

ALCOHOL ABUSE IN THE DENTAL PATIENT AND TEMPOROMANDIBULAR DISORDER CAUSED BY TRAUMA

Tomislav Badel¹, Ivana Savić Pavičič², Sandra Kocijan Lovko³, Dijana Zdravec⁴,
Sandra Anić Milošević⁵ & Andreja Carek⁶

¹Department of Removable Prosthodontics, School of Dental Medicine, University of Zagreb, Zagreb, Croatia

²Department of Dental Anthropology, School of Dental Medicine, University of Zagreb, Zagreb, Croatia

³Psychiatry Clinic Sveti Ivan, Zagreb, Croatia

⁴Department of Diagnostic and Interventional Radiology, Clinical Hospital Centre "Sestre milosrdnice", Zagreb, Croatia

⁵Department of Orthodontics, School of Dental Medicine, University of Zagreb, Zagreb, Croatia

⁶Department of Fixed Prosthodontics, School of Dental Medicine, University of Zagreb, Zagreb, Croatia

SUMMARY

The aim of the paper was to describe the multidimensional character of alcoholism and its effects on oral health, with a review of the relation between the traumatogenic factor of temporomandibular disorders (TMDs) and bruxism development. The difference between moderate drinking and the development of alcohol addiction which leads to alcoholism-related medical, social, legal and economic issues is not always clear. Alcoholism is often hidden within the private and wider social framework of a patient. Oral diseases are easy to notice in recorded alcoholics as well as in, for example, smokers. TMDs consist of a disorder of masticatory muscles and/or a disorder of temporomandibular joint (TMJ). Since the traumatogenic factor of individuals under the influence of alcohol is clearly evident, it can potentially become an initializing factor of TMJ disorder's clinical signs and symptoms development. A modern approach to the etiopathogenesis is to include the multifactorial model, that is, combinations of potential factors with various individual importances. In everyday dental practice, co-morbidities of oral diseases and alcoholism are expected more often, as well as oral diseases with their etiopathogenesis partially related to alcohol use.

Key words: alcoholism - oral health - temporomandibular joint – trauma - bruxism

* * * * *

INTRODUCTION

In our contemporary culture and reaching back into the age of ancient human civilizations, drinking of ethyl alcohol has had a multidimensional significance in everyday life. A key moment in the development of an alcohol related illness is the loss of voluntary personal control of alcoholic beverages consumption (Dragišić Labaš 2016, Mešanović et al. 2020). There are many indicators of alcoholism in the 17th and 18th century Croatia, with many phrases describing alcoholism as a disease in the bilingual dictionary *Gazophylacium* by Belostenec (1998) (for example: *Pianěcz, t.j. koi, ali koja prevech pije. 2. koi ali koja jako hlepi na pitje / skup pitje, 2. Pianchuvanye / Vu pitju tovarus. skup pitnik. 2. Pijanecz.* – A drunkard be he or she that doth greatly quaff; 2 he or she that doth mightily yearn for the drink / communal drinking, 2 carousal / drinking companion, communal drinker, 2 drunkard).

Temporomandibular joint (TMJ) is certainly one of the joints in the body with the highest loads; statically and dynamically engaged both by everyday activities of the stomatognathic system (speech, mastication, mimicry, swallowing) and during sleep (bruxism) (Kuhn M & Türp JC 2018, Vidaković et al. 2016). The correlation between trauma and TMJ pathology has been confirmed by research (Zdravec et al. 2014) and since the exact number of people addicted to alcohol is

unknown, a possible increase in these numbers could be expected (Herremans & Baeken 2012, Zaman et al. 2019). The negative effects of ethanol on chondrocyte metabolism as well as on the osteoblasts and the increased activity of osteoclasts have been described (Michael et al. 2016).

In this review paper, the multidimensional character of alcoholism and its effects on oral health are described, with an overview of the relationship between traumatogenic causal factors of TMJ disorders and bruxism and shifting focus from the public health aspects towards a systematic preventive interdisciplinary approach.

DENTISTRY AND THE ALCOHOLIC PATIENT

Although the advanced form of alcohol addiction can be recorded in a questionnaire or an interview, this is not often done in medical-dental practice. Namely, the direct effects of alcohol abuse are not the most visible ones, considering the most common reasons for visiting the dentist (pain due to caries, pulpitis, abscess, etc.) (Fiedlander et al. 2003, Lepušić et al. 2013, Rifkind 2011, Schreiber 2001).

General tolerance to alcohol consumption is very high and the level of abstinence is low or does not exist, which is evident in its complex sociological role

(Cvijetić et al. 2017). Considering the fact that Croatia alone has about 250 000–300 000 treated alcoholics, it is very difficult to evaluate their total number and therefore, it is assumed that, in dental practice, many cases of co-morbidities with alcoholism will be encountered as well as oral diseases partially etiopathogenetically related to alcohol consumption (Khocht et al. 2009, Vuković et al. 2008).

The majority of oral changes in alcoholics are related to diseases of the mucosa and tongue as well as the result of poor dental health (Figure 1). The loss of teeth and/or their caries involvement are not only the consequences of poor oral hygiene (dentogingival plaque, periodontitis), but also of xerostomia due to salivary glands involvement. Salivary gland enlargement (most commonly in the form of a bilateral parotid hypertrophy) comes secondary to fatty infiltration of the glands (Merlo et al. 2010, Priyanka et al. 2017). The second pathological condition is termed sialosis or sialoadenosis – alcohol-produced peripheral autonomic neuropathy causing a disorder of salivary metabolism and secretion (Yu et al. 2009). Hyperacidity in the stomach can also cause tooth erosion due to frequent regurgitation. Burning mouth syndrome, gingival inflammation, and other oral changes (angular cheilosis, filiform and fungiform atrophy of the tongue, *glossitis exfoliativa areata non migrans*, visible capillaries of soft palate, etc) can also occur (Dukić et al. 2010, Savić Pavičin et al. 2010, Sikora et al. 2018).



Figure 1. An uncared-for dentition from the perspective of dental health

Strong alcoholic beverages can cause, after a long-term consumption, a catarrhal inflammation of the soft palate oral mucosa. Regarding malignancies, the squamous-cell carcinoma of the oral cavity (tongue and floor of the mouth) can be related to smoking and alcohol addiction. Acetaldehyde as an ethanol metabolite damages DNA and causes oncogene expression of oral keratinocytes. The most important oral precancerous conditions – erythroplakia and leukoplakia – should be taken into consideration in alcoholics due to the possibility of malignant alterations, wherein all local

irritations and known systemic etiological factors, which include alcoholic beverages, should be eliminated (Lepušić et al. 2013, Savić Pavičin et al. 2010, Warnakulasuriya et al. 2008).

TRAUMA AND ALCOHOLISM

Within the framework of the public health issue of nonfatal injuries and unintentional falls, the contribution of alcohol-abuse as an etiological factor of trauma is particularly important. Drinking alcohol results in impaired cognitive and behavioral skills, which predisposes an individual to injury (Kool et al. 2009). Craniofacial trauma is the more severe form of effects alcoholism has on health and the affected patients are cared for by oral surgery and maxillofacial departments. Mandibular fractures are common due to falls and physical altercations. Alcoholism can cause difficulties in healing of post-extraction wounds, for example, an infection or osteomyelitis. Potential craniofacial injuries in every patient treated at the emergency room due to acute alcohol intoxication should always be taken into consideration, and due to diminished general cerebral function, a thorough examination of neurological abnormalities and other physical symptoms should be included (Johnson et al. 2008, Khocht et al. 2009, O'Meara et al. 2012, Schreiber 2001).

However, latest data on the consumption of alcohol in Croatia indicate that in the last 12 months 78.1% of subjects consumed alcoholic beverages (85.3% of men and 71% of women). Following the prevalence of trauma in the sample of both genders in Croatia, 8.3% was recorded, with head trauma (10.4%) in the fourth place (Krapac et al. 2001). In Zagreb, the affected population older than 65 was also included and it was determined that men consume alcohol significantly more often. The correlation between the frequency of alcohol consumption and the elderly being exposed to domestic violence is also relevant. Also, elderly individuals who consume alcohol have been shown to commit more violent acts (Rusac 2015).

BONE DISEASE AND ALCOHOLISM

The effects of chronic alcoholism on the damaged metabolism of osseous tissues are visible from decreased bone formation and increased osteoclast activity. This explains the relationship between decreased bone mineral density (BMD) and alcohol abuse. It was found that in murine bone marrow cultures, ethanol itself and the main metabolite of ethanol – acetaldehyde – significantly reduced osteoblast proliferation and decreased the number of colony forming units for fibroblasts (Song et al. 2018).

The homeostasis and bone remodeling mechanism has been described by the maintaining of physiological

balance between osteoclast and osteoblast function. Formation of osteoclasts is induced by the presence of osteoblasts; in other words, the secretion of receptor activator of nuclear factor kappa-B ligand (RANKL) is increased on the osteoblast surface. RANKL binds to receptor activator of nuclear factor κ B (RANK) from immature precursor osteoclasts. RANKL is an essential cytokine responsible for creating and activating osteoclasts. In order to keep the effects of RANKL under control, the osteoblasts secrete osteoprotegerin (OPG), a receptor which binds itself to RANKL and prohibits its binding to osteoclast receptors. This results in suppressed differentiation of osteoblasts and inhibited formation of osteoclasts, which in turn reduces bone resorption (Badel et al. 2010).

Ethanol-induced expression of proinflammatory cytokines such as tumor necrosis factor (TNF)- α and interleukin (IL)-1beta, as well as reduced growth hormone signaling may stimulate the formation of osteoclasts. This may explain reduced BMD among alcoholics. The potentially increased levels of OPG in alcoholic patients may be explained by a compensation mechanism which causes a state of osteopenia in alcoholics (Cvijetic et al. 2016, Kc et al. 2015).

In contrast to moderate drinking which appears to have neutral or beneficial effects, chronic heavy alcohol consumption is associated with decreased BMD and increased fracture risk. Abstinence has beneficial effects on the level of bone remodeling markers, which also indicates reversibility of negative effects of ethanol on BMD decrease. During abstinence, better conditions for metabolism of bone remodeling develop which can in turn have positive effects on the increase of BMD (Gaddini et al. 2016, Kc et al. 2015).

With respect to inflammation mediators and the negative effects caused by alcohol consumption, the role of the inflammatory component in the description of osteoarthritis (OA) should be paid special attention (Figure 2). Proinflammatory cytokine interleukin-1 β (IL-1 β) and tumor necrosis factor α (TNF α) are considered to have the main role in transforming the physiological chondrocytes into OA ones and participate in the degradation of the extracellular matrix, as well as of chondrocytes and synoviocytes. However, for the development of OA, apart from the concept of synovial inflammation, the influence of other factors is important as well, particularly of mechanical stress on cartilaginous articular surfaces (Palla & Gallo 2013, Rahmati et al. 2016).

THE RELATIONSHIP BETWEEN TMJ DISORDER AND OROFACIAL TRAUMA

TMJ is a heavily loaded joint in the body with demanding dynamic functions and small surfaces on which the forces in the joint transfer within articular planes.

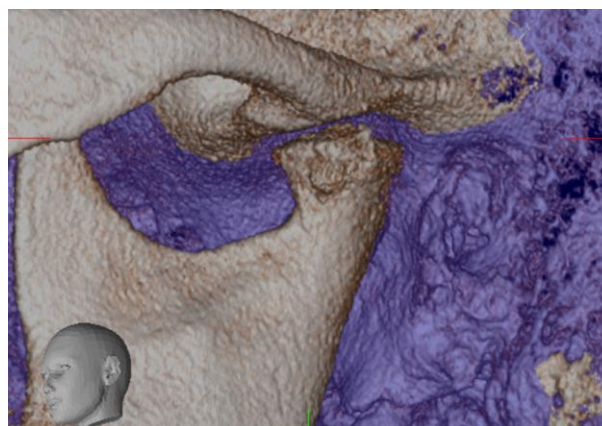


Figure 2. Cone beam computerized tomography has advantages in the diagnostics of osseous tissues including osteoarthritis

It has been observed that musculoskeletal diseases of the TMJ appear at least a decade before those of the weight-bearing joints (such as knee and hip), the main function of which is to carry the mass of the body (Herremans & Baeken 2012).

The relationship between articular cartilaginous surfaces during increased mechanical load, and the relationship between the structure of cartilaginous surface and the synovial fluid have been described by several models of cartilage lubrication. Explanation of the tribological mechanism of synovial joint function, including the TMJ, is an important contribution to describing the effects of time and load of mechanical pressure on maintaining the physiological structure and function of the articular cartilage of the TMJ (Palla & Gallo 2013).

Temporomandibular disorders (TMDs) consist of a disorder of masticatory muscles and/or a disorder of TMJ. Arthrogenic disorder is divided in two separate subgroups: osteoarthritis (Figure 2) and disc displacement (Figure 3). The most frequent forms of disc disorder are variations of anterior disc displacement (DD).

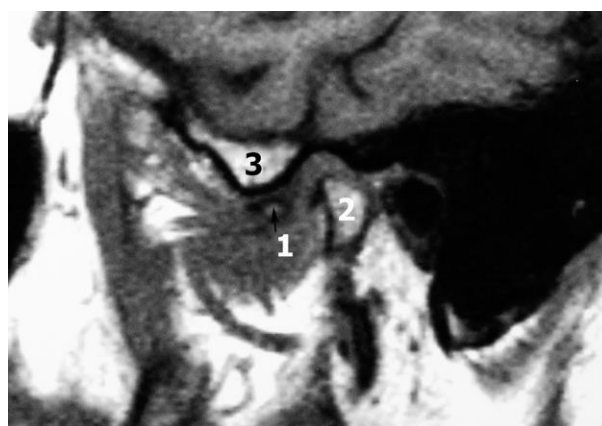


Figure 3. Magnetic resonance imaging of left temporomandibular joint (1 - displaced disc; 2 - condyle; 3 - tuberculum)

Pain, limited mouth opening, and clicking or crepitation, that is, TMJ noises are the most important symptom and a clinical sign of myogenic and arthrogenic form of TMDs (Badel et al. 2014). While there was at least one clinical TMD found in as much as 75% of examined individuals from the general population, the prevalence of patients is about 12%. Pain related to TMJ disorder as well as tendomyopathy of masticatory muscles are the main reasons for seeking treatment and help (Badel et al. 2016, Vidaković et al. 2016).

Etiopathogenesis

In the beginning, TMDs was explained by a unique etiological factor, the first theory being that of dorso-cranial displacement of condyles towards the auriculo-temporal nerve, which subsequently causes orofacial pain (*Costen's syndrome*). According to the neuromuscular theory, parafunction (bruxism) is the consequence of occlusal interferences which cause muscle spasms and hyperactivity. According to the muscle theory, the primary cause of dysfunction is muscle hyperactivity which causes muscle tension and spasms. The psychological theory considers TMDs psychosomatic – psychological disorders initiate muscle hyperactivity (parafunction), which leads to occlusal disorders (Badel et al. 2019, Jerolimov 2009).

Bruxism

Bruxism is considered an oral dyskinesia, that is, parafunction which due to clenching and/or grinding of teeth has non-physiological attrition of dental tissue as a consequence. The etiopathogenesis of bruxism is also explained by the multifactorial model. Consumption of alcohol, coffee and other even stronger psychoactive substances can be linked to bruxist activity (Figure 4). From the antidepressants group of drugs, SSRIs are linked to increased masticatory muscles activity. Psychological factors such as anxiety and stress are also some of the so-called central etiological factors of



Figure 4. Habitual occlusion – shortened dental arches and wear of the remaining teeth

bruxism. Apart from attrition due to bruxism, tooth wear often includes erosion of hard dental tissues caused by gastroesophageal reflux, consumption of acidic beverages and food, etc (Badel et al. 2006, 2007, Goldstein & Auclair Clark 2017).

Trauma and TMDs

Trauma is stated as the initiating factor in TMDs development, with several forms of macrotrauma, which exclude classic orofacial injuries treat by oral surgery and/or maxillofacial therapy. There was described a case of a male patient whose onset of clinical signs and symptoms is directly related to minor trauma of the orofacial region and the subsequent propagation of symptoms of disc displacement of TMJ (Figure 4). Apart from impacts to the mandibular region (injury, contact sports), macrotrauma can also occur from opening the mouth for too long during a dental procedure (extractions, conservative treatments), from endotracheal intubation, etc. The patient mentioned in his medical history being under the influence of alcohol during a fall-injury at home (Zadravec et al. 2014). Microtraumas can be caused by uneven teeth contacts as well as other occlusal factors caused by malocclusion, loss of certain teeth, prosthodontic work, etc. (Jerolimov 2009).

DISCUSSION

There is no universal definition of alcoholism since alcohol consumption can be only increased, problematic, poorly controlled or just unacceptable, whereas Alcoholism as a disease expresses a craving for alcohol along with the development of addiction (Palla & Gallo 2013). Widespread availability of alcoholic beverages creates difficulties in differentiating excessive alcohol use from early onset of the disease. Apart from alcohol-abuse by adolescents and the working-age population, the problem is its prevalence in the elderly, who have been exposed to alcohol consumption for a longer period of time (Cvijetić et al. 2017, Vuković et al. 2008).

Alcohol use has an effect on social contact with dentists during the treatment. Patients under the influence of alcohol can skip appointments, be argumentative regarding the results of treatment procedures and at the same time, behave completely differently when they are sober. If a dental patient is not under the influence of alcohol when visiting the dentist, it is difficult to determine the causes of frequent dental prostheses' fractures because they might not admit to having been under the influence of alcohol. Alcoholism can also be related to the development of dental anxiety in patients who underwent a dental procedure carried out by a dentist who was under the influence of alcohol (Priyanka et al. 2017, Rifkind 2011).

Alcohol addiction can help develop a generalized disorder of human health related to an individual level of tolerance. Many symptoms (for example, insomnia, sweating, rapid pulse, anxiety, nausea, vomiting, sweating and xerostomia) are related to a current level of intoxication and in the period afterwards, as the concentration of alcohol in the blood decreases, these symptoms disappear. Alcoholism causes numerous pathological changes on almost all the organs with particular stress on: alcoholic liver disease (fatty liver, hepatitis, or cirrhosis), low-grade hypertension, gastrointestinal ulcers, increased rate of cancer (oral cavity, pharynx, larynx, esophagus and stomach), poor nutrition with hypovitaminosis B, D, K and A which in turn affects the central (intoxication and withdrawal, progressive alcoholic dementia, cerebellar degeneration, etc.) and peripheral (alcohol polyneuritis) nervous system, hematologic disorders (anemia, leucopenia, thrombocytopenia, and coagulation defects), and the co-morbidity with other addictions is common (nicotinism). Alcoholism also involves numerous psychiatric complications (Korsakoff syndrome, delirium tremens, alcoholic depression, jealousy psychosis, etc.) (Briegleb et al. 2020, Fiedlander et al. 2003, Khocht et al. 2009, Matošić et al. 2016, Priyanka et al. 2017).

The study by Savić Pavičin et al. (2010) revealed a great co-morbidity of smoking and alcoholism (80% of subjects), oral hygiene was unsatisfactory (70% of subjects), and there were numerous oral diseases (xerostomia, leukoplakia, changes on the tongue, teeth impressions on the tongue, etc.). On the other hand, Hlheim et al. (2012) relate alcohol consumption with myocardial infarction based on bactericidal effects of alcohol on oral microflora. The limitation of the cross-sectional study is the fact that data on myocardial infarction, as well as on previous teeth extractions were self-reported. It is suggested that, apart from moderate consumption of alcoholic beverages (2–7 times per week), the best prevention of myocardial infarction is good and regular oral hygiene. On the contrary, the risk of caries is reduced by a regular pattern of alcohol drinking. Alcohol is a bactericidal agent and may reduce the level of the microbiota of the oral cavity.

The approach to dental treatment of alcoholic patients should be modified, particularly if the patients do not hide their alcohol addiction. The traumatogenic effects of alcoholic beverages in dental practice are not very obvious in cases of minor injuries of hard dental tissues or the orofacial region in general (Priyanka et al. 2017). Trauma related to alcohol-abuse can be better quantified within the hospital protocol (blood alcohol concentration). Procedures on visibly intoxicated individuals should be avoided in dental practice. Numerous, already described dental-oral changes and diseases in alcoholics should be registered although it is unlikely that a patient will admit his/her alcohol addiction (Pachito et al. 2021, Rifkind 2011).

There are many factors within the multifactorial model which are related to TMDs but their causal relationship has not been proven. TMD is the most common cause of non-odontogenic orofacial pain and it is predominant in women aged between 18 and 45. In the systematization of potential factors, the traumatogenic factors are often related to orofacial trauma in sports and whiplash injury of the neck (Zadravec et al. 2014).

Bruxism is more often mentioned as a co-morbidity of TMDs than as a potential etiopathogenetic factor. The etiology of bruxism is also not completely clear but it has been observed in psychiatric patients and particularly in individuals treated for alcoholism. Central etiological factors of bruxism (pathophysiological and psychological ones) dominate the theoretical model of bruxism development but they do not provide an option of using them to complete a direct and effective treatment or even prevention of bruxism. The occlusal splint is the method of choice in initial treatment of TMJ and bruxism (Badel et al. 2007, Goldstein & Auclair Clark 2017).

CONCLUSION

Alcohol consumption and alcohol (ethanol) addiction is a widespread and, possibly, neglected psychiatric disease with many social and medical consequences. Patients addicted to alcohol have a special place in dental care due to many complications with teeth and oral tissues' health and issues with wearing removable dental appliances. Since the traumatogenic aspect of individuals under the influence of alcohol is undoubtedly pronounced, it can potentially be expected to be an initiating factor of the development of clinical signs and symptoms of TMJ disorder.

Acknowledgements: None.

Conflict of interest: None to declare.

Contribution of individual authors:

Tomislav Badel: idea, concept and design of the article, literature searches, writing manuscript.

Ivana Savić Pavičin: idea, concept and design of the article, data analysis, comments on first draft.

Sandra Kocijan Lovko: comments on the concept of the article, writing manuscript, literature searches.

Dijana Zadravec: comments on the concept of the article, comments on first draft.

Sandra Anić Milošević: writing manuscript, literature searches.

Andreja Carek: idea, comments on first draft, revisioning the manuscript.

All authors approval of the final version.

References

1. Badel T, Kocijan Lovko S, Pandurić J, Keros J: Bruxism and alcoholism: A clinical report. *Alcoholism* 2006; 42:85-92
2. Badel T, Keros J, Šegović S, Komar D: Clinical and tribological view on tooth wear. *Acta Stomatol Croat* 2007; 41:355-365
3. Badel T, Keros J, Krapac L, Savić Pavičin I: Relationship between osteonecrosis of the jaw and bisphosphonate treatment [in Croatian]. *Arh Hig Rada Toksikol* 2010; 61:371-380
4. Badel T, Kocijan Lovko S, Zadravec D: Anxiety and Temporomandibular disorders: a Relationship in Chronic Pain Development. In: Shiloh AR, editor. *Anxiety disorders – Risk Factors, Genetic Determinants and Cognitive-Behavioral Disorders*. New York: Nova Science Publishers, 2014. p. 93-123
5. Badel T, Savić Pavičin I, Čimić S, Zadravec D: Diagnostics and Management of Temporomandibular Joint Disorder – a Reported Case with a Review of Literature. *J Dent Probl Solut* 2016; 3:018-023
6. Badel T, Zadravec D, Bašić Kes V, Smoljan M, Kocijan Lovko S, Zavoreo I, et al.: Orofacial pain – diagnostic and therapeutic challenges. *Acta Clin Croat* 2019; 58(Suppl. 1):82-89
7. Belostenec I: *Gazophylacium illyrico-latinum*. 1740 [reprint]. Zagreb: Stari Grad, 1998
8. Briegleb M, Hanak C: Gastric Bypass and Alcohol Use: A Literature Review. *Psychiatr Danub* 2020; 32(Suppl 1): 176-179
9. Cvijetić S, Grazio S, Kosovic P, Uremovic M, Nemcic T, Bobic J: Osteoporosis and polymorphisms of osteoprotegerin gene in postmenopausal women - a pilot study. *Reumatologia* 2016; 54:10-13
10. Cvijetić S, Sabolić Pipinić I, Maria Varnai V, Macan J: Relationship between ultrasound bone parameters, lung function, and body mass index in healthy student population. *Arh Hig Rada Toksikol* 2017; 68:53-58
11. Dragišić Labaš S: Alcohol use: social aspect, gender differences and stigmatization. *Alcoholism and Psychiatry Research* 2016; 52:51-64
12. Dukić W, Dobrijević TT, Katunarić M, Milardović S, Segović S: Erosive lesions in patients with alcoholism. *J Am Dent Assoc* 2010; 141:1452-1458
13. Fiedlander AH, Marder SR, Pisegna JR, Yagiela JA: Alcohol abuse and dependence: psychopathology, medical management and dental implications. *J Am Dent Assoc* 2003; 134:731-740
14. Gaddini GW, Turner RT, Grant KA, Iwaniec UT: Alcohol: A Simple Nutrient with Complex Actions on Bone in the Adult Skeleton. *Alcohol Clin Exp Res* 2016; 40:657-671
15. Goldstein RE, Auclair Clark W: The clinical management of awake bruxism. *J Am Dent Assoc* 2017; 148:387-391
16. Håheim LL, Olsen I, Rønningen KS: Oral infection, regular alcohol drinking pattern, and myocardial infarction Medical Hypotheses 2012; 79:725-730
17. Herremans SC, Baeken C: The current perspective of neuromodulation techniques in the treatment of alcohol addiction: a systematic review. *Psychiatr Danub* 2012; 24(Suppl 1):S14-20
18. Jerolimov V: Temporomandibular disorders and orofacial pain. *Rad 504 Medical sciences* 2009; 33:53-77
19. Johnson D, Hearn A, Barker D: A pilot survey of dental health in a group of drug and alcohol abusers. *Eur J Prosthodont Restor Dent* 2008; 16:181-184
20. Kc R, Voigt R, Li X, Forsyth CB, Ellman MB, Summa KC, et al.: Induction of Osteoarthritis-like Pathologic Changes by Chronic Alcohol Consumption in an Experimental Mouse Model. *Arthritis Rheumatol* 2015; 67:1678-1680
21. Khocht A, Schleifer SJ, Janal MN, Keller S: Dental care and oral disease in alcohol-dependent persons. *J Subst Abuse Treat* 2009; 37:214-218
22. Kool B, Ameratunga S, Jackson R: The role of alcohol in unintentional falls among young and middle-aged adults: a systematic review of epidemiological studies. *Inj Prev* 2009; 15:341-347
23. Krapac L: Frequency of injuries in Croatian population before the Croatian War of Independence. *Fiz Med Rehabil* 2001; 18:9-15
24. Kuhn M, Türp JC: Risk factors for bruxism. *Swiss Dent J* 2018; 128:118-124
25. Lepušić D, Radović-Radović S: Alcohol – a predictor of risky sexual behavior among female adolescents. *Acta Clin Croat* 2013; 52:3-9
26. Matošić A, Marušić S, Vidrih B, Kovak-Mufić A, Ččin-Šain L: Neurobiological bases of alcohol addiction. *Acta Clin Croat* 2016; 55:134-150
27. Mešanović M, Pajević I, Hasanović M, Babić D: The Social Characteristics of Patients with Alcohol Use Disorder in the Area of the Tuzla Canton - Bosnia and Herzegovina. *Psychiatr Danub* 2020; 32(Suppl 2):273-280
28. Merlo C, Bohl L, Carda C, Gómez de Ferraris ME, Carranza M: Parotid sialosis: morphometrical analysis of the glandular parenchyme and stroma among diabetic and alcoholic patients. *J Oral Pathol Med* 2010; 39:10-15
29. Michael AR, Bengtson JD: Chronic alcoholism and bone remodeling processes: Caveats and considerations for the forensic anthropologist. *J Forensic Leg Med* 2016; 38:87-92
30. O'Meara C, Witherspoon R, Hapangama N, Hyam DM: Alcohol and interpersonal violence may increase the severity of facial fracture. *Br J Oral Maxillofac Surg* 2012; 50:36-40
31. Palla S, Gallo LM: Biomechanics and Mechanobiology of the TMJ. In: Green CS, Laskin DM, editors: *Treatment of TMDs. Bridging the Gap Between Advances in Research and Clinical Patient Management*. Chicago, Quintessence, 2013; p.101-112
32. Pachito DV, Pega F, Bakusic J, Boonen E, Clays E, Descatha A, et al.: The effect of exposure to long working hours on alcohol consumption, risky drinking and alcohol use disorder: A systematic review and meta-analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury. *Environ Int* 2021; 146:106205
33. Rahmati M, Mobasheri A, Mozafari M: Inflammatory mediators in osteoarthritis: A critical review of the state-of-the-art, current prospects, and future challenges. *Bone* 2016; 85:81-90
34. Rifkind JB: What should I look for when treating an alcoholic patient (current or recovered) in my office? *J Can Dent Assoc* 2011; 77:b114
35. Rusac S: Elderly Abuse and Alcohol Consumption. *Coll Antropol* 2015; 39:869-875
36. Priyanka K, Sudhir KM, Reddy VCS, Kumar RK, Srinivasulu G: Impact of Alcohol Dependency on Oral

- Health - A Cross-sectional Comparative Study. J Clin Diagn Res* 2017; 11:ZC43-ZC46
37. Savić Pavičin I, Karlović D, Buljan D: Alcoholism and oral health. *Alcoholism* 2010; 46:93-100
38. Schreiber A: Alcoholism. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2001; 92:127-131
39. Sikora M, Verzak Ž, Matijević M, Včev A, Siber S, Musić L, et al.: Anxiety and Depression Scores in Patients with Burning Mouth Syndrome. *Psychiatr Danub* 2018; 30:466-470
40. Song TH, Shim JC, Jung DU, Moon JJ, Jeon DW, Kim SJ, et al.: Increased Bone Mineral Density after Abstinence in Male Patients with Alcohol Dependence. *Clin Psychopharmacol Neurosci* 2018; 16:282-289
41. Vidaković B, Uljanić I, Perić B, Grgurević J, Sonicki Z: Myofascial pain of the head and neck among Croatian war veterans treated for depression and posttraumatic stress disorder. *Psychiatr Danub* 2016; 28:73-76
42. Vuković O, Cvetić T, Zebić M, Marić N, Britvić D, Damjanović A, et al: Contemporary framework for alcohol craving. *Psychiatr Danub* 2008; 20:500-507
43. Warnakulasuriya S, Parkkila S, Nagao T, Preedy VR, Pasanen M, Koivisto H, et al.: Demonstration of ethanol-induced protein adducts in oral leukoplakia (pre-cancer) and cancer. *J Oral Pathol Med* 2008; 37:157-165
44. Yu YH, Park YS, Kim SH, Son BK, Jun DW, Jo YJ, et al.: Sialadenosis in a patient with alcoholic fatty liver developing after heavy alcohol drinking (in Korean). *Korean J Gastroenterol* 2009; 54:50-54
45. Zadravec D, Badel T, Jerolimov J, Krolo I, Krapac L, Kern J: Magnetic resonance in diagnostics of temporomandibular joint disorders in patients with previous trauma. *Acta Stomatol Croat* 2014; 48:78
46. Zaman R, Hankir A, Jemni M: Lifestyle Factors and Mental Health. *Psychiatr Danub* 2019; 31(Suppl 3):217-220

Correspondence:

Ivana Savić Pavičin, PhD
Department of Dental Anthropology, School of Dental Medicine
Gunudlićeva 5, 10 000 Zagreb, Croatia
E-mail: savic@sfzg.hr