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# The influence of sports drinks on the occurrence of erosion among athletes - a narrative review

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**Abstract**

**Introduction:**

Sports drinks are widely consumed by athletes to support hydration and performance. However, their acidic composition and frequent intake have raised growing concerns about their potential role in dental erosion, a condition that irreversibly damages the hard tissues of the teeth. Athletes may be particularly vulnerable due to exercise-induced changes such as reduced salivary flow and altered oral pH.

**Aim of the Study:**

The aim of this narrative review is to explore the relationship between the consumption of sports drinks and the prevalence of dental erosion among athletes, and to discuss the underlying mechanisms and preventive strategies.

**Materials and Methods:**

This review is based on a comprehensive analysis of scientific literature obtained from databases such as PubMed, Scopus, and Google Scholar, with a focus on the composition of sports drinks, erosion risk factors, salivary changes during physical exertion, and clinical observations among athletic populations.

**Conclusions:**

Frequent consumption of sports drinks, especially in combination with physical activity-related factors like dehydration and mouth breathing, significantly increases the risk of erosive tooth wear in athletes. Preventive strategies should emphasize education, dietary counseling, and fluoride-based interventions. Early recognition and personalized dental care are essential to reduce long-term damage and preserve athletes' oral health.

**Keywords:** “dental erosion”, “sports drinks”, “athletes”, “sports professionals”, “athletic performance” and “oral health”

## 1. Introduction

Sports and energy drinks, often promoted for their ability to delay fatigue, enhance concentration, and support hydration during physical exertion, have gained widespread popularity among adolescents and athletes worldwide [1, 2]. Studies have demonstrated that dental erosion affects both children and adults, with a clear age-related increase in prevalence and severity, the older the population, the more frequent and advanced the erosive changes appear to be [3]. In research conducted by Vered et al. [4], the prevalence of tooth erosion rose from 36.6% among individuals aged 15–18 to 61.9% in the 55–60 age group. A similar observation was made in the study by Wei et al. [5], where 67.5% of participants aged 35–49 exhibited signs of erosion, while in the 50–74 age group, erosion was reported in 100% of individuals. However, despite the functional benefits of these kinds of beverages, they are more often recognized as a potential threat to oral health [6-8].

Frequent intake of sugar-sweetened, acidic drinks, particularly in combination with intense physical exertion, creates a perfect environment for the development of dental erosion and other oral conditions [6, 9]. The low pH of these products, often made of ingredients such as citric acid, combined with reduced salivary flow during training, can accelerate enamel wear even in individuals who report otherwise good oral hygiene [8, 10].

Historically, sports dentistry has focused on trauma prevention, particularly in contact sports, yet evidence increasingly supports the role of chronic oral conditions in influencing sports performance. Attention is now shifting toward chronic conditions such as caries, gingivitis, periodontitis, and erosion - all of which appear to be prevalent among both amateur and elite athletes [11]. Recent data demonstrates a high need for dental treatment among athletes, with oral problems sometimes directly impairing daily function and athletic performance. Moreover, self-reported discomfort, difficulty in eating, and disrupted sleep due to dental pain have been documented as contributing factors to diminished training efficiency and reduced recovery capacity [12-14].

Erosion-related tooth wear is increasingly observed in athletes who regularly consume sports drinks, energy gels, or bars. Even with adequate hygiene practices, these individuals often experience irreversible damage to dental hard tissues [6, 7, 12] . This raises important concerns about the lack of awareness and preventive measures regarding oral health in the context of sports nutrition. This review aims to show current evidence on the relationship between sports drink consumption and dental erosion in athletes, with attention to risk factors, clinical manifestations, and preventive strategies relevant to sports health professionals.

## 2. Materials and Methods

A non-systematic literature review was conducted using PubMed, Web of Science, and Google Scholar databases. The search terms included “dental erosion”, “sports drinks”, “athletes”, “sports professionals”, “athletic performance” and “oral health”. Articles published until 25th of May 2025 were included. Fifty-three articles were identified for analysis.

## 3. Discussion

### 3.1 Biochemical Properties of Sports Drinks Relevant to Dental Health

Sports drinks were originally developed to support athletic performance by preventing dehydration and replenishing electrolytes and carbohydrates lost during exercise. Typically, these beverages contain water, glucose, maltodextrin, and fructose, along with added minerals such as sodium, potassium, and chloride to help maintain fluid and electrolyte balance [15]. While they were designed with athletes in mind, sports drinks have become increasingly popular among adolescents and young adults for casual consumption, often unrelated to physical exertion [16]. However, their widespread and frequent use raises concerns for oral health. Sports drinks are acidic by nature, often containing citric and phosphoric acids, and have a low pH that can fall below the critical threshold for enamel demineralization (pH 5.5). Repeated exposure to these acids can soften dental hard tissues, leading to erosive tooth wear over time [17, 18]. This risk is further compounded by the high sugar content in many of these drinks, which not only contributes to acid production by cariogenic bacteria but also promotes caries development.

Despite their marketing as functional and performance-enhancing beverages, there is limited evidence to support their benefits over water for most recreational athletes [19]. Instead, their frequent use, especially when consumed slowly, swished around the mouth, or used outside of training, may result in significant cumulative damage to enamel, increased tooth sensitivity, and a need for restorative treatment [16].

### 3.2 Mechanisms of Dental Erosion

Dental erosion is defined as the progressive and irreversible loss of dental hard tissue caused by chemical processes not involving bacterial action. The mechanism underlying this condition involves direct exposure of the tooth surface to acids, either of extrinsic or intrinsic origin, that destroy the protective and reparative capacities of the oral environment [20, 21]. Initially, acidic agents lead to the dissolution of the superficial mineral matrix of enamel, causing softening and increasing susceptibility to mechanical wear. If acid challenges are repeated and sufficient time is not allowed for remineralization via saliva, this softened layer is gradually lost, exposing underlying structures such as dentin, which is even more vulnerable due to its lower mineral content and higher critical pH [22]. In extrinsic erosion, the acids originate from dietary sources such as soft drinks, fruit juices, sports beverages, and acidic medications; they act primarily on labial and buccal surfaces of anterior and posterior teeth, respectively [1, 23]. In contrast, intrinsic erosion is the result of endogenous gastric acid exposure from conditions such as gastroesophageal reflux disease (GERD), chronic vomiting in eating disorders, or alcohol abuse. These acids primarily affect palatal surfaces of maxillary anterior teeth and occlusal surfaces of posterior teeth [22]. Saliva normally functions as a buffer and provides calcium and phosphate necessary for enamel repair; however, factors such as dehydration, mouth breathing, or medication-induced xerostomia can significantly reduce its protective capabilities, accelerating the erosive process [24]. Unlike caries, dental erosion often progresses silently, with minimal or no symptoms until advanced stages. Because the process is cumulative and irreversible, early detection and identification of causative factors are essential for effective prevention and management strategies [25, 26].

### 3.3 Reasons for Poor Oral Health Among Athletes

#### 3.3.1 Oxidative Stress

Numerous studies have reported elevated concentrations of oxidative stress markers in blood, saliva, and gingival crevicular fluid in individuals with periodontitis, reinforcing the connection between oxidative stress and periodontal inflammation [27, 28]. The progression of periodontal disease appears to be influenced by oxidative imbalance. While reactive oxygen species (ROS) are naturally produced during cellular metabolism and serve vital roles in immune responses and intracellular signaling, their overproduction leads to oxidative stress, influencing the body's antioxidant defenses [27, 29]. This imbalance contributes to damage of cellular membranes, impairs antioxidant systems, and is closely associated with the progress of periodontitis [2]. ROS also stimulate the production of pro-inflammatory cytokines and contribute to degradation of extracellular matrix components, leading to clinical manifestations such as attachment loss, bone destruction, and disease progression [2, 30].

The relationship between physical activity and oxidative stress is complex and depends on factors like exercise intensity, duration, and type. Moderate, regular physical activity promotes oral health and reduces oxidative stress levels [31]. In contrast, high-intensity training has been linked to elevated oxidative stress, which may compromise immune function, especially in elite athletes experiencing chronic stress and elevated cortisol levels, ultimately affecting oral and periodontal health [32]. Additionally, diets high in carbohydrates can exacerbate oxidative and inflammatory processes [33].

### 3.3.2 Sports Diet

The dietary habits of athletes are closely tied to the physical demands of their sport and often mean high carbohydrate intake to maintain performance, endurance, and recovery. While this nutritional approach is critical for muscle function and glycogen replenishment, it can have bad consequences for oral health. Frequent consumption of fermentable carbohydrates, such as energy drinks, sports gels, sugary snacks, and high-carbohydrate meals, creates an environment favorable to the proliferation of bacteria in the oral cavity [34, 35]. These products are often consumed multiple times per day and outside of main meals, leading to frequent acid exposure and extended periods of lowered salivary pH, which compromises enamel integrity and promotes caries development [36, 37]. Studies have linked sugar consumption between meals with significantly increased caries experience, underlining the importance of consumption frequency in addition to the quantity [2, 38].

The situation is further exacerbated by exercise-induced physiological changes. During intensive training, athletes often experience dehydration and mouth breathing, both of which reduce salivary flow. This impairs the natural buffering capacity of saliva, promotes plaque accumulation, and decreases its antimicrobial and remineralizing functions [2, 39]. Combined with elevated levels of cortisol and other stress hormones during intense physical exertion, which can suppress immune responses and decrease salivary immunoglobulin A (IgA) and antimicrobial proteins, the oral environment becomes more vulnerable to inflammation and bacterial imbalance [40]. The oral microbiota shifts toward a pathogenic composition, increasing the risk not only of dental caries but also of periodontal disease [41, 42].

Although foods rich in protein, common in sports diets, have been shown to have cariostatic properties and support tissue regeneration, their benefits can be decreased when consumed alongside or following sugary products [43]. Furthermore, some athletes may overlook the importance of consuming protective foods, such as cheese or milk, at the end of meals to decrease acidic effects, or forget to space meals adequately, which is crucial for maintaining oral pH balance. Therefore, while a well-structured sports diet is essential for performance, inadequate consideration of its oral health implications may predispose athletes to a higher risk of caries, gingivitis, and periodontitis, despite otherwise healthy lifestyle choices [44].

### 3.3.3 Salivary flow

Salivary flow plays a crucial role in maintaining oral homeostasis by contributing to the clearance of food debris, buffering of acids, antimicrobial defense, and enamel remineralization [12, 45, 46]. In athletes, however, several exercise-related factors contribute to decreased salivary secretion, thereby compromising these protective functions. Prolonged and intense physical activity often leads to dehydration and mouth breathing-both of which are well-documented causes of reduced salivary output [47, 48]. For example, research has shown that after a two-hour cycling session, salivary flow can decline by up to 39%, while secretory IgA levels - critical for mucosal immunity - may decrease by approximately 19.5% [12, 47]. This exercise-induced hyposalivation not only reduces the mouth's buffering capacity, increasing the time during which the oral pH remains below the critical threshold for enamel demineralization, but also diminishes its ability to neutralize acids and control microbial proliferation [49].

The frequent use of acidic and carbohydrate-rich sports drinks further exacerbates this issue. These beverages typically contain citric, phosphoric, or other organic acids, and their pH values often fall below 3.5 - well beneath the critical pH of enamel (5.5) and even more so of dentine (6.2) [37, 47, 50]. Under normal salivary conditions, the mouth can return to a neutral pH within 10 minutes after acid exposure; however, in dehydrated states with diminished salivary flow, this recovery may take up to 30 minutes or more [51]. As a result, prolonged or repeated contact between demineralizing acids and the tooth surface significantly increases the risk of dental erosion and sensitivity. Moreover, the high sugar content of sports drinks promotes acid production by oral plaque bacteria, contributing to caries development in addition to erosion [52].

Compounding these effects is the fact that many athletes consume sports drinks habitually, not only during competition but also in training and recovery phases. The frequency of intake - more so than total volume - has been identified as a key risk factor in dental erosion and caries among this group. Furthermore, during and immediately following high-intensity training, the protective properties of saliva may remain compromised for up to two hours, leaving the oral cavity vulnerable to acid challenges and microbial imbalance. This highlights the need for preventive strategies tailored to athletic routines [12].

## 3.4 Preventive and Educational Strategies

Preventive and educational strategies play a key role in limiting dental erosion, especially among young individuals regularly consuming acidic beverages like sports drinks. Education should focus on raising awareness of the harmful effects of frequent acid exposure and promoting behavioral changes [22]. Patients should be advised to reduce consumption of erosive drinks, avoid sipping them slowly or before bedtime, and use straws to minimize contact with teeth. Delaying brushing the teeth for at least 30 minutes can also protect softened enamel [7, 16, 20, 53]. Recommendations also include rinsing the mouth with water after consuming sports drinks, using fluoride-containing mouthwashes, and stimulating salivary flow with sugar-free chewing gum, though the latter should be approached cautiously in individuals prone to temporomandibular joint discomfort [12, 52]. Dentists play an important role in identifying early signs of erosion and guiding patients through practical, personalized prevention strategies [9].

## 4. Conclusions

Dental erosion is an increasingly recognized oral health concern among athletes, strongly associated with the frequent consumption of sports drinks. These beverages, while intended to support hydration and performance, often contain acids and sugars that can compromise enamel integrity. The cumulative effects of these factors place athletes at heightened risk of irreversible tooth structure loss. Given the asymptomatic nature of early erosion, timely diagnosis and prevention are crucial. Dental professionals should play an active role in educating athletes on the risks associated with sports drinks, promoting safer consumption habits, and implementing protective strategies such as fluoride use and dietary modifications. Raising awareness and integrating preventive oral care into sports health protocols may help reduce the long-term impact of dental erosion in this vulnerable population.

## Disclosure

Authors contribution
Conceptualisation: Wiktoria Musyt, Przemysław Klasicki
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Data curation: Wiktoria Musyt
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