptibility to caries formation.</td>
<td>Only recommended if there is a deficiency of vitamin K.</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>Plays a crucial role in promoting the health of the gingiva and facilitating the healing process.</td>
<td>Citrus (orange, kiwi, lemon, and grapefruit), bell peppers, tomatoes, cruciferous vegetables (broccoli, Brussels sprouts, cabbage, and cauliflower), and white potatoes</td>
<td>Depletion in humans leads to gingival bleeding, regardless of oral hygiene.</td>
<td>Only recommended if there is deficiency of vitamin C.</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Activates a pivotal role in the formation of enamel and dentin during the tooth development process due to its interaction with receptors in ameloblasts and odontoblasts.</td>
<td>Dark-green leafed vegetables, cheese, milk, cod-liver oil, oyster mushrooms, eggs, and certain species of wild salmon</td>
<td>The insufficiency of vitamin D can lead to enamel hypoplasia, a noteworthy factor contributing to early childhood caries.</td>
<td>For strict vegans (those avoiding milk) and elderly, vitamin D supplements could be taken in combination with minerals as either vitamin D alone or minerals alone may not provide systemic benefits.</td>
</tr>
</tbody>
</table>
Table 3. Cont.

<table>
<thead>
<tr>
<th>Micronutrient</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>Engages actively in the protection and reconstruction of tooth enamel.</td>
<td>Cheese, milk, plain yogurt, calcium-fortified tofu, leafy greens, and almonds</td>
<td>Enamel hypoplasia, salivary glandular hypofunction, and alterations in saliva composition may represent mechanisms through which an association with caries is established.</td>
<td>Calcium is the most important supplement with vitamin D for elderly and vegetarians for dental health. It may also be recommended for pregnant women and children when they do not consume dairy products daily.</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>The equilibrium between enamel demineralization and remineralization is actively influenced by the levels of calcium and phosphorus ions in saliva, and their deficiency markedly alters the morphology of the tooth.</td>
<td>Protein-rich foods like meat, poultry, fish, milk, and eggs</td>
<td>Incorporating amorphous calcium phosphate nanoparticles into orthodontic cement can prevent the occurrence of white spot lesions during orthodontic treatments as these nanoparticles possess the capability to inhibit caries and promote the remineralization of lesions.</td>
<td>Supplementation may be essential in deficiency.</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Demonstrates noteworthy antibacterial and biofilm activity against cariogenic bacteria.</td>
<td>Green leafy vegetables, such as spinach, legumes, nuts, seeds, and whole grains</td>
<td>Has the potential to diminish the progression and development of dental caries by releasing magnesium ions.</td>
<td>Supplementation may be essential in deficiency.</td>
</tr>
<tr>
<td>Zinc</td>
<td>Exhibits the capacity to inhibit S. mutans, diminish plaque formation, and promote remineralization.</td>
<td>Meet, fish, and seafood</td>
<td>Failed to foster antimicrobial activity.</td>
<td>Supplementation may be essential in deficiency.</td>
</tr>
</tbody>
</table>
5. Current Food Technology and Its Influence in the Formation of Caries

The prevailing trend in the food and beverage industry is to meticulously design products to maximize their appeal to consumers. Sugar-sweetened beverages, exemplified by soft drinks, fruit juices, chocolate milk, and energy drinks, epitomize products strategically crafted for consumer allure. The heightened attractiveness of these beverages is primarily attributed to their elevated carbohydrate content, which, by elevating blood glucose levels, induces a pleasurable mood [58]. Furthermore, the caffeine present in many beverages serves to stimulate the trigeminal nerve in the brain, acting synergistically with carbonic acid [59]. Despite the euphoric symptoms associated with their consumption, it is imperative to acknowledge that such drinks may precipitate bone loss, likely attributable to their high caffeine and phosphorus content [58,60]. A similar concern arises with “energy drinks”, wherein the carbonate they contain poses a substantial risk, though the precise mechanism through which they exert their detrimental effects remains incompletely elucidated [61].

Contemporarily, there is a discernible trend among younger demographics to substitute traditional beverages, such as water, milk, and juice, with these enticing alternatives [58,62]. Encouragingly, tea, a beverage commonly consumed by young adults, possesses a notable concentration of polyphenols, which contribute significantly to the prevention of dental caries [63–65]. Routine consumption of energy drinks is characterized by elevated sugar content and extreme acidity. With a pH range falling between 2.4 and 3.5, these beverages harbor high concentrations of carbonic acid, phosphoric acid, malic acid, and citric acid [66]. Both the sugars and acids in these drinks significantly contribute to the development of dental caries. Prolonged and frequent consumption of energy drinks has been associated with the induction of dental caries, substantiated by established positive correlations between caries and the intake of soft drinks [50,67,68].

The acidity of these beverages plays a dual role in the development of dental caries. Firstly, it augments the acidic pH initiated by cariogenic attacks, thereby intensifying the deleterious impact of the carious process [66]. Secondly, it imposes selective pressure that fosters the proliferation of a more acidogenic and aciduric microbiota in the oral cavity, creating conditions conducive to cariogenic processes [69]. The frequency of consumption of such beverages directly correlates with the magnitude of their detrimental effects on dental health.

The ascendancy of green marketing in the food industry over recent years has yielded positive nutritional shifts, particularly for infants and young children. The adoption of green chemical technology has enhanced the bioavailability of products with high nutrient value, facilitating the absorption of nutrients that might otherwise be overlooked [70]. An illustrative instance is the enriched pasta with vegetables, designed to facilitate children in meeting daily vegetable recommendations [71]. Such applications bear the potential to confer significant benefits to oral health, particularly when increased bioavailability of essential nutrients like magnesium and calcium through dietary means is anticipated to exert a positive influence on oral health and caries prevention [57].

Despite the commendable strides in formulating food products for children aged 4–7 and 7–10 years, with sugar content generally limited to less than 5 or 6 teaspoons, overconsumption remains a pertinent concern associated with both obesity and dental caries [72]. The crux of fostering proper infant growth lies in ensuring the right balance of essential and supplemented nutrients, either through breastfeeding or alternative nutrition formulas [73]. Notably, formula manufacturers have already heeded recommendations by reducing sugar content and adhering to guidelines for carbohydrate and corn syrup restrictions [74]. The incorporation of fructo-oligosaccharides and galactic-oligosaccharides in infant formula, with specified content limits, underscores their potential impact on dental health given the pivotal role played by calcium and phosphorus [75].
To mitigate the potential misunderstanding of nutrient labels, health professionals advocate for color-coded labeling on the front of food packages. The rationale behind this system is to categorize products as “red” for cautious and infrequent consumption while encouraging the selection of more “green”- and “amber”-labeled products to minimize the risk of caries and enhance overall oral health (Table 4) [76].

Table 4. Color indication on the food label indicating the sugar content per 100 g of product and/or per portion adapted with permission from Ref. [77].

<table>
<thead>
<tr>
<th>Sugar in food (per 100 g)</th>
<th>Sugar in drink (per 100 mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (Green)</td>
<td>Low (Green)</td>
</tr>
<tr>
<td>5 g or less</td>
<td>2.5 g or less</td>
</tr>
<tr>
<td>Between 5 g and 22.5 g</td>
<td>Between 2.5 g and 11.25 g</td>
</tr>
<tr>
<td>High (Red)</td>
<td>High (Red)</td>
</tr>
<tr>
<td>More than 22.5 g</td>
<td>More than 11.25 g</td>
</tr>
<tr>
<td>High Per Portion If More Than 100 g/150 mL</td>
<td>High Per Portion If More Than 100 g/150 mL</td>
</tr>
<tr>
<td>27 g</td>
<td>13.5 g</td>
</tr>
</tbody>
</table>

6. Guidelines and Legislation on Food Intakes to Control Caries

The WHO advocates a carbohydrate intake ranging from 45 to 60 g per meal for both adults and children [78]. In addition, there is a recommendation for consumers to actively engage in food label reading, focusing on the indication of total grams of carbohydrates per serving. This empowers individuals to make informed and healthier dietary choices throughout the day. Nutrient-rich snacks, such as fresh fruits, honey [79], or yogurt, in between meals are regarded as beneficial, while water, low-fat milk, and unsweetened tea or coffee are considered safe options during intervals between meals, applicable to all age groups [62,79,80].

In the interest of maintaining dental health, the WHO issued a cautionary advisory against the excessive consumption of ultra processed foods [81]. Notably, the portion size of consumption becomes a crucial determinant in categorizing a food item, such as mushrooms, as either safe or potentially toxic [82]. The European Food Safety Authority (EFSA) has established guidelines specifying the maximum permitted limits of sweeteners: acetosulfamate K at 9 mg/kg body weight, aspartame at 40 mg/kg body weight, cyclamate at 7 mg/kg body weight, saccharin at 5 mg/kg body weight, sucralose at 15 mg/kg body weight, and stevia at 4 mg/kg body weight [83].

Furthermore, it is imperative to recognize that a suboptimal dietary plan stands as a major contributor to tooth loss in adults [11,84]. This underscores the profound impact of dietary choices on oral health outcomes, emphasizing the importance of a well-balanced and nutritionally sound diet for overall dental well-being.

From this narrative review of 46 studies, it was found that a healthy habit, such as the consumption of fibers, may become harmful for dental care when children do not brush their teeth. The American Academy of Pediatric Dentistry (AAPD) encourages not only regular visits to the dentist but also brushing after consumption of meals and snacks or at least twice a day with fluoride toothpaste [85] and parental education [86]. On the other hand, the WHO recommendations are the consumption of carbohydrates of 130 g/day and adequate intake (AI) of total fiber of 25, 31, and 38 g/day for males aged 4–8, 9–13, and 14–18 years, respectively, and 25, 26, 26 g/day for females aged 4–8, 9–13, and 14–18 years, respectively [87]. For European health claims related to bowel function, the foods must also be “high in” the particular fiber (mentioned in the claim), which means the food should provide at least 6 g/100 g or 3 g/100 kcal (418 kJ) (corresponding to at least 7 g/MJ) [88].

Finally, although there are many recommendations from organizations for the daily consumption of nutrients and the Mediterranean diet as a dietary pattern with evidenced health benefits, consumers should eat the right portion at the right time (small and regular meals) [78]. Intermittent fasting is not for everyone (excludes diabetics or pregnant women), especially if it is not clear how many hours this should take place and whether it involves those with medical conditions. Reference is made to the usual pattern of 8 hours of eating...
and 16 hours of fasting. Moreover, it is not clear whether this dietary pattern benefits oral health or causes dental caries [89].

For healthy adults, the recommended consumption of whole grains varies by country as dictated by authoritative sources. This range spans from 75 g of whole grains per 2400 calories in Sweden to 48 g based on 16 g of whole grains per serving of 100% whole-grain wheat bread in the United States. Denmark’s recommendation aligns with four portions per day, equivalent to a minimum of 75 g of whole grains to meet energy requirements of 10 MJ/d [90]. Notably, recommendations regarding vegetable and fruit intake extend beyond fresh produce, advocating for a daily intake of at least 400 g of vegetables and fruits [78].

7. The Role of the Dentist in Promoting Healthy Nutrition to Support Oral Health and Prevent Dental Caries

The insights gleaned from review articles of this study underscore the potential role of alternative treatments as adjuncts to the field of dentistry. Effectively preventing and controlling dental caries necessitates the avoidance of sugary foods and drinks, coupled with the maintenance of adequate dental hygiene through regular brushing and flossing [15]. Achieving comprehensive nutritional intervention extends beyond merely “prescribing” nutritional instructions or imparting nutritional knowledge. It entails a collaborative effort between patients, dentists, and dietitians–nutritionists to attain nutritional goals [91]. Dietitians–nutritionists assume a multifaceted responsibility encompassing nutritional assessment, treatment planning, and patient guidance or consultation. But in guiding individuals towards desired modifications in dietary intake and behavior, dentists may play a pivotal role in communicating the nutrition and health messages for oral health [92].

The recognition of counseling expertise by dietitians–nutritionists and other health professionals gained prominence in the 1980s, prompted by clinical studies demonstrating that systematic counseling techniques contribute significantly to the successful long-term management of nutritional aspects in diseases, including caries [93,94]. Presently, referral to a dietitian–nutritionist is emphasized in the recommendations of numerous international guidelines [95–97]. Comprehensive nutritional therapy encompassing counseling has demonstrated greater efficacy compared to simple nutritional guidance [98]. Nonetheless, financial constraints or time limitations may hinder individuals from visiting a dietitian–nutritionist or a dentist, leading to a reliance on nutrition education as a viable alternative to oral health and diet [99].

A positive trajectory in the counseling process emerges when health professionals, dietitians–nutritionists, or dentists create a conducive environment to employ appropriate techniques [100]. These techniques aid individuals in recognizing the need for change and identifying specific, feasible actions to address their nutritional issues, which may manifest as dental problems [31]. The efficacy of this process hinges on the proficiency of health professionals in applying counseling skills with a focus on fostering a collaborative relationship with patients, encouraging adherence to recommendations, and ultimately enhancing the effectiveness of nutritional treatment [85].

A fundamental asset in nutritional counseling lies in the understanding and assessment of social, psychological, and other crucial personal factors that shape an individual’s receptiveness to a change in nutritional behavior [101]. The process of change disrupts established routines, induces feelings of insecurity and anxiety, and necessitates adaptation. It is inherent that certain patients exhibit varying degrees of resistance to change, which is both normal and anticipated. Furthermore, considering that beliefs underpin habits, a thorough investigation or reconstruction of these beliefs becomes imperative within the counseling process [102]. Consequently, although individuals with dental caries may recognize the importance of dental check-ups for their health, the decision to modify their diet can pose considerable challenges [32]. Thus, addressing the thoughts and emotions surrounding eating problems becomes an integral aspect of the problem-solving process. In essence, health professionals should utilize diet-counseling guidance as an instigator.
or facilitator of change in the initial stage, with subsequent involvement of other experts in the process’s later stages. Thus, nutrition counseling, with its multifaceted aspects and diverse applications, has emerged as a compelling field [103]. Moreover, dental caries shares common risk factors with other noncommunicable diseases, and integrated prevention and management efforts could yield positive impacts on overall health [104]. Given the shared risk factors with other chronic/systemic diseases, opportunities exist to formulate common prevention strategies and advocate for healthy dietary patterns. The involvement of all stakeholders is paramount in shaping future diet planning for a comprehensive intervention towards the relationship of diet with dental caries and oral health [103] (Figure 2).

Guidelines encompass several key recommendations for caries prevention in children, including avoiding frequent consumption of juice or other sugar-containing drinks in bottles or sippy cups; discouraging the practice of a child sleeping with a bottle, advocating for noncariogenic foods as snacks; promoting eating patterns consistent with the Food Guide Pyramid; limiting the intake of cariogenic foods to mealtimes; promptly clearing cariogenic foods from the child’s oral cavity through either tooth brushing or the consumption of protective foods; and restricting the consumption of slowly eaten sugar-containing snacks, such as candy, cough drops, lollipops, and suckers [105].

For adults, caries prevention and management protocols are structured around the individual’s caries risk [106]. Beyond dietary counseling, the emphasis is placed on maintaining an oral hygiene routine, receiving frequent fluoride varnish applications, and adopting personalized strategies, such as fluoride mouthwashes, remineralizing agents, and antimicrobial agents. Conversely, in the elderly population, often affected by hyposalivation due to medication, radiotherapy, or chemotherapy, measures to enhance salivary function (e.g., xylitol gums, antimicrobial mouthwashes, and salivary substitutes) are implemented. Recent advancements have introduced novel strategies, including the utilization of probiotics, prebiotics, and synbiotics [62]. Adhering to appropriate nutritional guidelines not only prevents complications associated with dental diseases but also enhances overall health, especially in the elderly [97].
8. Discussion

In the 21st century, oral diseases, especially dental caries, remain a major public health concern. Although progress has been achieved in developed countries like Greece to maintain and improve population health, managing these diseases requires a blend of preventive dentistry, self-care practices, and individual involvement. Recognizing that many health determinants are beyond individual control, the public dental health system bears the responsibility of supporting personal involvement [107]. Addressing diverse populations with varying issues and adapting to evolving epidemiological patterns demands constant adjustments from the public dental health sector. Similarly, the field of nutrition continues to evolve, requiring ongoing education for health professionals to instill healthy eating habits [61]. Consequently, members of the public dental health team play a crucial role in providing appropriate nutrition education and facilitating its implementation [97].

The objective of this literature review was to scrutinize the factors influencing human eating habits, the ramifications of poor nutrition across different age groups (children, adults, and the elderly), the psychological factors influencing these habits, and the dentist’s role in nutrition education. The focus on human malnutrition was deliberately omitted, with emphasis placed on the prevalent concerns of overconsumption [18] and psychogenic abnormalities or emotional eating disorders influencing dental caries within our country and the broader European region [81].

In general, educational interventions have demonstrated a positive impact on improving oral hygiene practices and mitigating the development and progression of caries across various surveys. For instance, in Thailand, children received health education every three months, showcasing the efficacy of such interventions [28]. Greek researchers compared different age groups and observed more pronounced benefits from educational interventions among the younger cohort [32]. Studies by Kariya et al. [30], Lueangpiansamut et al. [27], and da Silva et al. [28] indicated that children with lower body mass index (BMI) faced an elevated risk of dental caries, although Rani et al. [26] reported different findings in their survey. The evaluation of oral health was consistently conducted by experienced dentists across all studies [21,31,32], with oral health knowledge specifically assessed in only one study [23]. This study not only compared rural and urban populations but also juxtaposed their results with those from other counties [23]. Dietary habits, particularly the consumption of sugary foods outside of main meals, were frequently identified in surveys involving children [31,32]. Lifestyle factors, including the frequency of sugary food intake, age at initiating tooth brushing, tooth brushing frequency, fluoride toothpaste use, and parent-assisted brushing, exhibited close associations with dental caries, independent of dietary considerations [23]. Demographic characteristics, such as age, gender, parents’ education level, and nationality, were also subjects of examination in these surveys [23].

Another important finding is that most of the risk factors for dental caries were similarly associated between the sexes, so interventions targeting both men and women can be beneficial for dental health. As far as health-related issues are concerned, the perception of obesity as a “disease” requiring lifelong management, starting from childhood, stems from the realization that the behaviors contributing to the risk factors for dental caries originate in early life [4]. Effectively addressing this phenomenon entails an initial assessment by healthcare professionals to diagnose the root causes of overconsumption and subsequent excess weight. Subsequent interventions can then be tailored accordingly [81]. Moreover, fostering a stable family environment, encouraging active childhood engagement in physical activities, and instilling knowledge of healthy nutrition and oral hygiene practices from an early age lay the groundwork for cultivating healthy habits in adolescence and adulthood [15].
It is further recommended that children adhere to nutritional guidelines promoting the maintenance of a healthy weight status [108]. A balanced intake of fats, with an emphasis on unsaturated fats, along with dietary fiber, controlled sodium, and limited consumption of refined grains, while avoiding soft or energy drinks contributes to mitigating risk factors for dental caries [46]. Notably, most learners exhibit consistent flossing practices and demonstrate awareness of the significance of dental floss in maintaining oral health [109]. Consequently, this review underscores the imperative need for a comprehensive nutrition education program. Likewise, human pH telemetry studies show that subjects consuming three meals a day have periods of demineralization counteracted by periods of remineralization. When the meals are a greater number than normal and snacking is more often than twice besides the meals, children face dental caries [110]. Higher vegetable consumption is associated with lower caries incidence, and nitrates as supplements to diet can also have important anticaries effects. Long-term intake of nitrate-rich vegetables and fruits can reduce the risk of caries disease. Food sources that have high amounts of nitrate are rocket, spinach, beet leaf, basil, lettuce, parsley, cabbage, fenugreek, onion bulbs, radish, carrot, and tomato. The WHO suggests that the acceptable daily nitrate intake is 3.7 mg/kg body weight. Inside the oral cavity, exogenous administration of nitrate can maintain a balanced pH of saliva. A decreased concentration of nitrate is typical in the saliva of patients with dental caries compared to healthy individuals and during caries progression [11,92].

Thus, in promoting overall dental health, a diet characterized by low fat and sugar intake is crucial. Dental patients are encouraged to incorporate specific foods into their diet, such as onions, which are known for their ability to neutralize oral bacteria, and leafy greens like kale and spinach, which are rich in vitamins and minerals, including vitamin C, which aids in reducing inflammation. Green tea, which contains catechin, supports gum health by combating inflammation, while peppers and citrus fruits, which are high in vitamin content, contribute to oral well-being. Shiitake mushrooms, which contain lentinan, an antibacterial compound, help combat plaque-building bacteria. Crunchy vegetables are particularly beneficial as they stimulate saliva production, and dairy products have been linked to a reduced risk of caries, especially in the elderly [11,84]. Water, especially fluoridated water, is emphasized as the optimal choice for dental health, aiding in maintaining oral cleanliness and combating dry mouth. Regular fluoride intake is essential throughout life, regardless of dietary control, to protect teeth against decay [111].

For individuals dealing with bulimia nervosa, effective treatment focuses on understanding the patient’s emotions, facilitated by a therapist [112]. Conversely, addressing anorexia nervosa involves fostering acceptance of the individual’s external image, emphasizing a healthy perspective on body weight without resorting to extremes [113]. Adopting a Mediterranean diet, with olive oil as the primary source of fat, is associated with a reduced risk of depression symptoms and contributes to improved mood and overall well-being [11,114]. While the link between emotions, emotion regulation, and the gut microbiome is still a hypothesis, evidence supports the association between food consumption and positive emotions like happiness and hopefulness [115]. Thus, adhering to healthy dietary patterns not only enhances the quality of life but also fosters a willingness to engage in healthy body and oral care habits [92].

Overall, from our study, it is derived that the creation of a detailed nutritional lifelong profile involves a comprehensive understanding of dietary needs at various life stages and corresponding interventions to ensure oral health without caries. Below is a simplified tabular representation of a nutritional lifelong profile for a country like Greece, incorporating nutritionist interventions and educational actions for each age group (Table 5).
Table 5. Summary of nutritionist interventions and educational actions for each age group.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Nutritional Lifelong Profile for Oral Health</th>
<th>Nutritionist Interventions</th>
<th>Educational Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants (0–2)</td>
<td>Breast milk/formula for infants, introduction of solid foods with guidance</td>
<td>Nutrition counseling for breastfeeding/formula feeding</td>
<td>Oral hygiene education for parents, early childhood feeding</td>
</tr>
<tr>
<td>Children (3–12)</td>
<td>Balanced diet with emphasis on calcium-rich foods, limit sugary snacks</td>
<td>Nutritional guidance for parents and caregivers</td>
<td>School programs on healthy eating, importance of oral care</td>
</tr>
<tr>
<td>Adolescents</td>
<td>Increased calcium and vitamin D intake, reduced sugar consumption</td>
<td>Individualized dietary plans, addressing peer influences</td>
<td>School-based workshops, promoting healthy food choices</td>
</tr>
<tr>
<td>Adults (18–50)</td>
<td>Mediterranean balanced diet and focus on fruits, vegetables, and whole grains</td>
<td>Personalized nutrition consultations</td>
<td>Workplace wellness programs, seminars on nutrition and its impact on oral health</td>
</tr>
<tr>
<td>Older adults</td>
<td>Adequate calcium and vitamin B12, hydration, and soft food options</td>
<td>Nutrition support for age-related oral health challenges</td>
<td>Community seminars on nutrition for seniors, workshops on senior nutrition and oral care</td>
</tr>
</tbody>
</table>

Based on our research, it is evident that a one-size-fits-all approach to nutritional profiles and interventions will not suffice. Our findings emphasize the necessity of tailoring these strategies to individual health conditions considering factors such as cultural nuances, socioeconomic status, and health-related specifics within each country [1]. The key takeaway is the importance of a customized approach that addresses the unique needs of diverse populations. Moreover, our study underscores the critical role of collaboration among nutritionists, healthcare professionals, and educational institutions in effectively implementing and promoting lifelong oral health practices. This collaborative effort ensures a comprehensive and tailored approach that factors in the complexities of different contexts, contributing to the overall well-being of individuals.

Moreover, an increase in dental visits not only mitigates the risk of dental diseases, notably caries, but also serves as a catalyst for adopting a healthier lifestyle incorporating proper nutrition [108]. Positive impacts on psychological well-being through improved oral hygiene could further influence attitudes towards eating habits, facilitated with the assistance of a dietitian–nutritionist [50].

Given the absence of a definitive cure for dental caries, aside from dental visits, a personalized approach to food intake with a careful selection based on ingredient lists now available on product labels becomes imperative [108]. The market introduction of new tests employing RNA technology to unveil health insights and formulate precise, personalized nutritional products empowers individuals to take charge of their health. Recognizing healthy eating as a priority area, WHO underscores its significance in launching and strengthening oral health programs [11,92]. The latest WHO guide published in 2023 [1] identified factors that could be helpful for dentists, dietitians–nutritionists, and other health professionals to promote oral health and prevent dental caries through education. The main purpose is the provision of better access to effective nutrition education from health professionals to the whole population by sharing the risk factors, including obesity, malnutrition, excess sugar intake, weight, age, drinks consumption, and ultra processed food, at the first meeting. Then, a patient-centric approach to dental and overall health is required.

However, this study acknowledges certain limitations, including variations in intervention duration and methodology, as discussed elsewhere [108]. To comprehensively understand the impact of dietary patterns on dental caries, a deeper exploration into the role of daily eating occasions is warranted. Future longitudinal studies are recommended to collect detailed nutrition, teeth, and health data across all age groups. The study under-
scores the necessity of advancing consultative techniques in nutrition education among various health professionals considering their unique effects on overall and dental health. Collaborative efforts, such as referrals from dentists to dietitians–nutritionists for individuals at high risk of dental caries and joint community health promotion initiatives involving dentists and dietitians–nutritionists, are encouraged. Training seminars for dentists and dietitians–nutritionists by food scientists can further enhance their ability to develop and promote informative food labeling for relevant nutrients, such as sugar and caffeine.

9. Conclusions

Despite the emergence of new lifestyles that contribute to various health issues, particularly among the youth, such as oral diseases, targeted intervention programs implemented at a community level, either within educational institutions and/or by healthcare professionals, hold the potential to reshape lifestyles. These interventions aim to instill healthier habits in both the younger generation and the elderly. By embracing a healthy and balanced diet, both children and parents can prevent associated health problems, including dental caries.

To promote healthy nutrition and curb dental caries, strategies should extend beyond children to encompass adults. This can involve reducing the consumption of locally, regionally, and globally prevalent foods high in sugar and foods that are energy dense and nutrient poor. Interventions should be designed to influence food market manufacturers and align with nutrition labeling regulations to effectively address and prevent various nutrition-related diseases.

Moreover, the review identifies a notable gap in acknowledging the role of dentists in the nutrition education process. Future research directions should focus on exploring the influence of dentists in this domain, shedding light on this crucial aspect for a more holistic approach to oral health and caries prevention education.

Author Contributions: Conceptualization, T.V. and M.A. (Maria Antoniadou); methodology, M.A. (Maria Antoniadou) and T.V.; validation, M.D., M.A. (Maria Antoniadou), M.A. (Markos Amargianitakis), T.V., O.G. and O.A.; formal analysis, M.D.; investigation, M.D., M.A. (Maria Antoniadou) and M.A. (Markos Amargianitakis); resources, M.D., M.A. (Maria Antoniadou), M.A. (Markos Amargianitakis) and T.V.; data curation, M.D., M.A. (Maria Antoniadou) and M.A. (Markos Amargianitakis); writing—original draft preparation, M.D. and M.A. (Maria Antoniadou), writing—review and editing, M.D., M.A. (Maria Antoniadou), M.A. (Markos Amargianitakis), O.A., O.G. and T.V.; visualization, M.D., M.A. (Maria Antoniadou) and T.V.; supervision, M.A. (Maria Antoniadou) and T.V.; project administration, M.A. (Maria Antoniadou) and T.V. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

Nutritional status: overall health condition of an individual in relation to their dietary intake and the utilization of nutrients by the body. Body mass index (BMI): numerical value derived from an individual’s weight and height, providing a standardized measure to assess body fat and categorize individuals into different weight status categories, such as underweight, normal weight, overweight, or obese. FFQ: food frequency questionnaire. Adequate intake (AI): the average daily nutrient intake level that is assumed to be sufficient to meet the nutritional needs of a healthy population group; it is set when there is insufficient scientific evidence to establish a recommended dietary allowance (RDA), which is the average daily intake sufficient to meet the nutrient requirements of most individuals in a specific life stage and gender group.


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