DISORDERED EATING: PREVALENCE IN SPORTS AND ORAL MANIFESTATIONS: A REVIEW

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Abstract

The purpose of this review is to compare recent studies and to describe the presence of disordered eating, its complications, and oral erosive manifestations in athletes and normal subjects. Caloric restriction caused by diet or excessive exercise is an increasing trend and has significant health consequences. Disordered eating can lead to adverse effects on health and physical performance. Several personality characteristics have been claimed to be associated both with eating disorders and sport participation: competitiveness, concern about performance, body shape and perfectionism. Although eating disorders are mostly diagnosed in women, their prevalence among males is thought to have been increasing in recent years (e.g. body builders, weight lifters). But also non-professional performers of sports emphasizing thinness or muscularity, show a high degree of inappropriate eating behaviors. Many studies reported higher prevalence of disordered eating in athletes and in women, other studies, in contrast, found no significant differences between athletes and controls. This heterogeneity of the studies was the reason for this review. The major intention was to focus on the high-risk groups for disordered eating, and to outline oral complications affecting the hard (dental erosion) and soft tissues. Athletes are at greater risk of dental caries, dental erosion and traumatic injuries. The level of oral health is often described as poor. Possible causes include the diet/disordered eating, consumption of carbonated beverages, lemon, and sports drinks, decreased salivary flow during exercise, exercise-induced immune suppression.

Keywords: Prevalence. Disordered. Eating. Sport. Oral.

Disordered eating

Disordered eating is described as a spectrum of abnormal eating patterns, including bingeing, purging, food restriction, prolonged fasting, use of diet pills, diuretics, and laxatives, and other abnormal eating behaviors.

Disordered eating (DN) occurs on a continuum from dieting and restrictive eating, abnormal eating behavior, and finally clinical eating disorders (1). The term eating disorder includes anorexia nervosa (AN), characterized by a conscious dietary restriction with consequent loss of weight, and bulimia nervosa, characterized by binge eating followed by purging (self- induced vomiting). The eating binges are planned and occurr when the individual is stressed and feels out of control (2,3).

Both are psychosocial pathological eating disorders. An intense preoccupation with food, weight and a distorted body image coupled with a morbid fear of becoming obese are common elements in both syndromes. Self-starvation with extreme weight loss is associated with anorexia nervosa. Bulimia nervosa is characterized by unrestrained eating sprees followed by purging, fasting or vomiting. Approximately 50% of anorexia nervosa patients also practice bulimia (4).

In both AN and BN there are restricting- and binge/purging categories. If someone does not meet all the strict criteria for AN or BN, but their behaviors or eating symptoms compromise the individual`s physical or psychological health-, and/or interfere with everyday activities, they might meet the criteria for EDNOS (5). EDNOS, short for eating disorder not otherwise specified, is considered to be present when one or more criteria for AN or BN are not present or lack the required duration or frequency. Persons who meet the criteria for EDNOS often have a "normal" body weight, but they are focused on body image, weight, and guilt surrounding eating. It is important to observe that athletes suffering from BN also usually have a "normal" body weight (5).

Perfectionism appears to play an important role among patients with an eating disorder. The personality of both, those with anorexia nervosa (AN) and bulimia nervosa (BN), is thought to be intrinsically perfectionistic, which suggests a need to understand the role perfectionism plays in the development, course and outcome of these disorders (6). According to Slade (7), body image has been defined as "the picture we have in our minds of size, shape and form of our bodies, and our feelings concerning characteristics and our constituent body parts". Hilde Bruch (8) emphasized body image disturbance as a core feature of AN; this observation has been confirmed later and extended to other eating disorders, being now a relevant criterion for their diagnosis (9). Nevertheless, disturbances of body size estimation are not limited to eating-disordered persons. Cultural pressure toward thinness has a strong influence on body image, so that the cultures that emphasize thinness have the highest prevalence of eating disorders (10-14).

Disordered eating in sports

There is an increased focus on perfectionism among athletes and on its relationship to the higher prevalence of eating disorders in this group (6). For many athletes, it is desirable to have a high lean body mass and a low body fat mass to achieve a high power-to-weight ratio.

Athletic participation has often been linked to a higher prevalence of eating disorders, which are found to be particularly widespread among performers of certain types of sports or physical activities, such as ballet (15-20), gymnastics (21-23), running (24-26) and skating (27,28).

Several personality characteristics have been claimed to be associated both with eating disorders and sport participation: competitiveness, concern about performance, compulsive concern about body shape and perfectionism (29). In addition to dieting, further important risk factors are: personality factors, pressure to lose weight, frequent weight cycling, early start of sport-specific training, overtraining, injuries, and unfortunate coaching behavior (1).

Relationships between athletes, abnormal eating behaviors, and eating problems have been demonstrated through the development of specific terms including weight cycling, anorexia athletica, and the female athlete triad (22, 30-36).

Female athlete triad (first described in 1992 by the American College of Sports Medicine) includes disordered eating, amenorrhea, and osteoporosis. Low energy availability from either dietary restriction or increased expenditure plays a central role in the development of the triad.

In trying to understand this complicated problem, one must grasp the concept that the three pathologies are interrelated and difficult to explain when the influence of any of the other components is missing (37). Disordered eating is linked to menstrual irregularities because caloric restriction or energy imbalance contributes to metabolic disturbances, such as irregular secretion of luteinising hormone (38, 39), oestrogen deficiency and other hormonal changes, which are involved in the regulation of the menstrual cycle (40). Oestrogen deficiency has been implicated as a primary cause of osteopenia in amenorrheic athletes (41). Thus, athletes with menstrual irregularities during their late teens or early adulthood may fail to reach peak bone mass (42), exposing them to the risk of osteoporosis and osteopenia later in life. But osteoporosis is not always caused by menstrual irregularity. Energy restriction may also lead to a lower bone mineral density (43). Prevention of osteoporosis as well as stress fractures and other considerable medical consequences is also critical, especially among women participating in sports that emphasize a lean physique and in weight-restricting sports such as gymnastics and competitive martial arts (44).

Although eating disorders are mostly diagnosed in women, their prevalence among males is thought to have been increasing in recent years (45). Different studies have been performed in order to evaluate the prevalence of eating disorders among males, especially athletes, and some authors described a new clinical feature, firstly known as "reverse anorexia" (46) and recently renamed into "muscle dysmorphia" (47,48), which is thought to affect about 8 to 9 percent of male body builders and weight lifters. Its mean feature is an altered body size perception that leads to an underestimation of the muscles and the whole body development (48-50). These subjects, performing highly competitive sport and beeing in need of a firm control upon their body weight and shape, often undergo physical hyperactivity, unbalanced diets and use of anabolic drugs (51-54).

Eating disorders are multidimensional problems. An interdisciplinary team that involves coaches, athletic trainers, nutritionists, physicians, and sport psychologists will offer the best approach for prevention, identification, and treatment.

Prevalence

Among sportsmen, eating disorders have a higher prevalence of 23 to 25 percent (55) and it has been estimated that the prevalence of disordered eating in athletes ranges from 15 to 62 percent (56, 57)

There is an increased focus on perfectionism among athletes and its relationship to the higher prevalence of ED. Also perfectionism plays a role in the development, course and outcome of these disorders (6). The body uneasiness is not a consequence of physical activity, but it is related to the type of sport performed. In fact, as suggested by several authors, the drive for thinness, which is present in several types of sports and is strictly related to the performance (e.g. ballet), plays a role in influencing the perception of body shape (16, 58, 59). Athletes most at risk for ED are those involved in sports emphasizing a thin body size/shape, a higher power-to-weight ratio, and /or sports utilizing weight categories, such as in some high-intensity sports. In addition to dieting, important risk

factors are: personality factors, pressure to lose weight, frequent weight cycling, early start of sport-specific training, overtraining, injuries, and unfortunate coaching behavior (1).

Athletes who participate in lean and aesthetic sports (those that emphasize weight categories or aesthetics, such as ballet, gymnastics, or endurance running) are at higher risk for developing eating disorders than those doing sports that do not have such a focus on body or weight (31, 51, 60-66).

The prevalence of eating disorders is increased in elite athletes and for this group the cause of starting a diet is related to a.) the perception of the paradigm of appearance in the specific sport, b.) the perceived performance improvements, and c.) the sociocultural pressures for thinness or an "ideal" body (1).

Disordered eating (DE) in athletes is characterized by a wide spectrum of maladaptive eating and weight control behaviors and attitudes. These include concerns about body weight and shape, poor nutrition or inadequate caloric intake, or both, binge eating, use of laxatives, diuretics, and diet pills; and extreme weight control methods, such as fasting, vomiting, and excessive exercising (67-70).

Many studies have showed a higher prevalence among athletes compared with controls (29, 31, 71). Two large, well-controlled studies reported the prevalence of eating disorders among female athletes, range from 20 to 22 percent as compared to 5.8 to 9.0 percent in the normal population (31, 62).

Disordered eating and related weight control behaviors, such as excessive exercising and restrictive eating, represent serious health problems for girls and women in the US and other industrialized nations (72). Walsh et al. (73) found out that 95% of patients with anorexia nervosa are female. The prevalence has been estimated to be about 1% in adolescent girls, although it may be subclinical in up to 10% of young women aged 16 to 25. Other risk factors for anorexia nervosa include being a middle- to upper-class female, participation in activities valuing thinness (ballet, gymnastics, modeling) and a family history in ED. An episode of anorexia nervosa is typically precipitated by a stressful situation. The estimated prevalence of bulimia nervosa is 3 to 10 percent of adolescent and college age women in the US (73). Other showed disordered eating in young females ranging from 13 to 30 years. Anorexia nervosa (AN) ranges from 0.5 to 2 percent, Bulimia nervosa (BN) from 1 to 3 percent and eating disorders not otherwise specified (EDnos) from 2 to 13 percent (9, 70).

The prevalence of disordered eating is higher in adolescent elite athletes than in controls and higher in female than in male athletes (74). Many female athletes exhibit DE patterns. Although these athletes may not meet criteria for anorexia nervosa or bulimia nervosa and typically do not have disturbances in body image, behaviors and complications similar to those seen in full-blown eating disorders are seen. A marked prevalence in women relative to men (F:M ratio of 10:1), the average age for anorexia of 16 years and a later presentational age of 25 for bulimia nervosa was found (75, 76).

Prevalence research supports the contention that female athletes are at risk for developing eating disorders (31, 60, 77-79). These studies suggested that female athletes a.) in general experience clinical eating disorders and even higher levels of subclinical problems, and b.) may be particularly at risk in sports that are identified as aesthetic (gymnastics) and/ or lean (swimming).

Anderson & Petrie (61) based their study on a geographically diverse group of female collegiate athletes from two sports, swimming/ diving and gymnastics, and they found rates of clinical (6.3 %) and subclinical (26.1 %) disordered eating. Their results were slightly higher than reported in previous studies with mixed sport samples of female collegiate athletes with reported prevalence rates for clinical disorders to be 2 to 5.7 percent and for subclinical levels to be 14.5 to 25.5 percent (61, 77, 78, 80, 81).

Amenorrhea, both primary and secondary, is more common in female athletes than in their more sedentary peers. The female athlete triad is more common in appearance- and endurance-based sports such as gymnastics, ballet, and long-distance running. It also seems to be more common in athletes who are training seriously and who have an over-controlling parent or coach. Estimates of the prevalence of disordered eating in athletes range from 15 to 62 percent, and amenorrhea may occur in 3 to 66 percent of the athletes (56, 57).

Female athletes have been identified as a subgroup to study because of the unique weight, performance, and body image pressures they experienced from coaches, teammates, fans, and judges. Such "sport-environment" pressures, when combined with general societal messages about the need to be thin and attractive, are thought to substantially increase female athletes´ risk of developing disordered eating problems (82).

Although the extent of DE in athletes is unclear due to methodologic limitations of existing studies (primarily the lack of standardized assessment tools and consistent criteria for defining DE), prevalence estimates have ranged as high as 62% among female athletes and 33% among male athletes (29-31, 71, 83-90). Although large-scale studies of at-risk subgroups of athletes (31, 60) have been methodically sound and provided useful prevalence data, they have been limited in two important ways. First, these studies focused solely on elite/ Olympic-level athletes from one country. Thus, the generalizability of the findings is limited and little is known about other levels of sport participation, such as college-level athletes. Second, their prevalence data were determined based on either the entire sample (vs. controls) or large subgroups of sports, such as lean, aesthetic, or ball game. Thus, the prevalence data are not specific to one sport but rather to a group of sports purposed to have similar characteristics (61).

Disordered eating (ED) can lead to adverse effects on health and physical performance. Consequences of ED upon health and physical performance depend on the athlete`s immediate health status, the demand of sport-specific training, the type, severity, and duration of the pathogenic weight control or eating behaviors, the degree of nutrient deficiency, the presence of comorbid physical and mental disorders, and the timing and quality of therapeutic interventions (31, 91, 92).

Coaches, sports medicine personnel, and sport psychologists need to be aware of that most female gymnastics, swimmers, and divers with an eating disturbance will be at the subclinical level and will not necessarily be underweight nor always "appear" to have a disorder (less than 2 % of the athletes in the study of Anderson & Petrie (61) were underweight in terms of their BMI). These disorders are also likely to occur equally across race/ ethnicity and school year (61).

Nevertheless, eating disorders usually go unnoticed unless the athletes themselves acknowledge their problem and seek medical help (93).

It is recommended that more attention may be placed on women participating in higher levels of competition, besides just those participating in the leanness sports.

But also non-professional performers of sports emphasizing thinness or muscularity, such as ballet and body-building, show a high degree of body uneasiness and inappropriate eating attitudes and behaviors (94).

Oral manifestations/ oral complications

Often the dental professionals are the first to discover and diagnose disordered eating by detecting the clinical dental and oral symptoms and consequently face the difficult task to motivate the patients, who often deny their illness, to seek psychiatric help and dental care. The patients are mostly embarrassed about their behavior and therefore highly secretive. Dental staff members often do not feel comfortable beginning a dialogue with patients who are suspected of having an eating disorder (95). Burkhart et al. (95) suggest a dialogue for approaching these patients and offer educational material to reduce further tissue destruction.

The difficulties of recognizing the oral manifestations, and the failure to do so, may lead to serious systemic problems in additions to progressive and irreversible damage to the oral hard tissues.

Detection requires awareness of risk factors, symptoms and signs of, anorexia nervosa (e.g. participation in activities valuing thinness, family history of an eating disorder, amenorrhea, lanugo hair) and bulimia nervosa (e.g. unsuccessful attempts at weight loss, history of childhood sexual abuse, family history of depression, erosion of tooth enamel from vomiting, parotid gland swelling, and gastroesophageal reflux (73)). The oral manifestations may vary in severity with the length of time the person has had the eating disorder, the degree and frequency of pathological eating behaviors, and the diet and oral hygiene.

Objective oral signs and symptoms of bulimia do exist and their presence can facilitate a diagnosis of bulimia during routine examination. The realization that five oral signs and symptoms of bulimia -- dental erosion, salivary gland enlargement, xerostomia, oral mucosa erythema, and cheilitis -- are associated with the disease can eliminate some laboratory tests as well as facilitate an earlier diagnosis of bulimia (96).

1. Dental erosion

Dental erosion is defined as the constant loss of the teeth hard tissues caused by chemical agents without the influence of a carious process or bacteria (97-99). The wear may cause the flattening of the occlusal surface and the loss of occlusal vertical dimension of the patient. Additionally, there may be shortening of anterior teeth, bringing serious consequences to the quality of life of the patient and preventing him from talking or smiling (100).

In general, root surfaces were more susceptible to erosion than enamel surfaces. This is expected because of compositional differences; enamel is approximately 95 % mineral and 5 % organic material while the root (i.e. cementum and dentin) has a lower mineral and higher organic content (101). The difference is clearly visible as enamel surfaces are almost completely eroded while the root surfaces retain an organic matrix (102).

Dental erosion is a multifactorial condition with many risk indicators. Medical condition including frequent mouth dryness, and having frequent bouts of vomiting or using a cortisol inhaler, dietary habits including consumption of carbonated beverages, lemon, sour candies, and sports drinks, keeping soft drinks in the mouth for a long time, brushing teeth following soft beverages or drinking lemon juice at bed time (103).

Erosion can be classified according to the criteria of Eccles and Jenkins (104). The following findings characterize an erosion: 1.) absence of development ridges on the enamel, resulting in a smooth glazed enamel surface; 2.) concavities in the cervical region on the labial enamel surfaces whose breadth greatly exceeded their depth, thus distinguishing them from cervical abrasion lesions; 3.) edges of amalgam restorations raised above the level of the adjacent tooth surface; 4.) depression of the cusps of posterior teeth, producing "cupping". In more severe cases, dentin is also involved.

Dental erosion can have extrinsic or intrinsic causes:

A. Intrinsic causes include recurrent vomiting, regurgitation of gastric contents, low salivary flow.

B. Extrinsic causes include demineralizing acidic foods (citrus fruits, acidic beverages), chewable vitamin-C tablets and iron tonics, frequent swimming in chlorinated pool water. (105).

Intrinsic dental erosions due to the frequent vomiting or gastroesophageal reflux

Dental erosion does not occur until gastric acid has acted regularly on the dental hard tissues over a period of several years. Dental erosion is caused by diseases which are associated with chronic vomiting or persistent gastroesophageal reflux over a long period, such as: disorders of the upper alimentary tract, specific metabolic and endocrine disorders, cases of medication side-effects and drug abuse, psychosomatic disorders, e.g. stress-induced psychosomatic vomiting, anorexia and bulimia nervosa or rumination (106). Brushing the teeth after a binge can worsen the problem, but rinsing with baking soda after vomiting seems to alleviate some of the acid-related complications (107-109).

Smooth erosion of enamel and permolysis (defined as a loss of enamel and dentine on the lingual surfaces of teeth) are a result of chemical and mechanical effects caused by stomach acid and chronic/ frequent self-induced vomiting and are activated by movements of the tongue. It is first seen on the palatal surfaces of the maxillary front teeth. The initially moderate demineralization or glassy erosion of the lingual surfaces of the maxillary teeth may enlarge, extending to the occlusal surfaces of posterior teeth and facial surfaces of maxillary, and, infrequently, mandibular teeth. A generalized erosion may lead to posterior teeth with outstanding amalgam restorations, to exposed and damaged dentine, even with visible pulps, resulting in teeth hypersensitive to temperature, chewing and brushing (110, 111) and to occlusal changes (anterior open bite, loss of vertical dimension (112).

Extrinsic dental erosions due to demineralizing acidic beverages and swimming in chlorinated pool water

Erosive potential of acidic beverages/sports beverages

Larsen et al. (113) of Denmark investigated the in vitro erosive potential of soft drinks, mineral waters and orange juices and compared erosion depths to the pH-value and buffering capacity of the beverage. They reported that erosion was minimal in beverages containing a pH-value above 4.2, but became more evident with pH-values decreasing below 4.0.

Rees et al. (114) reported that sports drinks based on acidic fruits popular in the United Kingdom have low pH-values, and are erosive when enamel is immersed in the sports drink. Sports beverages can produce substantial surface loss and surface softening (115). People with healthy lifestyles and athletes may consume acidic drinks, doing this frequently during low salivation conditions (physical training) or making excessive use of the same day by day, trying to keep body weight (98). An exaggerated intake of sports supplements (isotonics) may also cause gastroesophageal changes (116).

People with high consumption of acidic beverages, decreased salivary flow, prolonged beverage holding habits, or mouth breathing could be at an increased risk for dental erosion (102).

Frese et al. (117) observed no difference with regard to salivary parameters in endurance runners, but load-dependent changes in salivary parameters (after and at maximum workload, saliva flow rates decreased and saliva pH-value increased significantly) and an increased risk for dental erosion.

The nature of consumption (i.e. sipping for extended periods or concurrent with mouth breathing during athletic training) could increase the opportunity for erosion to occur (102). Rios et al. (118) reported an association between incisal tooth wear and mouth holding of beverages prior to swallowing in 6-year-olds from Brazil. Rios et al. also reported that brushing enamel immediately after exposing it to acidic beverages increased tooth loss (119).

Bryant et al. (120) reported about the risk factors for dental caries and erosion in elite triathletes in New Zealand. Sports drinks were consumed by 83.9 % of the triathletes while training; for 48.4 %, the consumption of both sports drinks and water was described as "little sips often, from a bottle". Eating during training session was reported by 93.5 % of the participants, of which 62.1 % only ate during cycling training. Only 3.2 % perceived training as a high risk to oral health. All clinical examination cases were assessed as a high risk for developing caries. The diet of elite triathletes is consistent with a high risk profile for caries and erosion.

Dental erosion/ tooth wear was also reported from Milosevic et al. (121) (swimming and cycling) and Needleman et al. (122) (Olympic sports) with no data from control populations. In the study of Bryant et al. (102) proportions of athletes with wear into dentine were high, ranging from 36 % to 85 % with only one study recording no wear.

Ehlen et al. (102) tested acidic beverages. The quantity of base required to neutralize the beverages upon opening was highest for energy drinks followed by regular and diet sodas and then 100 % juice and sports drinks. The quantity of base required to bring beverages to neutral after 60min of vigorous stirring was again highest for energy drinks followed by regular and diet sodas and then

100 % juice and sports drinks. The in vitro nature of the experimental design and artificial time of exposure are study limitations (102). The in vitro design exposes the tooth to the beverage for a defined time period without considering the rate of beverage consumption, length of swallow, movement within the mouth during swallowing, clearance by saliva and remineralization potential of saliva.

Järvinen et al. (123) detected a considerable risk of erosion when citrus fruits were eaten more than twice a day (37 times higher), soft drinks were drunk daily (4 times higher), apple vinegar was ingested weekly (10 times higher), or sport drinks were drunk weekly (4 times higher), in individuals who vomited once a week or more (31 times higher than vomiting not that often), or exhibited gastric symptoms (acid taste in the mouth, belching, heartburn, stomach-ache, gastric pain and awaking) once a week or more (10 times greater, each times respectively, than when the habit did not exist), and in those with a low unstimulated salivary flow rate (123). The demineralizing effect of citric acids is exceptionally great because its chelating action on enamel calcium continues even after the pH-value increased at the tooth surfaces (124, 125). For instance, consuming 350g of grapefruit juice each day for four weeks produced detectable changes in the enamel surface (126). Many soft drinks contain citric, phosphoric, carbonic, and other acids, and oftenhave a pH-value of less than 4.0 (104, 127). Soft drinks, except those containing just carbonic acid, have been reported to cause dental erosion, both in case studies (104,128,129) and in vitro (130). In studies, sport drinks have turned out to be strongly erosive (130-132). Frequent consumption of pickles causes erosion in those eating lactovegetarian diets (133). The unstimulated salivary flow rate is an important factor determining whether dental erosion occurs (2, 134). A patient with an unstimulated salivary flow rate of 0.1 ml/ min or less is at a 5 times higher risk of erosion than those with higher flow rates (123). At normal salivary flow rates, acidic drinks are eliminated from the mouth in about 10 min, and the pH-value at the tip of the tongue remains low for only some two min after the drink has been consumed (135). In contrast, in patients with low salivary flow rates, the pH-value remains low for about 30 min (136). Many such factors could be eliminated by general measures, such as increasing the availability of information about acidic products and gastric conditions, and through product development. It is important for erosion to be diagnosed at an early stage and to identify the risk factors. This increases the possibilities of successful treatment and reduces complications associated with mechanical intervention (123).

Due to the dental erosion risk, sports beverages should not be consumed in low salivation conditions during physical training or mouth breathing, not day by day, in no prolonged beverage holding habit, or little sipping often from a bottle. After the consumption the drinking of water is useful to increase the pH level. Sports beverages should have a pH-value higher than 4.2.

Erosive potential of swimming in chlorinated pool water

Savad (137) first reported that swimmers may be susceptible to acid erosion of enamel. Two other studies confirmed this suggestion (105, 138). Several reports indicate an increased prevalence of dental erosion among frequent swimmers due to low pH gas-chlorinated pool water. Contrary to other extrinsic factors which induce erosion located on the facial tooth surface, pool water with a low pH-value results in general dental erosion (138).

Swimming pools are chlorinated to reduce bacterial and algal contamination. There are several ways to add chlorine, which should preferably have a concentration of 2-3 ppm (minimum 1 ppm) (139). The pH-value of the water is then adjusted to about 7,5 by the addition of acid or alkali. Sources of chlorine are sodium hypochlorite, which has an alkaline pH-value and, has no potential to cause erosion in teeth (140); chlorine gas, which is used mainly in large public swimming pools; and "stabilized" chlorine, which is created by combining chlorine and the salts of cyanuric acid into a tablet form in a solution, chlorine generates hypochlorous and hypochloric acids, the former having disinfectant properties. Cyanuric acid retards the rate at which hypochlorous acid is broken down by sunlight. Unless the acids are neutralized, usually with sodium carbonate, the pH-value of the water may be less than 3 (105,138). A low pH-value may cause eye irritation and in contact with the teeth will cause irreversible erosion of the enamel (140).

In the study of Kaczmarek (141) each competitive swimmer spent 16-25 hours per week in the swimming pool and had more dental erosion than the control group. The erosion was mainly located on the labial surface of the maxillary incisors. The caries intensity was similar to the control. Baghele et al. (142) looked for the prevalence of dental erosion among young competitive swimmers in India. 90 % showed dental erosion, 94 % exhibited rough surfaces, directly proportional to the duration of swimming

Centerwall et al. (105) looked for dental erosion among competitive swimmer who swam in a gas-chlorinated swimming pool (pH-value of 2.7) and found erosion in 39 % of the swim team members. Geurtsen (138) described a very rapid occurrence of excessive general dental erosion at a competitive swimmer due to gas-chlorinated pool water that occured within 27 days.

A regular pH-value monitoring of chlorinated swimming pool water is very important and it is recommended to fluoridate the teeth of intense swimmers regularly to prevent dental erosion (138).

2. Parotid gland hypertrophy

The swelling is generally asymptomatic, painless and intermittent (108), the onset of swelling usually follows a binge-purge episode by 2 or 6 days (142). The mechanism of hypertrophy has been variously attributed to high carbohydrate intake or regurgitation of acid gastric contents. The unilateral or bilateral incidence is between 10 and 50 percent (143), and occasionally a swelling of the

mandibular gland can occur. Concerning the salivary chemistry, Tylenda et al. (142) found no differences in the concentrations of potassium, chloride, calcium, urea nitrogen or albumin between patients with bulimia nervosa and controls. There also was no evidence of olfactory dysfunction.

3. Salivary flow and xerostomia

Although apparently unrelated to gland hypertrophy there have been reports of reductions in unstimulated salivary flow rates in patients who binge eat and induce vomiting (142, 143). Vomiting and misuse of laxatives or diuretics cause a decreased total fluid volume in some patients, thus contributing to a diminished salivary flow and a possibly reduced buffering capacity and /or lowered pH-value (2, 144). Antidepressant drugs in the treatment of bulimia nervosa, as well as depression and anxiety, may also induce xerostomia (96). The reduction or loss of the salivary buffering capacity would likely contribute to the process of enamel erosion. The occurrence and the progression of dental erosion in this respect have been pointed out by various authors (106, 123).

Sanchez et al. (145) reported that children with erosion had lower salivary flow rates and buffering capacities than children without erosion.

4. Oral mucosa

The oral mucous membranes and the pharynx may be traumatized in patients who binge eat and purge, both by rapid ingestion of large amounts of food and by the force of regurgitation (146). Erythema of the palate, pharynx and posterior tongue, and traumatic pharyngeal tears may result from the use of fingers, combs, and pens, to induce regurgitation of the stomach contents. Dehydration and angular cheilitis have also been observed (146).

Poor oral hygiene is more common in anorectics than bulimic patients (147), -higher plaque indices and gingivitis are then likely clinical findings. Anoretics manifest less interest in oral hygiene, which is probably a result of the extremely serious nature of the anoretic psychopathology, particularly the distorted self-perception and body image (4, 75). Bulimic patients, apparently have a more realistic body image and are often so concerned about their appearance as to be scrupulous about their hygiene and oral care (4, 75). The loss of moisture and the protective properties of saliva can result in dehydration of the periodontal tissues, dietary vitamin and protein deficiency can exacerbate the situation (4). The development of caries is less predictable and appears to be dependent on the diet and oral hygiene.

General oral health in athletes

Athletes are at greater risk of dental caries, dental erosion and traumatic injuries (148). The poor level of oral health in athletes is not a new finding (149). Possible causes include the diet (120), use of sports drinks (150-152), decreased salivary flow during exercise (153), exercise-induced immune suppression (154), level of knowledge and beliefs related to oral health, difficulty of assessing oral health preventive care due to the availability of local services and prioritisation of time.

Ashley et al. (155) showed in their study that in contrast to the common perception that athletes are healthy "all over", the oral health of sampled athletes is poor. Caries occurred in up to 75 % of athletes surveyed. The examinated athletes also experienced other oral problems such as periodontal disease, dental erosion and dental trauma. The oral health of athletes appears to be poor across a wide range of sports. Dental caries and dental erosion affected the majority of sampled athletes. Irreversible periodontitis affected up to 15 % of the participants (155).

Frese et al. (117) observed no difference with regard to caries prevalence, but an exercise dependent caries risk (correlation between caries prevalence and the cumulative weekly training time).

No studies compared data with either controls or population norms. Owing to this lack of comparative data, it is difficult to make any statements regarding the oral health of elite athletes relative to a non-athlete population. Data from control groups, or population norms, concerning prevalence of periodontal disease in athletes were not presented (155).

Oral and dental treatment

The major component in the therapy of disordered eating is psychological, with influences from the family, social, and even religious spheres (156).

the primary goal of dental care is to preserve the remaining teeth and to prevent further erosive loss of dental hard tissues. It is recommend to reduce the consumption of isotonic drinks, change the eating habits (no spicy and fatty foods, citrus fruits, coffee, tea, chocolate, alcohol, and soft drinks) and to get used to walks after eatings (157).

Palliation of pain and temporary cosmetic procedures, until the patient is adequately stabilized, are the first steps of dental treatment. The prognosis for dental treatment depends on the cessation of the binge eating and vomiting habit. Extensive restorative oral rehabilitation should be postponed until the underlying psychiatric components of the disorder are stabilized (4).

Initial dental care focuses on improved oral hygiene. The use of gastric acid-neutralizing antacid rinses and the daily application of topical fluorides can be useful in reducing enamel erosion (4). Calcium and fluoride have been shown to limit the extent of erosion by saturating the solution and/or altering the solubility of enamel (113,158-161).

Dental restorative therapy must be part of a combined medical and dental treatment plan and should not be started before the ED has been treated and the patients are considered to have stable prognosis. In view of the young age of the patients, the large extensions of the erosive lesions and in order to avoid endodontological treatment of mostly sound pulps, non-invasive restorative concepts using adhesive technology should be preferably used (162). Composite restoratives exhibit acceptable resistance to dissolution by acids and they are reversible.

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