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## **Risk factors for erosive tooth wear in a healthy lifestyle**

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## **Abstract**

Dental erosive wear is of growing concern among clinicians, and it is of general belief that the prevalence of erosive wear among children, adolescents and young adults has increased. The aim of this study was to investigate risk factors for erosive tooth wear in a group of physically active people in a training centre in Tromsø, Norway. The hypothesis was that individuals with a pronounced healthy lifestyle with frequent physical exercise and specific dietary habits could have an increased risk for developing erosive tooth wear. 211 people who visited the training centre completed a questionnaire anonymously, with age ranging from 15 to 67 years old. The results showed that the participants had good oral hygiene habits and regular visits to the dentist. Most of them did not show increased risk in the pattern of consumption of sour drinks, sour foods, and sports drinks. Some of them drank nutritional supplements during exercise, most of the participants with high intake of these supplements were men. Most of the participants in this study did not report habits that indicated an increased risk for erosive tooth wear in their healthy lifestyle.

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## 1. Background

The prevalence of caries has decreased (Marthaler 2004) and dental erosive wear is of growing concern among clinicians. It is of general belief that the prevalence of dental erosion among children, adolescents and young adults has increased. This will entail a need for information regarding the risk factors and aetiology behind dental erosive wear and how to prevent it from both occurring and worsening (Lussi and Carvalho 2014).

In today's society there is a change in lifestyle, including eating and drinking habits in the population. Especially young adults experience the pressure of living a healthy lifestyle with eating healthy food, staying physically active and weight control. A healthy lifestyle with frequent physical activity combined with a high intake of acidic food and beverages could result in an increasing acidic influence on the teeth. Extensive physical activity may lead to considerable fluid loss affecting saliva flow. (MacKinnon and Jenkins 1993; Walsh 2004; Mulic et al. 2012; Frese et al. 2014). In combination with frequent consumption of acidic beverages, like sports drinks, decreased saliva flow may further increase the risk of negative influences on the teeth.

To our knowledge there are few studies on risk factors for erosive tooth wear in a healthy lifestyle. The project is designed with the intention to shed light on this subject and discuss the literature that can be included as relevant.

The hypothesis was that individuals with a pronounced healthy lifestyle with frequent physical exercise and specific dietary habits could have an increased risk to develop erosive tooth wear.

The aim was therefore to present the background, age, gender, education, behavioural, dietary and medical variables in a group of physically active people at a fitness studio in Tromsø, Norway. By this investigation we wished to explore what impact a healthy lifestyle entails on the oral health and what risk factors these individuals possibly can be exposed to. The clinical significance would be to illustrate the topic of dental erosive wear and, contribute to increased knowledge on how to prevent it from occurring and how to arrest progression, by identifying and modifying risk factors.

## 2. Introduction

### 2.1 Concept of risk

Risk is the probability that an event will occur, and is most often used to describe the probability of a certain outcome following a particular exposure. A risk factor is defined as an environmental, behavioural, or biological factor, which if present increases the probability of disease and if absent or removed reduces the probability (Beck 1998). The concept of risk has existed for a long time in health practice, but in dental health practice the concept of measuring and assessing risk presented itself as important more recently. In the last decades there has been a change in oral health status from a state where most of the population was affected with for example caries, to a state where only some are affected. This introduced the need for determining and predicting which individuals were at risk (Burt 2005). Erosive tooth wear is described as a multifactorial condition (Lussi and Carvalho 2013). It is important to identify risk factors, as they are basic in the targeting for prevention in populations, in certain groups and in individuals.

### 2.2 Change of perception

Physical activity promotes health, contributes to higher energy levels and is an important and well-documented mean in the prevention and treatment of over thirty different diagnoses and conditions according to the Norwegian Directorate of Health ([helsedirektoratet.no/publikasjoner/anbefalinger-om-kosthold-ertering-og-fysisk-aktivitet](https://helsedirektoratet.no/publikasjoner/anbefalinger-om-kosthold-ertering-og-fysisk-aktivitet)). Today's society focuses on being physically active and WHO (World Health Organization) published in 2010 global recommendations regarding the amount of physical activity recommended in different age groups. ([www.who.int/dietphysicalactivity/factsheet\\_recommendations/en/](http://www.who.int/dietphysicalactivity/factsheet_recommendations/en/)).

It is of general understanding that oral health is an important part of general health, welfare and quality of life. Taking the healthy lifestyle to the extreme is a new trend. This involves intensive bodybuilding and fitness exercises, which also is rising in the social media scene. Only in Instagram the amount of pictures titled with 'fitness' is over a 100 million. In the last 20 years there has been an increased focus on eating disorders. Not only girls, but also boys feel the need to become healthier and thinner. The difference is that boys wish to have bigger muscles as well as less fat (Skårderud et al. 2004). With the trends shifting the impression is that also girls wish to have a fit body with increased muscle mass.

### 2.3 Prevalence of dental erosive wear

Erosive tooth wear was for many years a condition of little interest. The increase in prevalence of dental erosion is of growing concern and creates a need for increasing knowledge among clinicians and the general public on the topic. Supplementary dental research is necessary to understand the multifactorial condition of erosive tooth wear and the aetiology behind it. The interest is rising with the increasing focus, both among clinicians treating patients with erosive tooth wear and among researchers, leading to increasing literature published on the topic.

Many epidemiological studies have shown high prevalence of erosive tooth wear among children and adolescents. Among adolescents outside of Norway the reported prevalence vary from 22% in Iceland (Arnadottir et al. 2003), 30% in the Netherlands (van Rijkom et al. 2002), 60% in UK (Dugmore, Rock 2004), and to 95% in Saudia Arabian boys (Al-Majed et al. 2002). Data from USA and Great Britain show that approximately 40% of 12-13 year olds in these countries have erosive tooth wear (Deery et al. 2000).

In Norway the reported prevalence of dental erosion varies from 37% to 64%. Mulic et al. (2012) studied 18-year old subjects in Oslo, Norway in 2008 and found that 38% had at least one tooth with erosive lesions. The same was observed in 2010 among 16 year olds in Troms (Fredriksen et al 2015). A recent study published in 2015 show a prevalence of erosive tooth wear in 37% of 16-18 year olds in Norway. The same study revealed a significant association between dental erosive wear and high consumption of sour sweets and sports drinks (Søvik et al. 2015).

An epidemiological systematic review and meta-regression analysis published in 2015 showed an estimated prevalence of erosive tooth wear in permanent teeth of children and adolescents of 30.4%. It was concluded that the variability of erosive tooth wear is dependant on the clinical index for dental erosion detection and the geographic location (Salas et al. 2015).

There are fewer studies carried out in the adult population. A study from Switzerland in 1991 showed that 30% of young adults (26-30 year olds) had at least one severe erosive lesion. The study also showed that intake of acidic drinks was associated with dental erosive wear (Lussi et al. 1991). A Swedish study published in 2014 showed a prevalence of erosion of 75% in 20-year olds and 18 % had extensive erosion (Isaksson et al. 2014). In a study investigating

the relationship between physical exercise, dental erosive wear and salivary secretion in young adults (18-32 years old) in Norway, the prevalence of dental erosive wear among the physically active participants was 64% (Mulic et al. 2012).

## **2.4 Definition of erosive tooth wear**

*Dental erosion* is the dissolution of tooth mineral by acidic substances, in the absence of plaque (Shellis and Addy 2014). Dental erosion is predominantly a demineralization process that occurs at the tooth surface in the interface between the enamel and the surrounding acidic solution, but it can also occur a few micrometres into the softened partly demineralized layer, which has led to the term “near surface demineralization” (Lussi and Carvalho 2014). Dental erosion can result in loss of hard tissue alone, but the acidic dissolution by erosive agents that causes a softening of the enamel, also enhances the tooth’s susceptibility to mechanical wear. Thus, dental erosion is often accompanied by mechanical wear, and the result is *erosive tooth wear* (Ganss 2014). The types of mechanical wear are abrasion; tooth wear produced by interaction between teeth and foreign objects, and attrition; tooth wear produced by contact between antagonistic teeth.

## **2.5 Chemical principles of dental erosion**

### **A. Enamel and dentine structure**

The main mineral component of enamel is calcium hydroxyapatite, which is present in a crystallite form. By volume, it comprises about 88-90% of the enamel, corresponding to about 95-96% by weight. The enamel also contains other impurity ions such as sodium, magnesium and chloride ions, which affects the chemical properties of the enamel. The remainder of the enamel is water and organic material, like enamel proteins and lipids. Dentine is a softer tissue than enamel, thus mineralized to a smaller extent. Calcium hydroxyapatite crystals comprise about 50% of the dentine by volume and 70% by weight. The dentine contains impurity ions in higher concentrations than the enamel. The rest of the dentine is water and organic matrix with collagen and proteins (Berkovitz et al. 2009).

### **B. What happens when a tooth is exposed to a solution?**

When a tooth is exposed to a solution, an exchange of components between the enamel surface and the solution starts. Dependent of the solubility of calcium hydroxyapatite in the enamel and other chemical and physical factors, ions in calcium hydroxyapatite will either



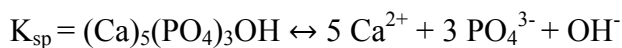
dissolve in the solution (dissolution) or ions from the solution will attach to the enamel (crystal growth) (Shellis et al. 2014).

Chemical equilibrium is the state reached when the concentrations of reactants and products remain constant over time. When the enamel is in a state of equilibrium with a solution, there is no *net* exchange between the two phases, which means that the rate at which ions leave the enamel surface equals the rate at which they attach to the enamel surface. This means that the solution is saturated with respect to enamel minerals (Shellis et al. 2014).

Solids *solubility* determines if the solid will dissolve in a particular solution. The solubility of the enamel is the concentration of dissolved calcium hydroxyapatite in a saturated solution. Enamel mineral is less soluble than dentine mineral, because of differences in their compositions and the higher content of impurity ions in dentine. In addition to the solubility, the rate of dissolution is influenced by many other factors, so a better “term” to define the solubility at equilibrium is the *chemical activity* of the solid. The ion activity product (I) defines the chemical activity, and is given by the product of all the ion activities:

$$I_{\text{HAP}} = (\text{Ca}^{2+})^{10}(\text{PO}_4^{3-})^6(\text{OH}^-)^2$$

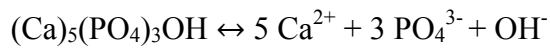
The solubility product ( $K_{\text{sp}}$ ) is the value of the ion activity product in a solution in equilibrium with the solid, thus the highest amount of calcium hydroxyapatite that can be dissolved at a given temperature, and is constant for a particular temperature.



When  $K_{\text{sp}} = I_{\text{HAP}}$  in a solution with calcium hydroxyapatite, the mineral on the enamel surface is in equilibrium with the ions in the solution and the solution is thus saturated. No net exchange will occur between the enamel and the solution. If  $K_{\text{sp}}$  is of greater value than  $I_{\text{HAP}}$ , the solution is undersaturated with respect to the solid, and tooth mineral will dissolve in the solution until the ion concentration is increased, and equilibrium is achieved. If  $I_{\text{HAP}}$  is of greater value than  $K_{\text{sp}}$  the solution is supersaturated with respect to the solid, and there is no dissolution of tooth mineral (Shellis et al. 2014).

### **C. What happens when a tooth is exposed to an erosive solution?**

When the tooth is exposed to an erosive solution, the acid will diffuse through the enamel pellicle to react with the enamel surface. Calcium hydroxyapatite will dissolve to form calcium, phosphate and hydroxyl ions in the solution.



$\text{H}^+$  ions in the erosive solution are responsible for the demineralization of tooth mineral, and will react with ions from calcium hydroxyapatite to form new ions. The equilibrium will change, and the reaction will favour dissolution of tooth mineral. Calcium hydroxyapatite in the enamel will thus dissolve to saturate the solution, so the enamel and the erosive solution are in a state of equilibrium. Degree of dissolution of tooth mineral is dependent of properties of the erosive solution, and patient-related factors. This will be discussed in detail in the section about aetiological factors.

## 2.6 Aetiology of erosive tooth wear

The aetiology of erosive tooth wear is multifactorial. Many risk factors and protective factors are involved in the development of erosive lesions, and the balance between them will decide if the tooth surface is eroded or protected from erosive wear. The aetiological factors can be classified in different ways. One method is to classify them into nutritional factors and patient-related factors (Lussi and Carvalho, 2014). The aetiological factors can help to explain why some individuals or groups are more prone to erosive wear than others are. A lifestyle that involves regular physical activity may increase the susceptibility to erosive wear, if physical active people are frequently exposed to risk factors for developing erosive lesions.

### A. Nutritional factors

Different erosive agents have different *erosive potential*, thus different potential to dissolve tooth mineral (Barbour and Lussi, 2014). Nutritional factors that influence the erosive potential of foods and soft drinks are:

#### pH

The most influent factor on the erosive potential of acidic foods and drinks is the pH of the erosive solution (Barbour and Lussi, 2014). Erosive solutions with lower pH-values have more hydrogen ions to react with ions in calcium hydroxyapatite, and thus a greater potential to dissolve tooth mineral. The lower the pH of the erosive agent, the greater is the erosive potential. However, other factors besides the pH will also influence the erosive potential.

### Mineral content (degree of saturation)

Presence of calcium and phosphate influences the degree of saturation in the solution, and will therefore affect the erosive potential of acidic foods and drinks (Barbour and Lussi, 2014). The erosive agent has to be undersaturated with respect to tooth mineral for erosion to occur. If the erosive food or drink is supersaturated with respect to tooth mineral, no erosion will occur, even though the pH is low. One example is yoghurt, which has a low pH, but contains enough calcium and phosphate to cause supersaturation, and will therefore not dissolve tooth mineral (Shellis et al. 2014). It is shown that by adding calcium carbonate to drinks the erosive potential can be reduced. The consecutive increase in pH will also enhance the effect of calcium carbonate (Barbour and Lussi, 2014). There are several orange juices on the market with added calcium, which retards the progression of erosion.

### Acid type/pKa

Different acids have different pKa-values – the pH value where the acid will dissociate H<sup>+</sup>-ions to the solution. Acids with lower pKa-values give away H<sup>+</sup>-ions at lower pH-values, and have a greater erosive potential. Type of acid in the erosive agent will thus influence the erosive potential. Some examples of acids are *citric acid*, which is present in many fruits, vegetables and juices, *phosphoric acid* that is present in cola beverages, *acetic acid* that is used as a condiment/dressing on salads and vegetables, and to preserve food.

### Buffer capacity

Weak acids can act as buffers and resist small changes in pH. The buffer capacity of an erosive agent is the amount of base necessary to neutralize it. The greater the buffer capacity of the acidic drink or food is, the better they will resist the neutralizing effects of saliva, and more dissolution of tooth mineral will occur (Shellis et al. 2014).

### Chelation properties

Some acids have the ability to bind calcium ions in saliva, which results in less degree of supersaturation of calcium in saliva, and a greater dissolution of tooth mineral. Several acids have chelation properties; examples are citric acid and phosphoric acid.

### Physical properties

Physical properties like adhesion properties, temperature and flowrate will also influence the erosive potential of an acidic food or beverage. Different erosive drinks and foods have different capability to adhere to the tooth surface, thus different *adhesion properties*. Better adherence of an erosive food or drink will increase the contact time with the tooth surface, and thus increase the erosive damage (Barbour and Lussi). The *temperature* will also affect the rate of dissolution of tooth mineral. The rate of dissolution increases as the temperature increases, so hot drinks will cause a greater dissolution than cold drinks if other factors are equal (Barbour and Lussi, 2014). Also the velocity of the acidic solution flowing over the tooth surface influences the rate of dissolution, the *flow rate*. Agitation of a soft drink will increase the rate of erosion.

### **B. Patient-related factors**

Patient-related factors that can influence the development of erosive wear can be biological factors, behavioural factors and pathological factors.

**Biological factors** include saliva, enamel pellicle, dental anatomy and occlusion, and soft tissue anatomy and its relation to the teeth.

#### Saliva

Saliva is an important biological factor that protects the teeth against erosive wear if the production and flow is adequate. Physical activity will lead to loss of fluids from the body and dehydration. This will entail a decreased secretion of saliva.

We have three major salivary gland pairs, and several minor salivary glands. The major salivary glands are the parotid glands, the submandibular glands and the sublingual glands. Saliva is being produced in the salivary glands from serous cells, mucous cells or both. Serous cells produce more watery protein-containing saliva, and mucous cells produce more viscous, carbohydrate-containing saliva (Berkovitz et al. 2009). Saliva consists of more than 99 % water and 1 % electrolytes, organic substances and macromolecules.

Saliva has many protective roles against erosive wear:

- Production of dental pellicle, which acts as a barrier for the erosive solution to contact the tooth surface



- Diluting/neutralizing acids
- Clearance of acids
- Buffering of acids
- Oversaturated with calcium, phosphate and fluoride, which reduces the demineralization and enhances remineralization of tooth mineral
- Production of proteins with diverse important functions

The major salivary glands are the main source of saliva with about 90 % of the secretion. The minor glands and the sublingual glands secrete saliva unstimulated, the parotid glands and the submandibular glands only produce saliva when they are stimulated. The average unstimulated salivary secretion is  $>0.3$  ml/min, with large addition from the major glands at stimulation, which makes an average daily secretion of saliva from 0.5 – 1.5 L (Hara and Zero 2014).

The buffer systems in saliva include the hydrogen carbonate system, the dihydrogen phosphate system and buffering from salivary proteins. The most important buffer in saliva is hydrogen carbonate, which makes up 90% of the buffer capacity of stimulated saliva. Its concentration rises from about 5 mmol/l in unstimulated saliva up to 60 mmol/l in stimulated saliva (Hara and Zero 2014). The buffer capacity of saliva thus increases with increased salivary flow rate. Hydrogen carbonate also makes up 50 % of the buffer capacity of unstimulated saliva. The phosphate system makes up 50 % of the buffer capacity in unstimulated saliva, but has less effect in stimulated saliva. The protein buffer system has less effect than the hydrogen carbonate and phosphate systems, but can contribute to the buffering properties of saliva when the pH-levels are low.

The autonomic nerve system controls the stimulation of the salivary glands. Sympathetic and parasympathetic nerve fibres innervate the salivary glands. Chemical stimulation of taste receptors in the oral cavity, and stimulation during chewing of mechanical receptors in the oral cavity, will give impulses to higher centres in the brain, which leads to activation of efferent autonomic nerve fibres, which stimulates salivary secretion. Salivary secretion can also be stimulated in response to extra-oral stimuli as odour or sight of foods or drinks (Hara and Zero 2014). Parasympathetic activation of salivary glands results in secretion of an increased amount of saliva, and an increased secretion of proteins. Sympathetic activation leads to a secretion of a smaller amount of saliva, and the saliva is more watery and rich in

electrolytes. The unstimulated salivary secretion is influenced by several factors like degree of hydration, body posture, light exposure, smoking, medicaments and circadian rhythm.

During physical exercise, there is an activation of the sympathetic nerve system. This, in addition to the sweat-induced dehydration during exercise, will lead to reduced salivary secretion. Mouth breathing during exercise will further decrease the amount of saliva. A reduced salivary flow rate will decrease the capacity of saliva to neutralize and buffering acids, thus increasing the chances for development of erosive wear (Hara and Zero 2014). Intake of acidic products when saliva secretion is decreased will give a higher risk for dental erosive wear.

### Pellicle

The enamel surface is covered by an enamel pellicle, which is an acellular biofilm, mainly composed of proteins and peptides from saliva. An erosive solution has to diffuse through the enamel pellicle to dissolve tooth mineral on the enamel surface (Lussi and Carvalho 2014). When the enamel is exposed to acids over short time, the pellicle can give partial protection against demineralization, but will dissolve during the exposure. It functions as a *semipermeable* barrier (Hannig and Hannig, 2014).

### Dental anatomy and occlusion

The form and position of the teeth in relation to the drinking- and swallowing pattern can influence the development of erosions. Eroded enamel is more prone to attrition, so the occlusion will have impact on the pattern for the erosive wear.

### Soft tissue anatomy and its relation to the teeth

The soft tissue influences the clearance and retention of different erosive agents. Erosive drinks can be retained on the tongue, and increase palatal erosive lesions.

**Behavioural factors** that can influence the development of erosive wear include the lifestyle of the individuals, thus the eating and drinking habits, and the oral hygiene habits.

### Lifestyle

Lifestyle can influence the risk for the development of erosive tooth wear. Physically active people can be in greater risk of erosive wear because of their lifestyle. Lifestyle includes the

type of food and beverages being consumed, frequency of intake and when during the day the intake happens (Järvinen et al. 1991). Way of consumption will also influence the erosive damages. Today's eating and drinking habits involve a higher and more frequent intake of erosive foods and drinks. A modern healthy lifestyle with increased physical activity and a high intake of acidic drinks and foods can be linked to an increased risk for dental erosive wear. Many studies show that there is a positive association between the consumption of acidic beverages and dental erosions, and a dose-response relationship (Schlueter and Tveit, 2014). Thus, increased amount and frequency of consumption will potentially increase the development of erosive lesions.

Acidic drinks are believed to be one of the most important factors leading to dental erosive wear (Schlueter and Tveit, 2014). Several studies show that acidic drinks such as wine, different types of fruit juices and soft drinks have erosive potential, and that there is a connection between consumption and occurrence of erosive lesions. (Järvinen et al. 1991; Bartlett et al. 2013; Lussi and Carvalho 2014; Mulic et al. 2012; Søvik et al. 2015). Sports drinks contain relatively high amounts of carbohydrates, salt, and citric acid. These ingredients create the potential for impact on oral health as well as general health. Sports drinks have the purpose of improving hydration and performance when exercising, by providing electrolytes to replace losses. They are manufactured for people participating in physical activity and intense activities like endurance training, but many in the general population drink sports drinks for their good taste. There are few studies that show an association between sports drinks and erosive tooth wear, among these is a study from Norway (Søvik et al 2015). Other factors such as drinking habits and saliva production could be of a greater importance for the developing of erosive tooth wear (Coombes 2005). There are different studies on the erosive potential on different beverages, where orange juice is showed to be highly erosive. One study showed that orange juice caused over double the amount of release of calcium from the tooth surface as grapefruit juice did. The popular soft drink Coca-Cola was about 8 times less erosive than orange juice (Mulic, Skaar 2006). Eating healthy entail eating fruits that have a natural content of acids. The most erosive fruits are citrus fruits and they also have the biggest dental erosive potential (Järvinen et al. 1991; Kunzel et al. 2000).

As mentioned there are few studies that show an association between sports drinks and erosive tooth wear. When it comes to training supplements there are new trends and products in the market. An increased sale of relatively new supplements has been reported. To our

knowledge there are no studies showing how popular these products are or how they affect dental health. These supplements are ingested before, during and/or after physical activity. Search online shows a multitude of information on different types of nutritional supplements. These supplements have the purpose of enhancing performance as well as to build muscle and repair damaged muscle tissue after strenuous exercise. They are advertised as essential to reaching your goals when training. Research shows the effect of these nutritional supplements is controversial.

One of the leading companies in Norway of sports supplements is [proteinfabrikken.no](http://proteinfabrikken.no). We asked about their current sales of supplements, trends and development of sales. Proteinfabrikken did not give out number of sales but informed us that they have an increase in sales and have more customers than ever before. They experience a decrease in sales in protein supplements per customer in 2015 than the year before. They also informed that they see a change in focus, away from dieting and losing weight towards a focus on performance and strength. Customers are equally men and women.

Among the available nutritional supplements are carbohydrate and protein supplements and products called Pre-workout and BCAA (branch chain amino acids). Pre-workout is as the name suggests a supplement ingested before your physical activity and its purpose is to improve performance. It contains in general high amounts of caffeine, BCAA, beta-alanine and creatine monohydrate. BCAA consists of a mixture of three amino acids; leucine, isoleucine and valine. These products come in containers as powder to mix with water and there are endless brands that produce these. The content list of these product in general mention citric acid and malic acid among several other components ([bodybuilding.com](http://bodybuilding.com)).

Studies show that the degree of damage from acid in the diet is dependent on how often, how long and how much is consumed (Søvik et al. 2015; Järvinen et al. 1991). A combination of acidic food and beverages with other food often entail less damage, but acidic diet ingested between meals gives a greater risk of damage. During the night, salivary flow rate is low and intake of acidic food and beverages or gastro-oesophageal reflux will damage teeth to greater degree compared to during the daytime (Lussi et al. 2004).

The way of consumption and habits of how food or beverages are ingested, are of importance for the development and extent of erosive damages. Examples are sipping, swishing or holding the acidic fluids in the mouth. A high daily intake of acidic fluids combined with



keeping the fluids for a long time in the mouth before swallowing, results in a higher prevalence of erosive tooth wear. (O`Sullivan and Curzon 2000; Johansson 2002). The use of straws reduces the erosive potential of the fluids because the fluid does not come in contact with the tongue and is kept in the mouth for a short period of time. (Lussi et al. 2004). Mulic et al. studied in 2012 18-year old subjects in Oslo, Norway. There were associations between having erosive lesions and different factors like being male, brushing teeth once per day or less, episodes of vomiting and incidents of gastro-oesophageal reflux, consumption of fruit juice and sugary soft drinks several times per day, as well as intake of sugary soft drinks daily to once per week.

### Oral hygiene habits

The softening of the enamel when an erosive demineralization occurs will enhance the tooth's susceptibility to mechanical wear. Tooth brushing can remove the softened layer and cause loss of tooth mineral (Lussi and Carvalho, 2014). Thus, excessive oral hygiene can contribute to the development of erosive wear.

**Pathological factors** that can influence the development of erosive wear include the use of medications and conditions that causes episodes of gastrointestinal reflux or vomiting.

### Medication

Acidic medications, such as acetylsalicylic acid, iron tablets or vitamin supplements are potentially erosive, if they are administered per orally with prolonged contact with the teeth. Medications can also have side effects as gastric reflux, vomiting or Xerostomia, which will increase the risk for developing dental erosions (Schlueter and Tveit, 2014).

### Reflux

An effect of physical activity can be gastrointestinal reflux. Gastroesophageal Reflux Disease (GERD) is a condition where the gastroduodenal content regularly reaches the oesophagus and then probably the oral cavity. In the population, 4-7% are diagnosed with chronic symptomatic reflux, but about 25 % of the population have reflux without symptoms (Schlueter and Tveit, 2014). Suffering from reflux is a risk factor for erosive wear, since gastric juice is highly erosive (Bartlett and Coward, 2001). Exercise can exacerbate symptoms of reflux, and experimental studies show that gastroesophageal reflux may be increased in athletes (Jozkow et al. 2006). During or after exercise the acidic gastric fluid with a pH of 1.5-

2.5 reaches the mouth (Zero 1996). A study done in 1989 by Clark et al. showed that strenuous exercise could induce gastroesophageal reflux in healthy subjects. Different workouts were studied and running induced most reflux, aerobic exercise less and only some of the participants experienced reflux with weight training.

### Vomiting

Diseases or conditions that cause regularly vomiting have the potential to cause erosive lesions, since gastric juice is highly erosive (Bartlett and Coward, 2001). Examples of such conditions are eating disorders and pregnancy. In a recent study on patients diagnosed with bulimia and self-induced vomiting it was found that 70% of these patients had erosive lesions (Uhlen et al. 2014).

To sum up the aetiology of erosive wear; there are many factors that influences the development of erosive wear, which makes the aetiology multifactorial. The sum of these risk factors and protective factors will decide if a person is at risk for developing erosive lesions. People that exercise regularly may have a healthy lifestyle with many risk factors, as eating and drinking habits, sweat-induced dehydration and reduced salivary secretion and oral hygiene habits.

## **2.7 Diagnosis of erosive tooth wear**

Clinicians can diagnose erosive lesions from deviations from the original tooth morphology. Clinically visible defects will occur on the tooth surface where the erosive agent has acted. The main aetiological factors responsible for the erosive damage may influence the appearance and severity of the erosive lesions (Ganss. 2014). If the acids origin is external, it is anticipated that more erosive wear will occur on the buccal surface, and if the acids origin is internal, more erosive wear will occur on the palatal/lingual surface. Early signs of erosive tooth wear, are shiny or dull enamel surfaces and if the erosive agent continues to dissolve tooth mineral, changes in morphology becomes evident. The convex smooth surfaces will flatten and concavities will eventually develop. These concavities is located above the enamel-cementum junction, so a small edge of enamel is visible cervical on the tooth (protected by dental plaque). Occlusal and incisal surfaces will also flatten, cusps become rounded (cuppings), restorations will rise above the level of the tooth surface, and if the erosive challenge is great, the entire occlusal morphology is lost (Ganss and Lussi, 2014).

There are various indices for the clinical diagnosis of erosive tooth wear. Two indices that are being used are the VEDE and BEWE indices. Visual Erosion Dental Examination (VEDE) system is a system used in the student clinics at the dental universities in Norway. VEDE measures erosive wear at tooth surface level, and grades the severity of the erosive wear from 0-5. All surfaces (except incisal) are graded (Mulic et al. 2010). The grading is:

- 0: No erosion
- 1: Initial loss of enamel, no dentine exposed
- 2: Pronounced loss of enamel, no dentine exposed
- 3: Exposure of dentine, <1/3 of the surface involved
- 4: Exposure of dentine, 1/3-2/3 of the dentine exposed
- 5: Exposure of dentine, more than 2/3 of dentine exposed

Basic Erosive Wear Examination (BEWE) is a scoring system that records only the most severe affected surface in a sextant. The BEWE system divides the dentition into sextants, and occlusal, palatal/lingual and buccal surfaces are examined in all teeth except 3.molars. The severity of wear is graded from 0 to 3:

- 0: No surface loss
- 1: Initial loss of enamel surface texture
- 2: Distinct defect, hard tissue loss (dentine) less than 50 % of the surface area
- 3: Hard tissue loss more than 50% of the surface area

Only the most severe score in each sextant is recorded. The score from all sextants is calculated and gives an index value. The score says something about the risk for erosive wear. A score below 2 indicates no risk, a score from 3-8 indicates low risk, a score from 9-13 indicates medium risk and a score more than 14 indicates a high risk. These risk levels can guide towards treatment (Bartlett et.al, 2008).

## **2.8 Treatment**

Erosive tooth wear is a multifactorial condition. It can therefore be difficult and time demanding to identify patients at risk. It is of importance to create awareness among clinicians that a healthy lifestyle can represent dental problems, and the clinicians have to be educated to diagnose early symptoms. Correct treatment of these patients depends on the correct diagnoses. Early diagnosis of erosive damages will contribute to the limitation and prevention of the development. A good anamnesis for every patient is essential to reveal risk

factors for the erosive wear. It is advisable that persons at risk can record their complete dietary intake for some days, so the dentist can evaluate the erosive potential of the different foods and drinks. It is also important to make the patient aware of their problem and give sufficient information about the situation, listen to the patients concerns and symptoms and together discuss possibilities for prevention and treatment (Lussi and Carvalho, 2013). These patients should also have frequent visits at the dentist to follow-up the development of the erosive lesions (Lussi and Hellwig, 2014). Some preventive strategies to prevent erosive wear and to stop further development of already existing erosive lesions:

- Reduce the consumption of erosive foods and drinks: amount and frequency of intake
- Drinking method: avoid sipping, holding or swishing erosive drinks
- Sugar free chewing gum after meals to stimulate secretion of saliva
- Rinse mouth with water after intake of erosive food and drinks
- Wait 20 minutes after intake of erosive products before brushing teeth: This concept relies on the possible capability of saliva to remineralize the tooth surface – so the surface can harden before applying an abrasive force. The effectiveness of the waiting period is a matter of debate (Lussi and Carvalho 2014; Carvalho et al. 2015).
- Use a soft toothbrush and avoid detrimental brushing
- Daily use of fluoride rinsing (0.2% NaF) or tablets (0.25 mgx2)
- Local application of fluorides at high concentration
- Toothpaste with stannous fluoride

The use of fluoride in the protection and treatment of erosive lesions is a discussed subject. There are little evidence for the effect, thus some studies have shown positive results. Studies have shown that fluoride application in low or moderate concentrations, as in regular fluoride toothpastes, has little or no preventive effect against erosive lesions, but high-concentration acidic fluorides, especially stannous fluorides, can have preventive effect against erosive lesions (Huysmans et al. 2014).

In cases with extensive erosive damages, restorative treatment may be necessary with the use of composites, laminates or crowns, in conjunction with preventive strategies. The purpose is to relief symptoms, protect the pulp, and replace lost tooth substance to improve function and aesthetics. If possible, the least invasive restorative therapy should be used, like direct composite restorations (Carvalho et al. 2015).



### 3. Materials and methods

#### 3.1 Participants

The person in charge of the training gym centre SATS Elixia in Tromsø was contacted. After we got positive feedback, we asked persons who visited the training centre to complete a questionnaire anonymously. A total of 211 people responded positively. Of these, 189 persons were included in the study, 97 women and 92 men. The mean age was 29.65, ranging from the age of 15 to 67 years old. 22 were excluded since they had not answered all questions.

#### 3.2 Questionnaire

The first part of the questionnaire requested information about age, gender, education and whether or not the participants were working, studying or was unemployed. The questionnaire also covered details of oral hygiene habits, frequency and duration. Other questions dealt with dental erosions: if the participants knew if they had dental erosions or not, and if they had received information about or knew how to prevent dental erosions.

In the second part of the questionnaire we asked about dietary habits; frequency and quantity of intake of water, soft drinks, sweets, sour sweets, cakes, cookies, snacks, fruits and several other food articles. In addition, it was asked about intake of sport drinks and nutritional supplements like pre-workout drinks, amino acid-supplements, gainers and energy bars.

In the third part of the questionnaire we asked about training habits; how often the participant trained and which sort of training they usually did. We included questions about food and drinks (type and amount) before, during and after the workout. Further, we asked about participants' habit of biting teeth hard together during the training session with weights. The questionnaire included also information about medical history such as possible gastro-oesophageal reflux and type and frequency of any regular medication used.

In the last part of the questionnaire we asked about the participant's attitude towards oral health, acidic drinks and foods. We used a Likert-type scale where they could answer different options varying from opposites. Their options were "totally agree", "agree", "neither disagree nor agree", "disagree" and "totally disagree".

### **3.3 Ethical considerations**

We informed the participants that the study was anonymous and voluntary. The age-limit at the gym is 15 years of age, so the participants could legally give consent to participate.

### **3.4 Statistical analysis**

Statistical analyses were performed by SPSS (Statistical Package for the Social Sciences) version 23. Chi square test was performed to test significant differences.

## **4. Results**

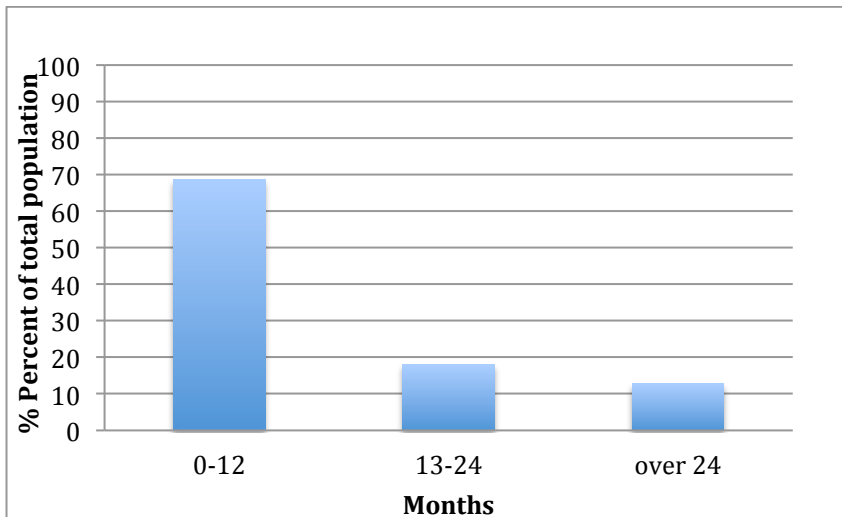
### **4.1 Background information**

The total population consisted of 211 participants, with an even distribution between males (47.4 %) and females (52.1%). 0.5 % did not state their gender. Their age varied from 15 to 67 years old, with an average of 29.65. Some of the participants did not answer all the questions, which means that in some results there are a few percent missing.

Most of the participants were employed (57.8%), followed by students (38.9%) and unemployed (0.9%), while 2.4% did not state their work situation. More than half of the participants had an education from a university or college (53.6%), followed by high school (35.1%) and elementary school (6.6%). 4.7 % did not state their education status

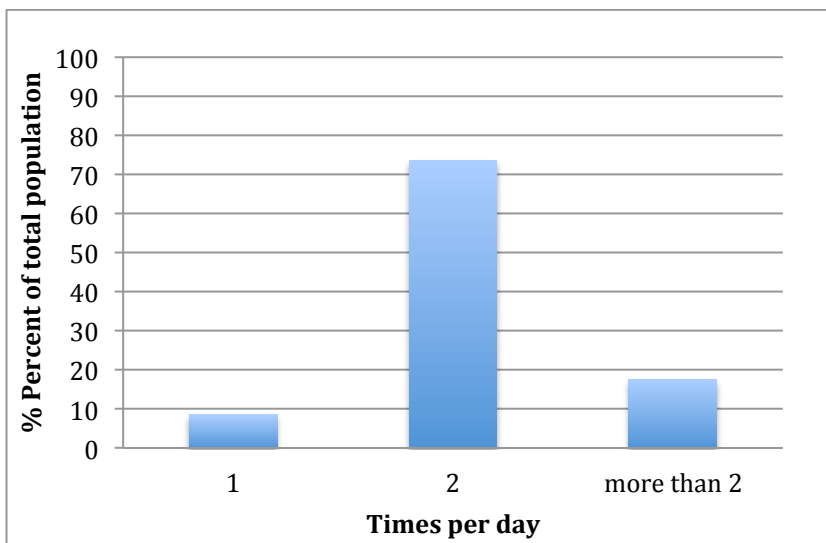
### **4.2 Oral health care**

A major part of the participants had visited the dentist within the last 12 months (68.7 %), 18% within the last 13-24 months and 12.8% answered that it was more than 2 years since their last dental appointment (Figure 1).



*Figure 1: Time since last dental appointment*

The majority of the participants brushed their teeth twice a day (73.5%). Some of the participants even brushed their teeth more than twice a day (17.5%), and fewer brushed their teeth only once a day (8.5%) (Figure 2). Most of the participants used 2-5 minutes daily on tooth brushing (57.3%), while some answered that they used under two minutes (25.6%) or more than 5 minutes (16.6%). 27% reported that they used fluoride supplements daily.



*Figure 2: Times of tooth brushing per day*

### 4.3 Knowledge about dental erosion

Almost all participants had knowledge of dental erosions (96.2%). Some answered that they thought they had erosive lesions themselves (39.2%), but most of the participants did not think that they had any erosions (59.2%) (Figure 3).

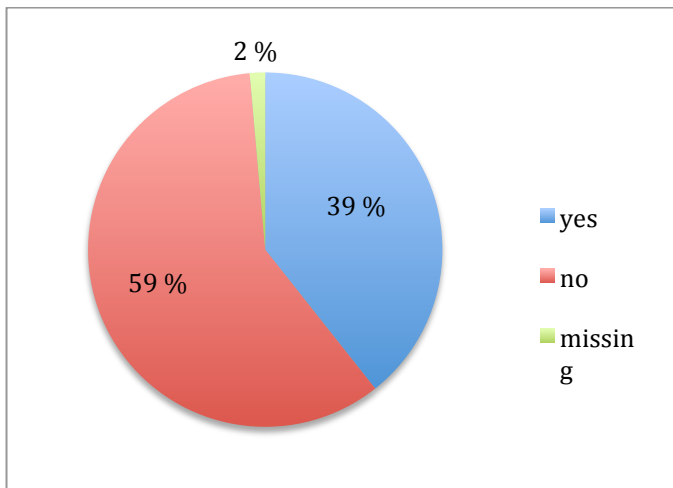


Figure 3: How many believe that they have dental erosions in the total population

Of the total population, 22.3% had been diagnosed with erosive lesions by their dentist and 77.3% not (Figure 4). In order to illustrate the distribution of affected individuals by age, they were divided into two age groups, one younger (15-26 years old) and one older (27-67 years old). A higher number of individuals in the older age group (26.1%) than in the younger age group (18.4%) had been diagnosed with erosive lesions (not sign.).

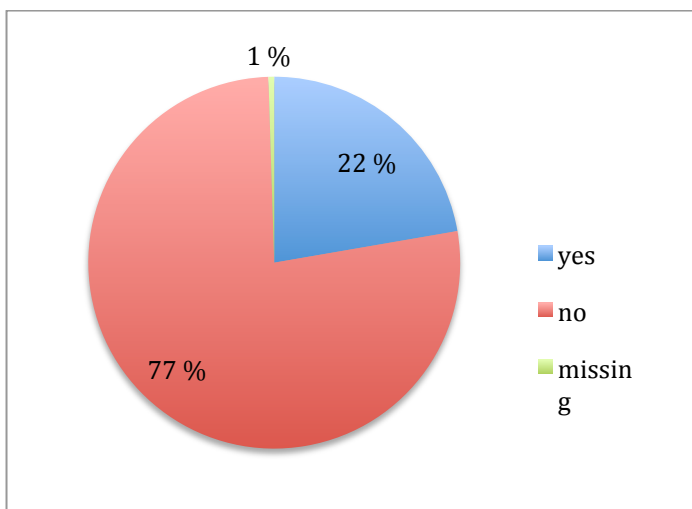
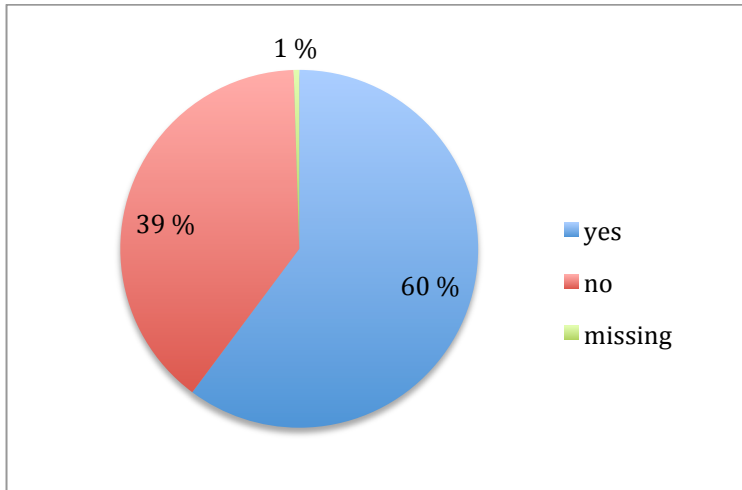


Figure 4: How many have been diagnosed with erosive lesions in the total population (previously)



A majority of the participants (60.2%), answered that they had been informed of how to prevent erosive lesions (Figure 5), a higher portion in the older age group (66.3%) than in the younger age group (55.1%) (not sign.). 39.3% in the total population answered “no” or “don’t know” (Figure 5).



*Figure 5: Knowledge of how to prevent erosive lesions in the total population*

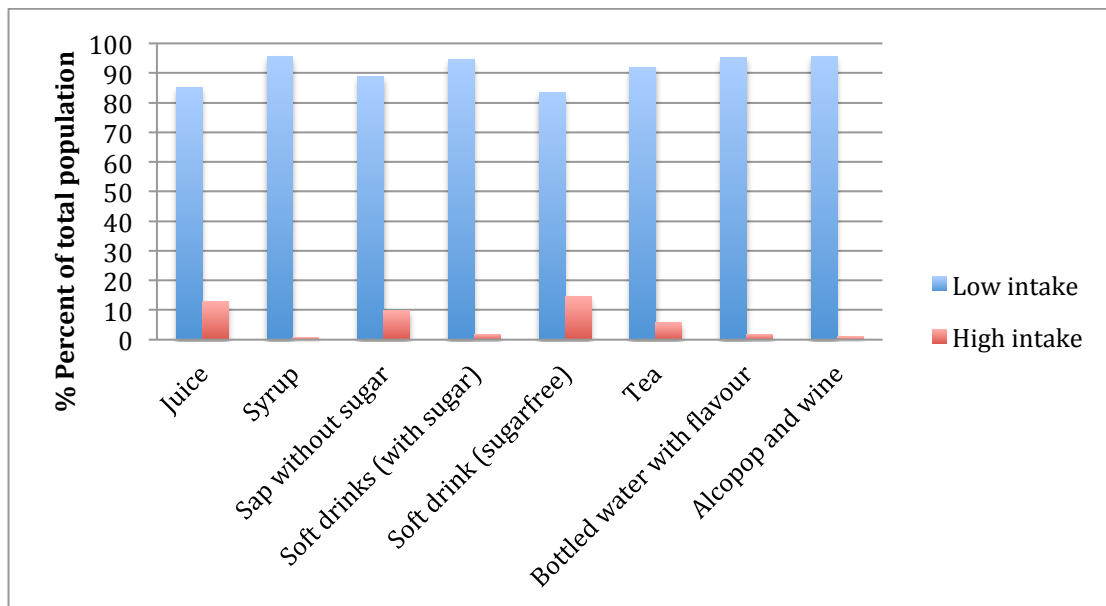
Of those who had been diagnosed with erosive lesions by their dentist, 78.7% had knowledge of or had been informed of how to prevent erosive lesions while, 21.3% had not.

16.1% of the participants answered that they had symptoms of sensitive teeth, and 76.8% did not have such symptoms.

#### **4.4 Drinking and eating habits**

The consumption of different foods and drinks were dichotomized into the categories low consumption (3-5 times a week or less) and high consumption (1-2 times a day or more).

In general the intake of sour drinks was low. Most of the participants had an intake of sour drinks less than 3-5 times a week, thus a low consumption and few had an intake once per day or more, thus a high consumption. There were no significant differences in intake between males and females or between the older and younger age group (Figure 6).



*Figure 6: Consumption of sour drinks in the total population. Low intake (3-5 times a week or less) and high intake (1-2 times a day or more).*

Regarding the way of consuming drinks, the majority of the participants swallowed the drink right away (82.9%), followed by those who held the drink in their mouth before swallowing (14.2%) and those who “swished” it (1.4%). Most of the participants usually drank from glass (39.3 %), followed by those who drank from a bottle or a sport bottle (34.1%). Some answered that they drank just as much from bottle as from glass (19%), and a few drank from a straw (2.8%).

In the part of the questionnaire that entailed food, there was in general a low consumption of sour foods. Most of the participants had low intake (3-5 times per week or less) and a few had high intake (1-2 times per day or more) (Figure 7).

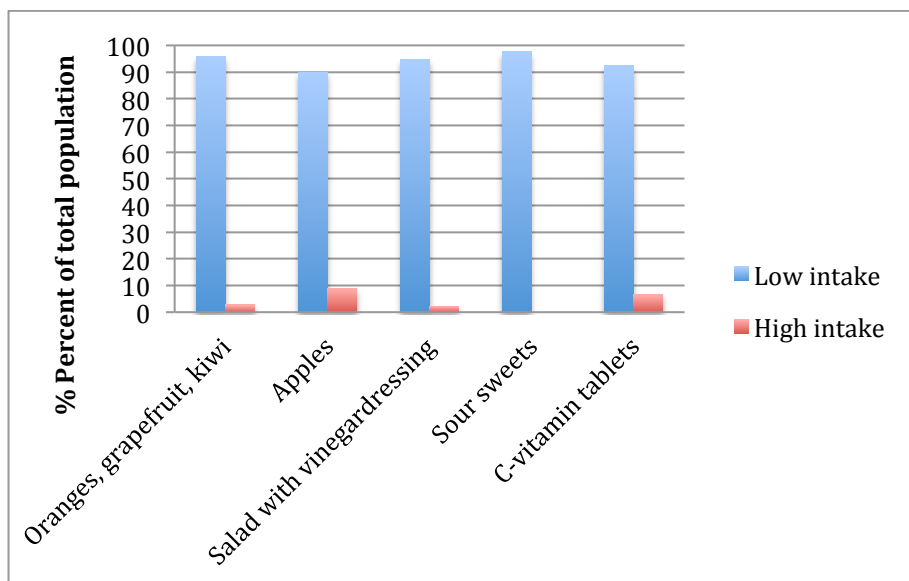


Figure 7: Consumption of sour foods. Low intake (3-5 times a week or less) and high intake (1-2 times a day or more).

The consumption of candy, cookies and other sweets was low as well (Figure 8).

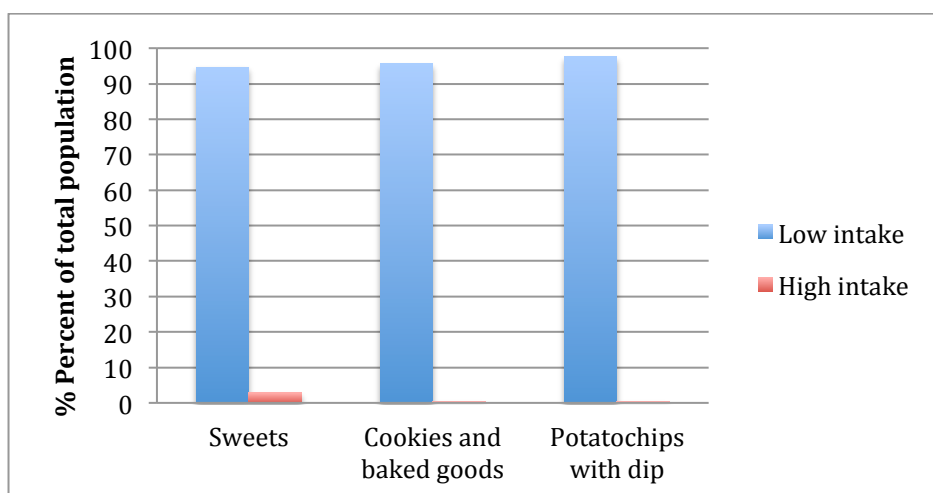


Figure 8: Consumption of sugary foods. Low intake (3-5 times a week or less) and high intake (1-2 times a day or more).

In the question about how many meals the participants had per day, most of the participants had 3-5 meals per day (64.4%). Fewer had more than 5 meals per day (13.7%) or less than 3 meals per day (9.9%).

When it comes to the consumption of nutritional supplements, low intake was defined as 1-2 times per week or less, and high intake was defined as 3-5 times per week or more. The general intake of supplements was low (Figure 9). There were some differences in gender and amount of intake of nutritional supplements. Men had a significant higher intake of pre-

workout supplements than women had ( $p < 0.005$ ). Of those who took pre-workout daily to 3-5 times per week, 91.3% were men and 8.7% women. Of the participants who took pre-workout 1-2 times per week or less, 47.8% were men and 52.2% women. Of those who took amino acid supplements several times per day to 3-5 times per week, 85.7% were men and 14.3% were women ( $p < 0.005$ ). Of those who took amino acid supplement 1-2 times per week or less, 47.4% were men and 52.6% were women. No women took the supplement gainer 3-5 times a week or more, thus all women answered that their intake was less than once per week ( $p < 0.005$ ). There were no differences between genders in the intake of restitution bars.

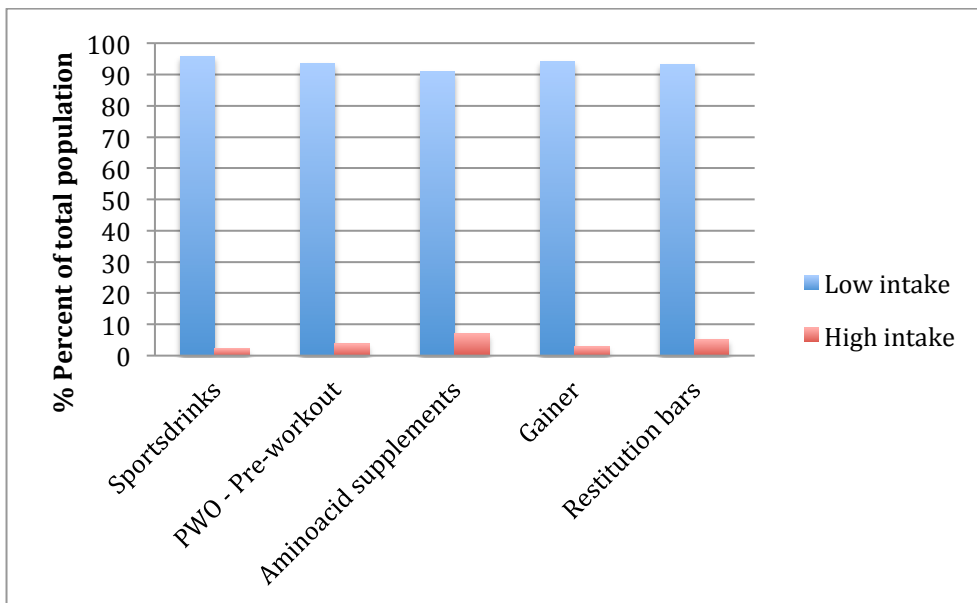


Figure 9: Consumption of nutritional supplements in the total population. Low intake (1-2 times a week or less) and high intake (3-5 times a week or more).

#### 4.5 Physical activity

81.5% of the participants ate before, during or directly after their activity, 17.1% did not (Figure 10). Most of the participants hydrated during their exercise, where 89.1% drank water and 7.1% drank something else. 2.8% did not drink during activity (Figure 11).

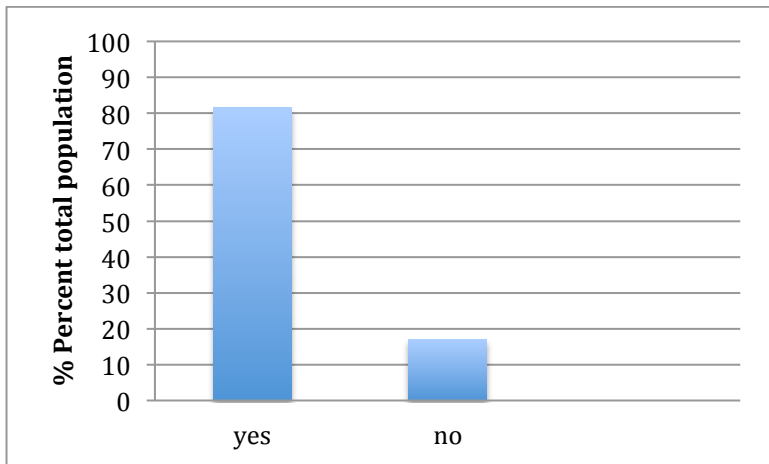


Figure 10: Eating before, during and/or directly after activity

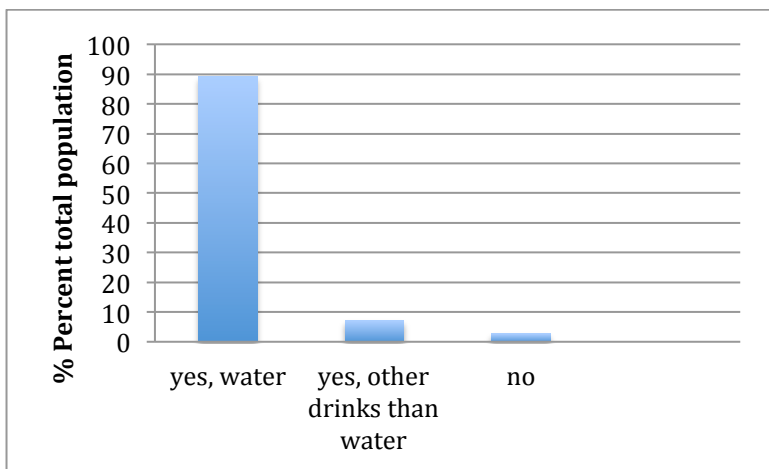


Figure 11: Drinking during activity

Regarding type of exercise, more than half of the participants did both cardio and strength training (57.3%), followed by those who did only strength training (28%) and those who did only cardio training (10%)(Figure 12). More in the younger age group did only strength training (37.2%) than in the older age group (18.7%) ( $p < 0.05$ ). 20.4% responded that they had a habit of biting teeth hard together when they were doing strength training, and 73.5% answered that they did not. The majority of the total population exercised daily to 4-6 times per week (69.7%). Fewer exercised 2-3 times per week (25.1%) (Figure 13). There were slightly more participants in the younger age group that exercised daily (23.1%), than in the older age group (11.1%). There was a significant connection between frequency of exercise and how many meals per day the participants ate ( $p < 0.05$ ).

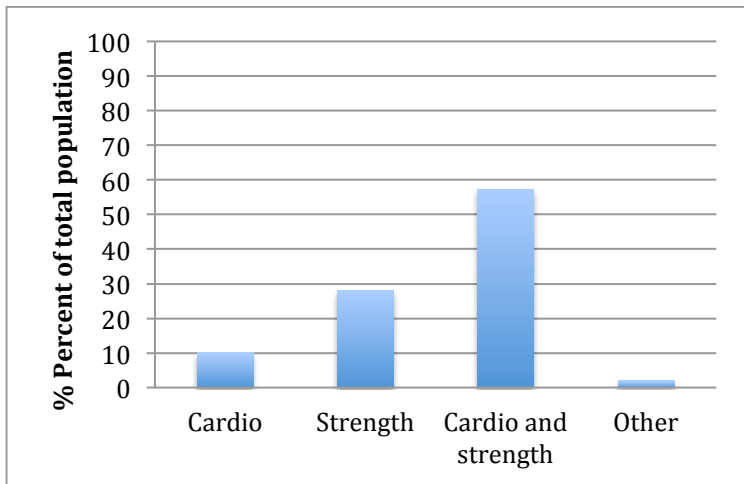


Figure 12: Type of exercise

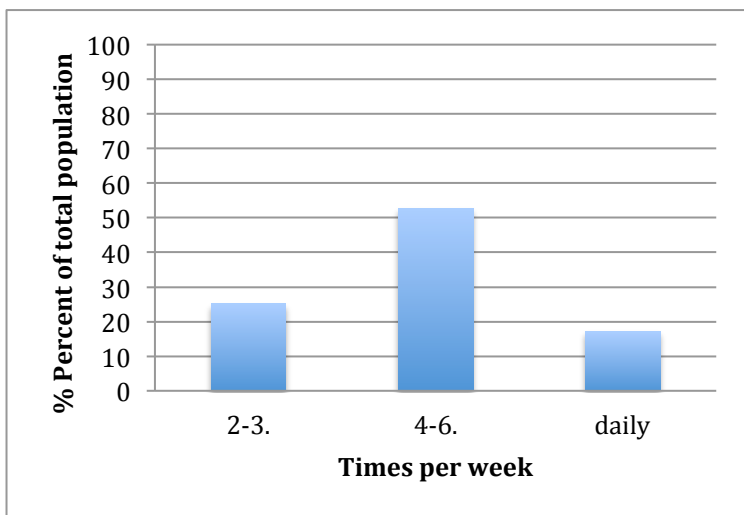


Figure 13: Frequency of exercise

#### 4.6 Gastric reflux and vomiting

Only a small group (13.7%) reported that they had experienced symptoms of gastric reflux (Figure 14). Of those who had symptoms, 74% of them experienced it once a month or less and 25.9% several times per week or more. It was no significant difference between the younger and older age group, and no connection between the frequency of exercise and with the symptoms of reflux. No participants reported episodes of vomiting.



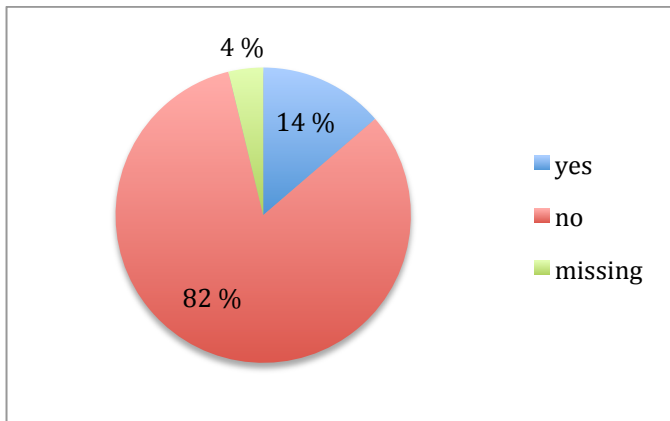


Figure 14: Symptoms of reflux

#### 4.7 Medication use

Most participants did not use any medications. (Figure 15). Of those who did (19%), 80.5% responded that this was in the form of tablets and 11.1% used inhalators for medicine administration.

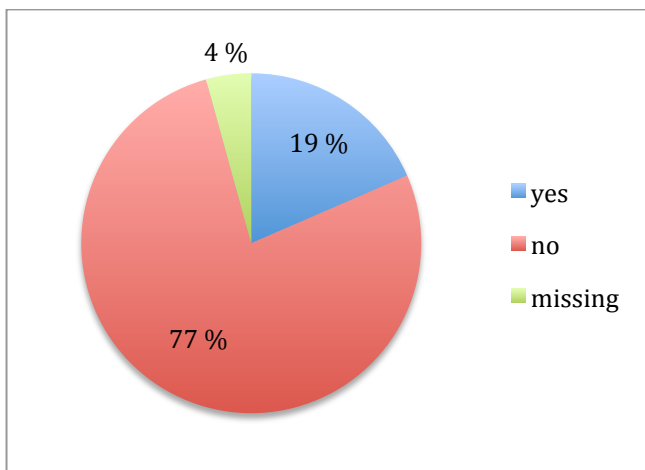


Figure 15: Use of medication

#### 4.8 Attitudes towards dental health, acidic drinks and foods

In the section about attitudes, the results were combined in those who answered that they disagreed and totally disagreed in the given statements. The same was done with those who answered that they agreed and totally agreed.

Most participants agreed that they cared about their teeth and dental health (76.3%) and only a few disagreed (3.3%). A small part of the participants neither agreed nor disagreed (14.2%)

(Figure 16). 25.6% of the participants agreed that they did not care if what they drank was acidic, and 40.2% disagreed. 28% were indifferent.

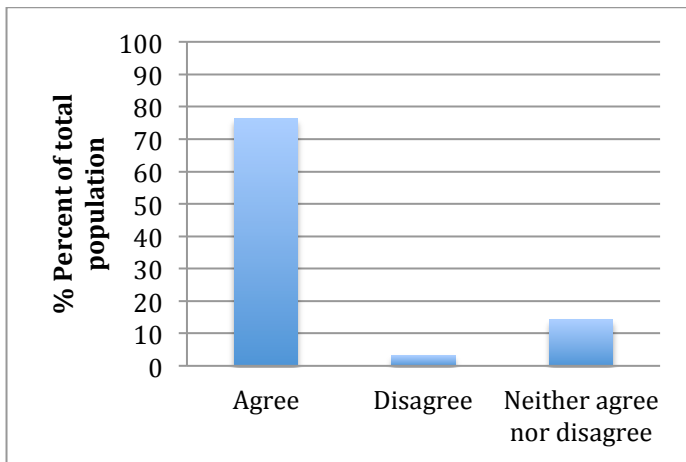


Figure 16: Answers to the statement "I care about my teeth and dental health"

The majority of the participants were satisfied with their teeth and dental health (55.4%), while 17.5% of the participants were not satisfied. 20.9% neither agreed nor disagreed (Figure 17).

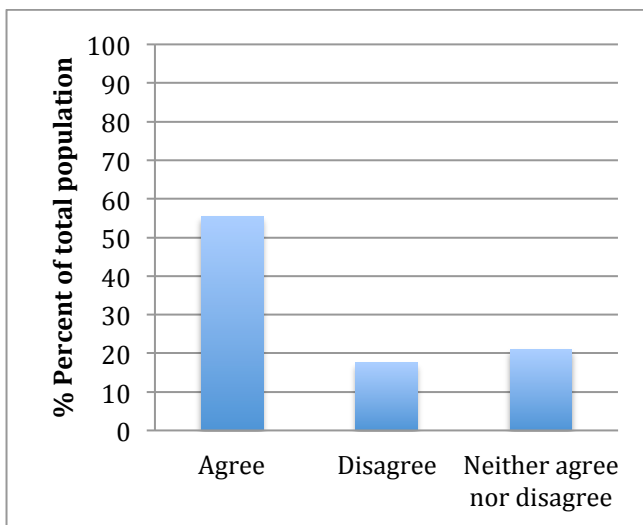
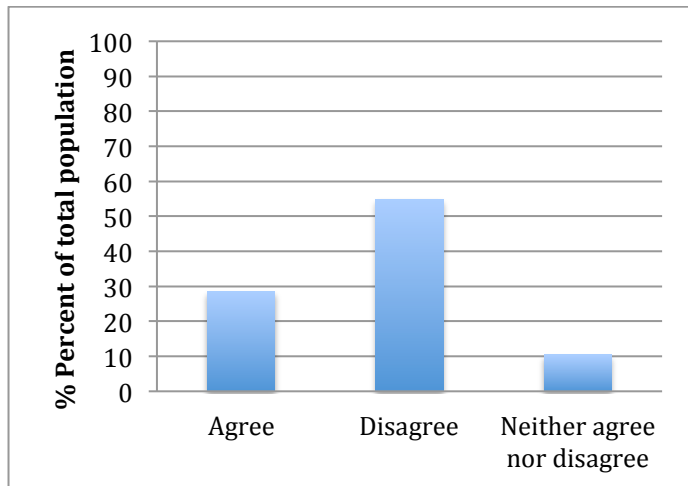


Figure 17: I am satisfied with my teeth and dental health

34.1% of the participants answered that their friends cared about their teeth and dental health, and 11% disagreed. 47.9% were indifferent. Most of the participants disagreed with the statement "my parents do not care about teeth and dental health" (55%), and fewer agreed (10.4%). Some of the participants neither agreed nor disagreed (26.5%).

68.2% of the participants had tried to limit how often they consumed soft drinks and juice; the rest had not or did not care. 28.5% of the participants answered that they found it hard to limit the amount of soft drinks and juice they consumed, and 54.9% disagreed. 10.4% had no

opinion about this question. (Figure 18). Most of the participants agreed that they felt they could control the amount of soft drinks and juice they consumed (66.9%). Some did not agree (15.2%), and fewer neither agreed nor disagreed (11.8%).



*Figure 18: Answers to the statement “I find it hard to limit the amount of soft drinks and juice I consume”.*

Most of the participants disagreed to the statement “It is not important for me if have erosive lesions” (75.8%). Fewer agreed (9.5%) or neither agreed nor disagreed (8.5%) (Figure 24).

Most of the participants would feel sorry about being diagnosed with erosive lesions (76.7%). Fewer disagreed to this statement (6.2%), and some neither agreed nor disagreed (10.9%).

82.4% of the participants would change habits if they were diagnosed with erosive lesions. 5.2% would not change habits, and 6.2% were indifferent.

4.7% answered that they taught they could not prevent erosive lesions. 74.9% answered that they could prevent erosive lesions, and 12.8% neither agreed nor disagreed (Figure 19). Some of the participants answered that the dentist best can prevent erosive lesions (7.1%). Over half disagreed to this statement (67.3%). 19.4% did neither agree nor disagree to this.

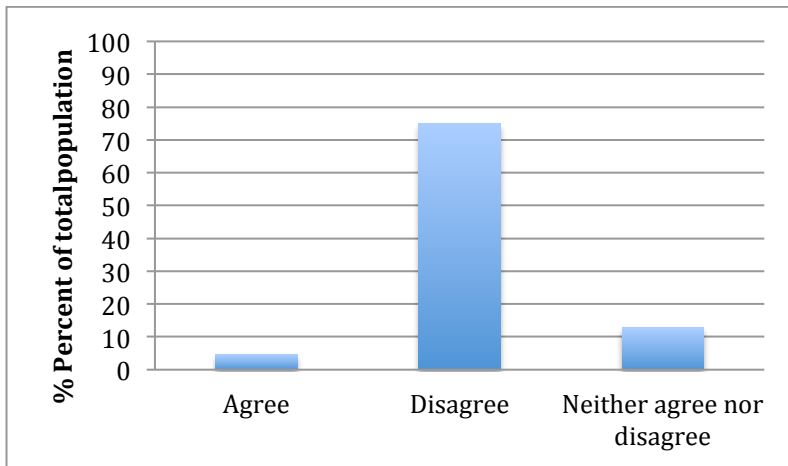


Figure 19: Answers to the statement "I cannot prevent erosive lesion"

Of the 60.2% who had knowledge of or had been informed of how to prevent erosive lesions, 6.8% answered that the dentist could best prevent the development of erosive lesions. Of the 39.3% who had not been informed or had knowledge of how erosive lesions can be prevented, 10.4% agreed that the dentist could best prevent the development of erosive lesions.

When the participants were asked if they cared about diet and general health, nearly 90% did (Figure 20). Of these 74.2% also cared about teeth and dental health. 42.7% of all participants answered that they tried to eat five fruits/vegetables a day, 18.9% did not while 32.2% were indifferent. All participants that exercised daily said that they cared about their diet and general health. Of the participants that exercised 4-6 times per week, and those who exercised 2-3 times per week, 91.7% and 90.2% respectively said the same.

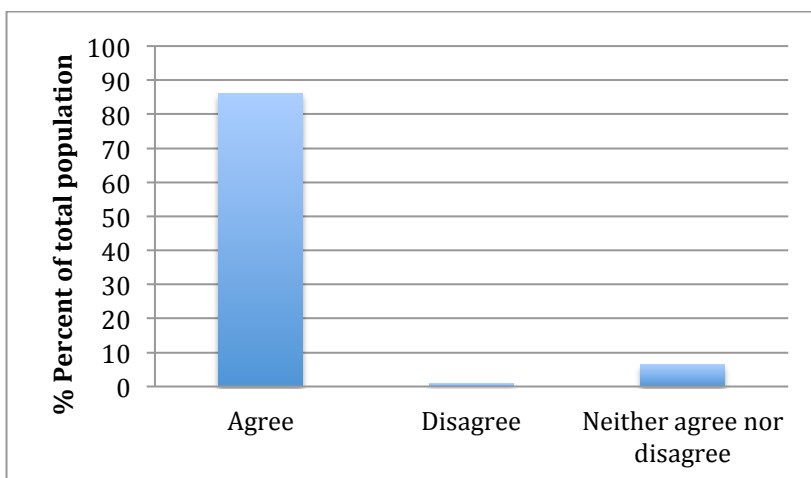


Figure 20: Answers to the statement "I care about diet and general health"

## **5. Discussion**

The present study aimed to present background, behavioural, dietary and medical variables in a group of physically active people attending a gym in Tromsø, Norway. The background was that to our knowledge there are few studies on risk factors for erosive tooth wear in a healthy lifestyle, thus meaning in a lifestyle with regular and frequent exercise and a healthy diet. We wanted to investigate if a healthy lifestyle in some way can represent a risk for dental health.

### ***Questionnaire***

The questionnaire was designed to give an indication of dietary habits, exercise habits, oral hygiene habits and attitudes towards dental health. Although a questionnaire is an easy way of collecting data of a large number of people, it has some disadvantages. A questionnaire requires a certain skill in construction. Questionnaires are limited to the current knowledge on the subject and they also tend to reflect the researchers view on the issues (Daly et al. 2013).

The questionnaire in this study was detailed and time demanding. This may have been the reason for the fact that some of the participants did not complete the entire questionnaire. For some participants, answering honestly on questionnaires can be difficult. Their diet may vary from week to week and it can be difficult to recall. People sometimes complete questionnaires in a way that reflects well upon them and therefore avoids answering honestly (Daly et al. 2013). People may also have habits they are unaware of, and not necessarily answer them in such a detailed questionnaire. We must assume that some of the answers do not represent the entire truth about habits. Also, there is a possibility that other important items that can be a risk for erosive damage might have been overlooked.

We were able to get a varied group of participants. Among the participants that registered their gender, 97 were women and 92 were men. We altered some questions, avoided leading questions and included some more alternatives to the list of foods and drinks. We also included questions about consumption of other nutritional supplements and foods, besides just sports drinks.

### ***Oral health care***

Oral hygiene is essential for maintaining a good oral health. Tooth brushing can be highly efficient for control of the development and progression of caries, especially in combination

with fluoride toothpaste (Marthaler, 2004; Nyvad 2008). The results from the questionnaire show that the study population had good routines regarding their oral health. The majority of the participants in the study answered that they brushed their teeth two times each day (73.5%) which has proved to be more effective than once a day (Marinho 2003). There is high evidence that daily use of fluoride toothpaste is effective in caries prevention in the permanent teeth in children and adolescents ([www.sbu.se/sv/publikationer/sbu-utvarderar/att-forebygga-karies/](http://www.sbu.se/sv/publikationer/sbu-utvarderar/att-forebygga-karies/)).

The duration of tooth brushing was mostly 2-5 minutes each day. This is in accordance with the general recommendations, and shows good oral hygiene routines. Few participants brushed their teeth more than two times each day, or more than 5 minutes. Excessive tooth brushing can in combination with acid exposure contribute increased erosive wear (Lussi and Carvalho, 2014). This seems not to be a significant problem for this group.

The majority of the study population had regular dental visits. A great part of the participants had visited the dentist within the last year (68.7%), and very few had not had a dental appointment in the last two years. Regular check-ups at the dentist have shown to be important for preventing recurrence of dental disease. In the Karlstad program (1971-72) adults participated in a clinical trial aimed at assessing the effect of a preventive program for caries and periodontal disease. It was based on plaque control and topical application of fluoride at frequent intervals. After 6 years of monitoring (recall every 2-3 months), the control group was discontinued but the participants in the test group were maintained in the preventive program for 9 more years (recall 3-6 times per year). Results showed that they had a low incidence of caries and almost no further loss of periodontal tissue support. In the conclusion the authors suggested that well performed oral hygiene, daily use of fluoridated products, as well as regularly repeated professional tooth cleaning effectively prevented dental disease (Axelsson et al. 1991).

### ***Knowledge about dental erosions***

It is positive that almost all of the participants had knowledge of dental erosions. There are frequently publications in newspapers and other media outlets discussing erosive tooth wear as well as increased focus amongst dental clinicians. There can be several explanations for the fact that almost 40% of the participants thought that they had erosive lesions. Some may be consuming food or beverages they believe or know is erosive, some may have heard it from

their dentist, and some may think erosive wear is a common diagnosis and that most people have erosive lesions. However, almost 60 % of the participants did not think that they had any erosive lesions. Explanations for this can be that some believe or know that their eating and drinking habits are non-erosive, some may not have been diagnosed with erosive lesions from their dentist and therefore believe that they do not have any, and some may have knowledge about dental erosions and know how to prevent lesions from developing.

The majority of the participants answered that they had not been diagnosed with erosive lesions from their dentist (77.3%). These results can indicate that the majority in this group actually do not have erosive damages. Another possibility is that some have erosive lesions without being informed by their dentist. The awareness and knowledge of erosive lesions differs among dentists. In one study, 82% of the participants diagnosed with erosive lesions reported that their regular dentist had not informed them that they had erosive lesions (Mulic et al. 2012). If patients are not diagnosed with erosive lesions, they may lack information of how to prevent development of these lesions as well. Many epidemiological studies have shown high prevalence of erosive tooth wear among children and young adults, as well as some studies in the adult population (Deery et al. 2000; van Rijkom et al. 2002; Al-Majed et al. 2002; Arnadottir et al. 2003; Dugmore and Rock 2004; Mulic et al. 2012; Isaksson et al. 2014; Fredriksen et al. 2015; Søvik et al. 2015; Salas et al. 2015). Studies from different countries show very variable prevalence of erosive wear, and because different groups are studied, and different indices are used, it is sometimes difficult to compare the results. There are few studies on the prevalence of erosive wear in physically active people. In 2012, a study on the relationship between physical exercise, dental erosive wear and salivary secretion in young adults was published, and the prevalence of dental erosive wear among the physically active participants was 64% and that was higher than the control group (Mulic et al. 2012).

It is of general belief that among children, youths and adults, the prevalence of dental caries has decreased and the prevalence of dental erosion has increased. Therefore it is an increasing need for information regarding preventive strategies for erosive wear (Lussi and Carvalho 2014).

It could be that information regarding erosive tooth wear is often presented to the patient when they show signs of erosive wear, thus prophylactic measures for stopping the further development, not before the erosive wear occurs. In the present study group, over half



answered that they knew how to prevent erosive lesions (60.2%). However, a great part, and in particular in the younger age group, did not have knowledge about preventive measures.

### ***Consumption of acidic drinks and foods***

Several studies show that acidic beverages and soft drinks have erosive potential, and the risk for developing erosive lesions and the degree of damage from acid in the diet is dependent on the amount and frequency of the consumption (Järvinen et al. 1991; Bartlett et al. 2013; Lussi and Carvalho 2014; Mulic et al. 2012; Søvik et al. 2015). A modern lifestyle includes a change in drinking habits. In general, our intake of soft drinks and juice is increased both in amount and frequency. (Espelid et al. 2000).

The results from the questionnaire show that the consumption of sour drinks in general was low in the present study population, since most of the participants had an intake of sour drinks 3-5 times a week or less. Also the consumption of sour foods was low. The majority of the participants in this study do not show an increased risk for erosive tooth wear by the amount of consumed acidic drinks. A study published in 2014 by Hasselkvist et al. showed that a high intake of sugary soft drinks was related to poorer oral health and an unhealthier lifestyle. It could be that focus on being healthy reduces risk for erosive tooth wear due to low consumption of sugary soft drinks, as they are not regarded as healthy. Studies have shown that high BMI, little physical activity and high consumption of soft drinks is associated with erosive tooth wear (McGuire et al. 2009; Isaksson et al. 2013).

The way of consumption of erosive drinks is of importance for the development and extent of erosive damages. Sipping, swishing or holding the drink in the mouth can increase the erosive potential, and use of straws can reduce the erosive potential (O`Sullivan and Curzon 2000; Johansson 2002). The results from the questionnaire show that the majority of the participants swallowed their drinks right away, thus their way of consumption is not a risk factor for developing erosive lesions.

There were few participants who had a high intake of acidic foods; the intake was in general low. Almost all participants ate oranges, kiwi and grapefruit 5 times per week or less (96.8%). Some of the participants ate apples once per day or more (9%). All participants answered that their intake of sour sweets was 3-5 times per week or less and most of them had an intake that was less than once per week. Thus all of the participants had a low intake. Søvik et al. showed in 2015 that a high erosion risk is associated with a high consumption of sour sweets. This

was not a problem for the present group, since there was in general a low intake of candies and sweets, as well as cookies and baked goods. This finding may reflect their focus on a healthy lifestyle.

### *Nutritional supplements*

There is in general a lower consumption of sports drinks and energy drinks than soft drinks, but the annual consumption per person is rising (Zucconi et al. 2013). The consumption of energy drinks before, during and after physical activity has recently been studied. A report in 2013 showed that consumption associated to sport activities had a prevalence of 52% in adults and 41% in adolescents (Zucconi et al. 2013). Other studies have shown a frequent consumption of sports drinks (55.3%-91.3%) of athletes (Mathew et al. 2002; Sirimaharaj et al. 2002; Bryant et al. 2011). For most individuals engaged in physical activity, sports drinks have no performance benefit over water (Coombes and Hamilton 2000). New nutritional supplements with purpose to be used in combination with physical activity are entering the market. To our knowledge there are no studies where the intake of these supplements is registered.

The Consumer Council of Norway has recently published studies regarding consumption of some nutritional supplements. These studies specifically registered the amount of protein supplements and energy drinks. In the total population of 10-18 year olds, only 9% consumed protein supplements and 60% used them once per week or more. These products were used more by boys (13%) than girls (5%). In the age 16-18, 25% of the boys and 9% of the girls used protein supplements. Regarding the use of energy drinks the highest consumption was in the age group 16-18, where 3 out of 5 consumed them. Only 7% in the age group 10-12, and one third of 13-15 year olds consumed these drinks. Boys (44%) had a higher consumption of energy drinks as well compared to the girls (30%). The consumption was higher in professional athletes (54%). ([forbrukerradet.no/undersokelse/2015](http://forbrukerradet.no/undersokelse/2015)).

In our study the intake of nutritional supplements was in general low. However there were significant differences in gender regarding the amount of intake ( $p < 0.005$ ). There were more men that had a high intake of these nutritional supplements. Of those who took pre-workout (acidic performance supplement) daily to 3-5 times per week, 91.3% were men. Of those who took amino acid supplements several times per day to 3-5 times per week 85.7% were men. Only men had a high intake of the supplement gainer. Low intake was approximately equally

divided between genders. There were no gender differences regarding the intake of restitution bars.

These gender differences could be explained by the purpose of the use of these supplements as well as their promoted functions. Studies have shown that boys often have the desire to build bigger muscles as well as obtain less fat (Skårderud et al. 2004). These nutritional supplements are ingested before, during and/or after physical activity and have the purpose of enhancing performance as well as to build muscle and recover after strenuous exercise. They are advertised as essential to reaching your goals when training (bodybuilding.com). Intake of some of the nutritional supplements could involve a risk for erosive tooth wear. Pre-workout and amino acid supplements often contain malic and citric acid. Others entail a risk for dental caries; like the product gainer, which is a carbohydrate supplement, and restitution bars who often contain high amount of carbohydrates and glucose sugar. During physical exercise the salivary flow decreases and the composition changes, thus the protective role of saliva may be reduced (MacKinnon and Jenkins 1993; Walsh 2004; Mulic et al. 2012; Frese et al.2014). The reduced protection of saliva would entail a reduced capacity for buffering of acidic beverages ingested during exercise as well as reduced capacity for clearance of sticky, carbohydrate rich training supplements such as restitution and energy bars.

### ***Behavioural factors***

The relationship between physical activity and oral health has been explored through a variety of studies (Ashley et al. 2015; Needleman et al. 2014). The subject of these studies varies from the risk of trauma to the basic oral health of athletes, including prevalence of dental caries and erosive tooth wear. The consumption of acidic foods and drinks is increasing in popularity. Consumption patterns could be different depending of which type of physical activity performed by the individual and how often they exercise. A person engaged in strenuous sports may be at risk for erosive wear based on several factors; frequent intake of acidic sports drinks and nutritional supplements, loss of body fluids, decreased salivary flow and altered salivary composition because of exercise and mouth breathing. All these factors may increase the risk for erosive wear.

There have been some studies on how frequency of physical activity affects dental health. Mulic et al. concluded that there could be an indication that hard exercise and decreased stimulated salivary flow rate may be associated with erosive lesions. Intrinsic risk factors

associated with sport are mouth breathing and dehydration. This could entail a risk of a reduction of the protective effects of saliva, like buffering of acidic drinks and clearance of foods ingested during exercise. Of the total population in the present study, over 80% ate before, during or directly after their activity. Over half of the participants ate 3-5 meals per day (64.4%). Some of the participants ate more than 5 meals per day. There was a significant association between the frequency of physical exercise and how many meals per day the participants ate ( $p < 0.05$ ). Those who exercised more also ate more. Most of the participants hydrated during their exercise, where almost 90% drank water. Still there were 7% that drank something else than water. They reported to drink different kinds of protein supplements, amino acid supplements and sports drinks. Only a few did not drink during activity. For most individuals water is recommended during physical activity and exercise. Unless you are exercising for longer periods of time, sports drinks have no performance benefit over water (Coombes and Hamilton 2000).

It is well known that being physically active is a mean for staying healthy. Popular literature and media show an increased interest in being “healthy” and in “slimness-lifestyles” that involve regular and frequent exercise and a healthy diet. Most of the present participants exercised daily to 4-6 times per week (69.7%). This high number of training sessions could indicate that the study population have an increased focus on a healthy lifestyle. Fewer exercised 2-3 times per week (25.1%). As well as the increased focus on being healthy, the means of being physically active are changing with trends. The top 5 fitness trends predicted for 2015 were body weight training, high-intensity interval training, strength training, training with a personal trainer and exercise for weight loss (Worldwide Survey of Fitness Trends for 2015). More than half of the participants did both cardio and strength training and almost 60% did only strength training. 10% did only cardio training. There were more participants in the younger age group that practiced strength training and this was a significant result ( $p < 0.05$ ).

During strength training some participants reported a habit of biting teeth hard together (20.4%), thus straining jaw muscle as a reaction to straining other muscles. Drinking acidic beverages during exercise, leads to an acidic dissolution by erosive agents that causes a softening of the enamel. This enhances the tooth’s susceptibility to mechanical wear (Ganss 2014). Thus biting teeth hard together during exercise could increase the erosive tooth wear.

Acidic influence on the teeth during exercise could also be due to intrinsic factors like gastric acid reaching the oral cavity and the teeth as a result gastro esophageal reflux. In the population, 4-7% are diagnosed with chronic symptomatic reflux, but about 25 % of the population have reflux without symptoms (Schlueter and Tveit, 2014). Gastric juice is highly erosive, thus a risk factor for erosive tooth wear (Bartlett and Coward, 2001). Exercise can exacerbate symptoms of reflux and studies show that gastro oesophageal reflux may be increased in athletes (Clark et al. 1989; Zero 1996; Jozkow et al, 2006). In our study, 13.7% of the participants answered that they experienced symptoms of gastric reflux. Most of those who did experienced it rarely. Out of those who experienced symptoms of gastric reflux, 25.9% experienced it several times per week or more. It was no significant difference between the younger and older age group, and no connection between more frequent exercise and of the number of participants with symptoms of reflux. There could be a higher number of participants that actually have gastric reflux. Some of them could not know what the symptoms of gastric reflux are and also some of them could be symptom free. Diseases or conditions that cause regular vomiting have the potential to cause erosive lesions (Bartlett and Coward, 2001). One of several reasons why individuals develop eating disorders may the wish to be slim and vomiting is often combined with strenuous physical exercise. However, no participants reported episodes of vomiting.

Medication use can also affect dental health and erosive tooth wear. Acidic medications, such as acetylsalicylic acid, iron tablets or vitamin supplements are potentially erosive, if they are administered per orally with prolonged contact with the teeth. Medications can also have side effects as gastric reflux, vomiting or xerostomia, which will increase the risk for developing dental erosions (Schlueter and Tveit, 2014). This seems not to be a risk factor in the study population since most of the participants responded in the questionnaire that they did not use medication (77.3%) and had a low consumption of vitamin tablets (92.5%). The majority who used medication used them in the form of tablets (80.5%) and 11.1% used inhalators for medicine administration.

### *Attitudes*

Being physically active may have advantages for dental health. Nearly 90% of the study population cared about diet and general health and of these, 74.2% cared about teeth and dental health as well. It seems reasonable to assume that those who consider it important to have a healthy lifestyle and good general health also think the same about good oral health.

Since there is no control group outside the training centre included in the study, we must take into consideration that this could be the case for other groups as well. It is a general perception that there is an increased focus on oral health in the population in general, and the dental health is improving (Marthaler, 2004). With regard to the study population the majority cared about their teeth and dental health (76.3%). About 1/3 of the participants had friends that cared about their teeth and dental health and the majority had parents that cared as well.

Most of the participants in this study were satisfied with their teeth and dental health, but there were some participants that answered that they were not satisfied or were indifferent (38.4%). It could be many reasons for this quite high number of not satisfied participants. It could be that some have been diagnosed with caries, periodontitis or other oral health diagnoses by their dentist, or previously have had some treatment done. Some of them could on a regular basis experience pain or discomfort from their mouth and teeth. The dental health of young people today is better than before and it could be that some of the participants in present time have had problems with how their teeth look, and that the dissatisfaction is not related to their actual dental health. A focus on exercise and slimness lifestyles could include a wish for perfect teeth as well. By not measuring up their ideal, it could be that some of the participants are not satisfied with their teeth and dental health.

Creating awareness of how our choices and behaviour affect dental health is important. It has for a long time been important for the prevention of caries and now the need is rising for prevention of erosive tooth wear as well. Most of the participants cared if what they drank was acidic and had tried to limit how often they consumed sour drinks (68.2%). Most of the participants did not find it hard to limit the amount of consumption, and felt that they could control the amount of sour drinks they consumed. Still there were 28.5% that found it hard to limit their consumption of soft drinks and juice.

These results show that the majority in this group of physically active people attending a gym consider dental health an important subject. Also there is an awareness of sour drinks, and they find it important to have a low intake. Most of the participants found it important not to have erosive lesions (75.8%), and would feel sorry about being diagnosed with it. Very many would change habits if they were diagnosed (82.4%). Most of the participants answered that they thought they could prevent erosive lesions (74.9%). These results indicate that an increased focus on erosive lesions and preventive strategies among dentists could reduce unfavourable habits among patients, and erosive lesions could be prevented. Still there were

some of the participants in the study that answered that the dentist best can prevent erosive lesions (7.1%). It could be that they feel the dentist have an important role in information and thus supplying the means for preventing erosive tooth wear. Another reason for answering this is displacement of the responsibility regarding their dental health.

### ***Limitations of this study***

In the present study we did not examine the participants clinically to record erosive tooth wear. The aim was to look into the risk for erosive tooth wear in a healthy lifestyle based on current knowledge on the subject. Therefore the total population in the study consist of participants in a fitness centre. It would been relevant to include a control group of persons with the same age range and gender distribution who did not practice physical exercise at the same level as the study population. A comparison could add information of differences between the groups and strengthen the results.

The total population in the study was rather small and by increasing the amount of participants different results could have appeared. Significant results are easier to see in bigger study populations.

The use of a questionnaire is an inaccurate mean of collecting data, though it is an easy way of collecting large amount of information in a study population. The results reflect he design of the questionnaire and it could be difficult to answer honestly and participants may have habits they are unaware of.

## **6. Conclusion**

A healthy lifestyle could incorporate strategies that coincide with risk factors for dental caries and erosive wear. When suggesting that a healthy lifestyle could be a risk factor, this could broaden the understanding of risk to include social determinants, general habits and lifestyle.

It became quite clear that the participants in our study lived a healthy lifestyle. Most of them exercised cardio/strength training 4-6 times a week. The individuals reported good oral hygiene habits and regular visits to the dentist. Most of the participants in the study did not show increased risk in the pattern of consumption of sour drinks, sour foods, and sports drinks. There were a few that exhibited some risk factors for erosive tooth wear by having a



high intake of these products. Most of the participants exercised frequently and some of them drank nutritional supplements during exercise instead of water. This could entail a risk for erosive tooth wear. Most of the participants hydrated with water during training. In this population there were few and only men that had a high intake of nutritional supplements.

As mentioned before, studies have shown that high BMI, little physical activity and high consumption of soft drinks is associated with erosive tooth wear. In this study population there was few that reported habits that showed increased risk for erosive tooth wear. It could be that having a healthy lifestyle like in the study population is healthy also for dental health. It is also important to create awareness about how behavioural factors affect our dental health and could constitute risk for erosive tooth wear also in a healthy lifestyle with high physical activity. There are acidic nutritional products entering the market. These products could entail a risk for erosive wear if they are frequently consumed and especially during physical activity when saliva production is low.

Erosive tooth wear is a multifactorial condition. It can therefore be difficult and time demanding to identify patients at risk. It is of importance to create awareness among clinicians that a healthy lifestyle can represent dental problems, and that acidic supplements other than sports drinks are increasing in popularity especially among men. It is important to further research into the aetiology of erosive tooth wear. Focus should be placed on behavioural, biological and chemical factors involved, in order to implement preventive strategies.

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## 8. Attachment: questionnaire

### SPØRRESKJEMA

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Registreringsnr. ....

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*Vennligst svar på alle spørsmål*

Kjønn: Mann  Kvinne  Fødselsår:

Arbeid: Elev/Student  Yrkesaktiv  Arbeidsledig

Utdanning: Grunnskole  Videregående  Høyskole/Universitet

#### *Tannhelse- og tannhelsevaner*

Svar på alle spørsmål og sett kun **ett** kryss for hvert spørsmål

**1. Hvor lenge er det siden sist du var hos tannlege/tannpleier?**

0-6 mnd  1  
7-12 mnd  2  
13-24 mnd  3  
Mer enn 24 mnd  4

**2. Hvor ofte pusser du tennene?**

Mer enn 2 ganger daglig  1  
2 ganger daglig  2  
1 gang per dag  3  
Sjeldnere  4

**3. Hvor lang tid omtrent bruker du på tannpuss daglig?**

Mer enn 5 min  1  
Mellom 2 og 5 min  2  
Mellom ½ og 2 min  3  
Mindre enn ½ min  4

**4. Bruker du fluortabletter, fluorskyllevann eller fluortyggegummi?**

Daglig  1  
2-3 ganger pr uke  2

**5. Har du hørt om syreskader på tenner?**

Nei  1  
Ja  2

**5a. Hvis ja, tror du selv du har syreskade?**

Nei  1  
Ja  2

**6. Har tannlegen nevnt noe om syreskader på dine tenner?**

Nei  1  
Ja  2

**7. Har du kunnskap/fått informasjon om hvordan man kan forebygge/ stanse syreskader?**

Nei  1

1 gang i uken  
Sjelden eller aldri

<input type="checkbox"/>	3
<input type="checkbox"/>	4

Ja  
Vet ikke

<input type="checkbox"/>	2
<input type="checkbox"/>	3

## Mat og drikke

Vennligst sett et kryss på hver linje

### 8a. Hvor ofte drikker du følgende:

	Flere ganger daglig	1 gang daglig	3-5 ganger i uken	1-2 ganger i uken	Sjeldnere enn 1 gang i uken
a. Juice					
b. Saft med sukker					
c. Saft uten sukker (Fun light etc.)					
d. Brus (Cola, Pepsi, Solo, Mosell, Iste etc)					
e. Lettbrus (Cola light, Zero, PepsiMax, Solo light, Iste light etc)					
f. Sportsdrikker (XL1, Maxim etc)					
g. Urtete, fruktte (eks. eplete, sitronte etc)					
h. Flaskevann uten smak (med eller uten kullsyre)					
i. Flaskevann med tilsatt smak (eks. dråpe sitron, bær, eple etc)					
j. Rusbrus/vin					
k. Prestasjonsøker/PWO					
l. Aminosyrer(pulver)					
m. Gainer					

### 8b. Hvor ofte spiser du følgende:

	Flere ganger daglig	1 gang daglig	3-5 ganger i uken	1-2 ganger i uken	Sjeldnere enn 1 gang i uken
a. Appelsiner/ grapefrukt/kiwi					
b. Epler					
c. Salat m/eddikdressing					
d. Potetgull/chips med dip/dressing (eks. Kim's, Maarud)					

e. Sure/syrlige godterier (eks. sure sild, sitrondrops etc)					
f. Annet godteri(sjokolade, lakris etc)					
g. C-vitaminer som sugetabletter/drops					
h. Yoghurt					
i. Boller, kaker, kjeks etc.					
j. Restitusjonsbarer/ energibarar					

<p><b>9. Hvor mye drikker du totalt av drikkene over pr. dag (unntatt flaskevann uten smak)?</b></p> <p>Mer enn 2 liter <input type="checkbox"/> 1  1-2 liter <input type="checkbox"/> 2  ½ - 1 liter <input type="checkbox"/> 3  0 – ½ liter <input type="checkbox"/> 4</p>	<p><b>11. Hvordan drikker du vanligvis leskedrikker?</b></p> <p>Av glass <input type="checkbox"/> 1  Av flaske <input type="checkbox"/> 2  Av sportsflaske, flaske med "drikketut" <input type="checkbox"/> 3  Av sugerør <input type="checkbox"/> 4  Like mye av glass og flaske <input type="checkbox"/> 5</p>
<p><b>10. Hvordan drikker du?</b></p> <p>Svelger rett ned <input type="checkbox"/> 1</p> <p>Holder drikken i munnen en stund før den svelges <input type="checkbox"/> 2</p> <p>"Skyller" drikken rundt i munnen før den svelges <input type="checkbox"/> 3</p>	<p><b>12. Hvor mange ganger spiser du pr. dag?</b></p> <p>3 <input type="checkbox"/> 1  3-5 <input type="checkbox"/> 2  Mer enn 5 <input type="checkbox"/> 3</p>

<p><b>13. Spiser du i forbindelse med trening (før, under eller rett etter)?</b></p> <p>Ja <input type="checkbox"/>  Nei <input type="checkbox"/></p> <p>Hvis ja, hva spiser du?</p> <p>.....</p> <p>.....</p>	<p><b>14. Drikker du under eller etter trening?</b></p> <p>Nei <input type="checkbox"/> 1  Ja, vann <input type="checkbox"/> 2  Ja, annet <input type="checkbox"/> 3</p> <p>Hvis ja, navn på drikken(e): .....</p> <p>.....</p>
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*Livsstil og helseforhold*

<p><b>15.a. Hvor lenge har du drevet med fysisk trening like aktivt som nå?</b></p> <p>.....</p> <p><b>b. Hva slags trening driver du med for tiden?</b></p> <table style="margin-left: 200px;"> <tr> <td>Styrke</td> <td><input type="checkbox"/></td> <td>1</td> </tr> <tr> <td>Kondisjon</td> <td><input type="checkbox"/></td> <td>2</td> </tr> <tr> <td>Annet</td> <td><input type="checkbox"/></td> <td>3</td> </tr> </table> <p>Hvis kondisjon, hva slags .....</p> <p>Hvis annet, hva slags trening: .....</p> <p><b>c. og hvor ofte?</b></p> <table style="margin-left: 100px;"> <tr> <td>Daglig</td> <td><input type="checkbox"/></td> <td>1</td> </tr> <tr> <td>4-6 ganger i uken</td> <td><input type="checkbox"/></td> <td>2</td> </tr> <tr> <td>2-3 ganger i uken</td> <td><input type="checkbox"/></td> <td>3</td> </tr> </table>	Styrke	<input type="checkbox"/>	1	Kondisjon	<input type="checkbox"/>	2	Annet	<input type="checkbox"/>	3	Daglig	<input type="checkbox"/>	1	4-6 ganger i uken	<input type="checkbox"/>	2	2-3 ganger i uken	<input type="checkbox"/>	3	<p><b>16a. Biter du tennene hardt sammen ved styrketrening/trening med vekter?</b></p> <table style="margin-left: 200px;"> <tr> <td>Nei</td> <td><input type="checkbox"/></td> <td>1</td> </tr> <tr> <td>Ja</td> <td><input type="checkbox"/></td> <td>2</td> </tr> </table> <p><b>16b. Har du problemer med ising i tennene?</b></p> <table style="margin-left: 100px;"> <tr> <td>Nei</td> <td><input type="checkbox"/></td> <td>1</td> </tr> <tr> <td>Ja</td> <td><input type="checkbox"/></td> <td>2</td> </tr> </table> <p><b>17. Bruker du medisiner?</b></p> <table style="margin-left: 200px;"> <tr> <td>Nei</td> <td><input type="checkbox"/></td> <td>1</td> </tr> <tr> <td>Ja</td> <td><input type="checkbox"/></td> <td>2</td> </tr> </table> <p>a. Hvis ja, hvilken medisin (mot hva)?</p> <p>.....</p> <p>b. hvis ja, i hvilken form?</p> <table style="margin-left: 100px;"> <tr> <td>Tabletter</td> <td><input type="checkbox"/></td> <td>1</td> </tr> <tr> <td>Mikstur</td> <td><input type="checkbox"/></td> <td>2</td> </tr> <tr> <td>Spray</td> <td><input type="checkbox"/></td> <td>3</td> </tr> <tr> <td>Inhalasjonsaerosol</td> <td><input type="checkbox"/></td> <td>4</td> </tr> </table>	Nei	<input type="checkbox"/>	1	Ja	<input type="checkbox"/>	2	Nei	<input type="checkbox"/>	1	Ja	<input type="checkbox"/>	2	Nei	<input type="checkbox"/>	1	Ja	<input type="checkbox"/>	2	Tabletter	<input type="checkbox"/>	1	Mikstur	<input type="checkbox"/>	2	Spray	<input type="checkbox"/>	3	Inhalasjonsaerosol	<input type="checkbox"/>	4
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<p><b>20. Har du vært, eller er du, plaget med sur smak i munnen eller sure oppstøt?</b></p> <table style="margin-left: 200px;"> <tr> <td>Nei</td> <td><input type="checkbox"/></td> <td>1</td> </tr> <tr> <td>Ja</td> <td><input type="checkbox"/></td> <td>2</td> </tr> </table> <p>Hvis ja, a) Hvor ofte?</p> <table style="margin-left: 100px;"> <tr> <td>Daglig</td> <td><input type="checkbox"/></td> <td>1</td> </tr> <tr> <td>Noen ganger i uken</td> <td><input type="checkbox"/></td> <td>2</td> </tr> <tr> <td>Månedlig</td> <td><input type="checkbox"/></td> <td>3</td> </tr> <tr> <td>Sjelden eller aldri</td> <td><input type="checkbox"/></td> <td>4</td> </tr> </table> <p>b) Hvor lenge har det vart?</p> <table style="margin-left: 100px;"> <tr> <td>Uker</td> <td><input type="checkbox"/></td> <td>1</td> </tr> <tr> <td>Måneder</td> <td><input type="checkbox"/></td> <td>2</td> </tr> <tr> <td>Flere år</td> <td><input type="checkbox"/></td> <td>3</td> </tr> </table>	Nei	<input type="checkbox"/>	1	Ja	<input type="checkbox"/>	2	Daglig	<input type="checkbox"/>	1	Noen ganger i uken	<input type="checkbox"/>	2	Månedlig	<input type="checkbox"/>	3	Sjelden eller aldri	<input type="checkbox"/>	4	Uker	<input type="checkbox"/>	1	Måneder	<input type="checkbox"/>	2	Flere år	<input type="checkbox"/>	3	<p><b>21. Har du vært, eller er du, plaget med oppkast?</b></p> <table style="margin-left: 200px;"> <tr> <td>Nei</td> <td><input type="checkbox"/></td> <td>1</td> </tr> <tr> <td>Ja</td> <td><input type="checkbox"/></td> <td>2</td> </tr> </table> <p>Hvis ja, a) Hvor ofte?</p> <table style="margin-left: 100px;"> <tr> <td>Daglig</td> <td><input type="checkbox"/></td> <td>1</td> </tr> <tr> <td>Noen ganger i uken</td> <td><input type="checkbox"/></td> <td>2</td> </tr> <tr> <td>Månedlig</td> <td><input type="checkbox"/></td> <td>3</td> </tr> <tr> <td>Sjelden eller aldri</td> <td><input type="checkbox"/></td> <td>4</td> </tr> </table> <p>b) Hvor lenge har det vart?</p> <table style="margin-left: 100px;"> <tr> <td>Uker</td> <td><input type="checkbox"/></td> <td>1</td> </tr> <tr> <td>Måneder</td> <td><input type="checkbox"/></td> <td>2</td> </tr> <tr> <td>Flere år</td> <td><input type="checkbox"/></td> <td>3</td> </tr> </table>	Nei	<input type="checkbox"/>	1	Ja	<input type="checkbox"/>	2	Daglig	<input type="checkbox"/>	1	Noen ganger i uken	<input type="checkbox"/>	2	Månedlig	<input type="checkbox"/>	3	Sjelden eller aldri	<input type="checkbox"/>	4	Uker	<input type="checkbox"/>	1	Måneder	<input type="checkbox"/>	2	Flere år	<input type="checkbox"/>	3
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## Holdninger til syreholdig mat og drikke

Vennligst kryss av **ett alternativ** på hver linje.

	helt uenig	uenig	verken enig eller uenig	enig	helt enig
19. Jeg synes jeg har et bevisst forhold til tenner og tannhelse	1	2	3	4	5
20. Jeg er ikke opptatt av om det jeg drikker er surt eller ikke	1	2	3	4	5
21. Jeg er fornøyd med egne tenner og tannhelse	1	2	3	4	5
22. Mine venner er opptatt av tenner og tannhelse	1	2	3	4	5
23. Tannhelse er ikke et tema i min omgangskrets	1	2	3	4	5
24. Mine foreldre er ikke opptatt av tenner og tannhelse	1	2	3	4	5
25. Mine foreldre har prøvd å kontrollere hvor ofte jeg drikker brus, juice el. lign.	1	2	3	4	5
26. Jeg prøver å begrense hvor ofte jeg drikker brus, juice el. lign.	1	2	3	4	5
27. Jeg synes det er vanskelig å holde meg borte fra brus, juice el. lign.	1	2	3	4	5
28. Jeg føler at jeg klarer å kontrollere inntak av brus, juice el. lign.	1	2	3	4	5
29. Det er ikke viktig for meg om jeg har syreskader på tennene eller ikke	1	2	3	4	5
30. Jeg vil synes det er ille hvis jeg får vite at jeg har syreskade på tennene	1	2	3	4	5
31. Jeg vil endre vaner hvis jeg får vite at jeg har syreskader på tennene	1	2	3	4	5
32. Det er ikke bryet verdt å endre vaner	1	2	3	4	5
33. Jeg kan ikke forhindre syreskader på tennene	1	2	3	4	5
34. Tannlegen er den som best kan forhindre at jeg får syreskade på tennene	1	2	3	4	5
35. Jeg er opptatt av kosthold og helse	1	2	3	4	5
36. Jeg prøver å spise "5 frukt/grønt om dagen"	1	2	3	4	5

