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## Učinak pušenja duhana na salivaciju

### The Effect of Tobacco Smoking on Salivation

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#### Sažetak

**Svrha:** U ovom istraživanju želio se ispitati štetan učinak pušenja duhana na funkciju žlijezda slinovnica. **Ispitanici i postupci:** Istraživanje je provedeno na 60 ispitanika podijeljenih u dvije skupine: na ispitnu skupinu u kojoj su bili pušači i kontrolnu u kojoj su bili nepušači. Svaka skupina obuhvatila je 30 ispitanika. Svi sudionici ispunili su upitnik kako bi se prikupili opći anamnestički podatci i podatci o trajanju pušenja i broju popušanih cigareta na dan. Slina je skupljena metodom pljuvanja u graduirane epruvete, a količina nestimulirane i stimulirane sline izmjerena je i zabilježena u ml po minuti. Stimulirana slina skupljena je odmah nakon ispiranja usta 2-postotnom vodenom otopinom limunske kiseline koja je služila za poticanje izlučivanja. Tijekom kliničkih pregleda zabilježen je nalaz pigmentacija na zubima i obloženost jezika. Stupanj oralne higijene određen je indeksom plaka. Svi dobiveni podatci statistički su analizirani na razini značajnosti  $p < 0,05$ . **Rezultati:** Rezultati su pokazali značajne razlike u količini sline između pušača i nepušača. Uz to količina sline značajno se smanjivala s trajanjem pušenja i povećanjem dobi pušača. Također je dokazana razlika u kvaliteti sline: pušači imaju gustu, mukoznu slinu, a nepušači više seroznu, vodenastu. Osim toga, pušači imaju lošiji nalaz oralne higijene u odnosu prema nepušačima, a dokazana je i pozitivna korelacija između stupnja oralne higijene i duljine pušenja duhana. **Zaključak:** Iz istraživanja se može zaključiti da pušenje negativno utječe na lučenje sline: dugotrajno pušenje ga smanjuje i mijenja njezinu kvalitetu.

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#### Ključne riječi

pušenje; duhanom uzrokovani poremećaji; slina; izlučivanje sline; kserostomija

#### Uvod

Slina obavlja mnoge funkcije u ustima: zaslužna je za probavu hrane, služi u zaštiti i podmazivanju sluznice, olakšava gutanje hrane i govor. Uz to, slina ima veliku ulogu u očuvanju oralnoga zdravlja i higijeni usta. Osim što pomaže u otplavlivanju patogenih bakterija i ostataka hranjivih tvari, proteolitički enzimi i protutijela iz sline mogu uništiti mikroorganizme na sluznici i zubima, uključujući i bakterije koje uzrokuju zubni karijes. Slina je prijeko potrebna i za stalni proces remineralizacije zuba, za što su nužni kalcijevi i fosfatni ioni iz sline (1).

Nedostatak sline velik je zdravstveni problem jer kompromitira u cijelosti oralnu funkciju i oralno zdravlje. Uz otežanu funkciju, suha usta bez sline podložna su razvoju upale, gljivičnoj infekciji, brzom razvoju karijesa, upali velikih žlijezda slinovnica i pojavi zadaha.

Količina sline može se objektivno izmjeriti sjalometrijom. Dnevno se izlučuje od 0,8 do 1,2 l sline. Lučenje sline od 0,4 do 0,5 ml u minuti smatra se normalnim, količina sline od 0,2 do 0,4 ml/min upućuje na oligosijaliju, a količina manja od 0,2 ml/min na hiposalivaciju (2).

Hiposalivaciju pacijenti najčešće doživljavaju kao subjektivan osjećaj suhoće usta, odnosno kao kserostomiju.

#### Introduction

Saliva has many functions in the oral cavity: it is responsible for the digestion of food, serves to protect and lubricate mucous membrane, and facilitates ingestion of food and speech production. Besides, saliva has a major role in maintaining oral health and oral hygiene. In addition to helping washing away pathogenic bacteria and debris nutrients, proteolytic enzymes and antibodies from saliva can destroy microorganisms on the mucosa and teeth including bacteria that cause tooth decay. The presence of saliva is necessary for the permanent process of remineralization of the teeth for which calcium and phosphate ions from saliva are required (1).

Lack of saliva represents a major health problem because it completely compromises oral function and oral health. Along with aggravated function, dry mouth is subject to the development of inflammation, fungal infection, the rapid development of caries, inflammation of major salivary glands, and bad breath.

The amount of saliva can be measured objectively with sialometry. Daily secretion of saliva is 0.8-1.2 l. Salivation from 0.4 to 0.5 ml/min is considered normal, while the quantity of saliva 0.2-0.4 ml/min indicates oligosialia and a quantity of less than 0.2 ml/min hyposalivation (2).

Uzroci hiposalivacije mnogobrojni su unutarnji i vanjski čimbenici: bolesti slinovnica, različite organske bolesti, različita psihička stanja i bolesti, liječenje zračenjem, kemoterapija i velik broj različitih lijekova (> 500) koji imaju kao dokumentiranu nuspojavu suhoću usta ili kserozomiju. Poznato je da pušenje duhana općenito štetno djeluje na opće i oralno zdravlje. A dokazi upućuju na to da je pušenje jedan od vanjskih čimbenika smanjenoga lučenja sline, ali su nalazi istraživanja kontradiktorni (3).

Stoga svrha ovog istraživanja bila je ispitati učinak pušenja duhana na kvalitetu i količinu sline i kakva je oralna higijena ispitanika.

## Materijal i metode

### Ispitanici

Istraživanje je obuhvatilo 60 ispitanika, nasumce odabranih pacijenata Kliničkoga zavoda za oralnu medicinu i Kliničkoga zavoda za fiksnu protetiku. Odobrilo ga je Etičko povjerenstvo Stomatološkoga fakulteta Sveučilišta u Zagrebu, a ispitanici su uključeni u istraživanje nakon što su potpisali informirani pristanak i dobrovoljno pristali sudjelovati. Kriteriji za uključivanje bili su punoljetnost pacijenata, odsutnost bolesti slinovnica i da nisu bili zračeni u području glave i vrata. Svi sudionici podijeljeni su u dvije skupine po 30 ispitanika: ispitnu skupinu činili su pušači, a kontrolnu nepušači.

Raspodjela ispitanika prema dobi i spolu pokazala je da su pušači bili mlađe dobi, (prosječna dob pušača bila je 37,8 godina) u odnosu prema nepušačima (47,7 godina). Kad je riječ o raspodjeli prema spolu, u obje skupine većina ispitanika bile su žene: u skupini pušača 63,33 posto, i u skupini nepušača 66,67 posto, iz čega proizlazi da je bilo više žena pušača.

### Metode

Svim ispitanicima postavljena su pitanja iz anketnoga upitnika koji je izrađen za ovo istraživanje. Pitanja su uključivala opće podatke i podatke o pušenju (broj popušanih cigareta na dan, koliko dugo puši) te podatke o sustavnim bolestima i lijekovima koje pacijent uzima.

Nakon toga je od svih ispitanika skupljena i izmjerena slina metodom pljuvanja u graduirane epruvete. Slina je mjerena od 9 do 12 sati prijepodne i najmanje dva sata nakon posljednjeg obroka. Svim ispitanicima najprije je izmjerena količina nestimulirane sline (QNS) tijekom pet minuta, a nakon toga svaki je isprao usta 2-postotnom vodenom otopinom limunske kiseline te je izmjerena količina stimulirane sline (QSS) koja je prikupljena također tijekom pet minuta. Iz ovih vrijednosti dobivena je količina sline u ml u jedinici vremena (ml/min) koje su korištene u obradi podataka.

Kvaliteta sline procijenjena je vizualno pri uzimanju svakoga uzorka i podijeljena je u pet kategorija: ljepljiva, pjenušava, gusta, serozna i vodenasta.

Svaki ispitanik klinički je pregledan kako bi se uočilo i zabilježilo stanje oralne higijene te pigmentacija na zubima

Patients usually experience hyposalivation as a subjective feeling of dry mouth or xerostomia.

Causes of hyposalivation are numerous. Internal and external factors are salivary gland diseases, various organic diseases as well as various mental conditions and diseases, treatment with radiation, chemotherapy as well as a number of different drugs (> 500) which have a documented side effect of dry mouth or xerostomia. It is known that smoking tobacco affects general and oral health. Also, evidence suggests that smoking is one of the external factors which reduces secretion of saliva, however, research findings are contradictory (3). Therefore, the aim of this study was to assess the effect of tobacco smoking on quality and quantity of salivation and the oral hygiene status of subjects.

## Materials and methods

The study included 60 subjects - randomly selected patients of Clinical Department of Oral Medicine and the Clinical Department of Fixed Prosthodontics. The study was approved by the Ethics Committee of the School of Dental Medicine, University of Zagreb, and the subjects were included in the study after signing the informed consent and voluntarily agreeing to participate in research. The inclusion criteria were age 18 and above of patients, the absence of salivary gland diseases and the fact that they were not irradiated in the head and neck area. All subjects were divided into two groups of 30 subjects: a test group consisted of smokers and a control group of nonsmokers. The distribution of subjects shows that the average age of smokers (37.8 years) was lower than non-smokers (47.7 years). Regarding the distribution by gender, in both groups, the majority of subjects were females: in the group of smokers 63.33% and in the group of non-smokers 66.67%, which means that there were more female smokers.

All subjects were asked the questions from the questionnaire that was developed for this research. The questions included: general information, information about smoking (number of cigarettes smoked per day, length of smoking), information on systemic diseases and medications taken by the patient.

Saliva of every subject was collected and measured in a graduated tube by spitting method. Saliva was measured from 9 to 12 am and at least 2 hours after the last meal. First, the amount of unstimulated saliva was measured (QNS) during 5 minutes, after which each subject rinsed their oral cavity with 2% aqueous solution of citric acid, and the amount of stimulated saliva (QSS) was measured for 5 minutes as well. From these values the amount of saliva produced in ml per time unit was obtained (ml / min), which was used in data processing.

The quality of saliva was assessed visually when taking each sample and was divided into categories: sticky, thick, foamy and watery.

In each of the subjects, clinical examination was performed to detect and record condition of oral hygiene and presence of teeth staining and coated tongue. Oral hygiene

i obloženost jezika. Stanje oralne higijene zabilježeno je prema indeksu plaka (Silness i Løe, 1964.) (4). Obloženost jezika i pigmentacija zuba zabilježena je kao pozitivan nalaz kod onih ispitanika kod kojih je nađena.

#### Obrada podataka

Podatci su prikupljeni i analizirani programom Microsoft Excel (Microsoft, SAD). Statistička analiza obavljena je u programu MedCalc v11 (MedCalc software, Belgija). Razlike kvantitativnih vrijednosti između skupina analizirane su nezavisnim t-testom, a kategorijske i kvalitativne varijable Fischerovim egzaktnim testom. Za analizu više od dvije grupe korišten je Kruskal-Wallisov test, a korelacije varijabli analizirane su Pearsonovim koeficijentom korelacije - r. Za razinu značajnosti određen je  $p < 0,05$ .

### Rezultati

#### Utjecaj pušenja duhana na salivaciju

Rezultati usporedbe količine sline između pušača i nepušača pokazuju da nije nađena statistički značajna razlika u količini nestimulirane (QNS) i stimulirane sline (QSS) između pušača i nepušača (slika 1.).

Slika 2. pokazuje usporedbu količine sline QNS i QSS u odnosu prema dobi između pušača i nepušača. Rezultat pokazuje da se u skupini pušača s porastom dobi značajno smanjuje količina nestimulirane sline ( $p = 0,0008$ ) u odnosu na nepušače kod kojih nema značajne razlike ( $p = 0,2195$ ). Sličan rezultat dobiven je i za stimuliranu slinu čija se količina značajno smanjuje s porastom dobi pušača ( $p = 0,0002$ ) u odnosu prema nepušačima ( $p = 0,2786$ ).

Rezultat korelacije duljine pušenja i količine sline kod pušača (QNS i QSS) također pokazuje značajno smanjenje količine nestimulirane (QNS  $p = 0,0186$ ) i stimulirane sline (QSS  $p = 0,0083$ ) kod pušača koji dulje puše (slika 3.). No količina sline nije značajno povezana s brojem popušenih cigareta na dan (QNS  $p = 0,6811$ , a QSS  $p = 0,5552$ ).

Rezultati pokazuju i razlike u kvaliteti sline. U skupini pušača najveći broj ispitanika ima gustu, mukoznu slinu, a među nepušačima prevladava serozna slina.

#### Utjecaj lijekova na salivaciju

Lijekove je uzimao manji broj pušača (40 %) u odnosu prema nepušačima (50 %). Najčešće korišteni bili su antihipertenzivi (51,5 %). Prosječan broj lijekova po pacijentu u skupini pušača bio je 0,83, a u skupini nepušača 1,3.

Usporedba količine sline QNS i QSS kod pušača koji uzimaju lijekove i pušača koji ih ne uzimaju, prikazana je na slici 4. Pušači koji uzimaju lijekove imaju značajno manje sline (QNS) u odnosu prema pušačima koji ih ne uzimaju, a razlika u QSS-u nije bila značajna.

Na slici 5. prikazana je usporedba količine sline (QNS i QSS) kod nepušača koji uzimaju lijekove i onih koji ih ne

status was recorded according to the plaque index (Silness and Løe, 1964) (4).

Data were collected and analyzed using Microsoft Excel (Microsoft, USA). Statistical analysis was made by the program MedCalc v11 (MedCalc Software, Belgium). Values of quantitative differences between groups were analyzed by an independent t-test, while for categorical and qualitative variables, Fischer's exact test was used. For the analysis of more than two groups, the Kruskal-Wallis test was used, while the correlations between variables were analyzed by Pearson correlation coefficient - r. For the level of significance,  $p < 0.05$  was determined.

### Results

#### The effect of tobacco smoking on salivation

The results of the comparison of the amounts of saliva between smokers and non-smokers show that statistically significant difference was not found in the amount of unstimulated (Qns) and stimulated saliva (Qss) between smokers and non-smokers (Figure 1).

Figure 2 shows a comparison of the quantity of saliva Qns and Qss in relation to the age of smokers and non-smokers. The results show that in the group of smokers with increase of age the amount of unstimulated saliva was significantly reduced ( $p = 0.0008$ ), compared to non-smokers with no significant difference ( $p = 0.2195$ ). A similar result was obtained for stimulated saliva as well, the amount of which significantly reduced by the increase in age of smokers ( $p = 0.0002$ ) compared to non-smokers ( $p = 0.2786$ ).

The results of the correlation of the duration of smoking and the amount of saliva of smokers (Qns and Qss) also show a statistically significant difference ( $p = 0.0186$  for Qns and  $p = 0.0083$  for Qss). The amount of unstimulated and stimulated saliva decreases significantly with increasing of the smoking duration (Figure 3).

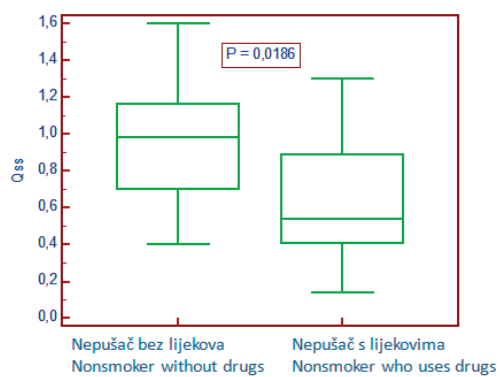
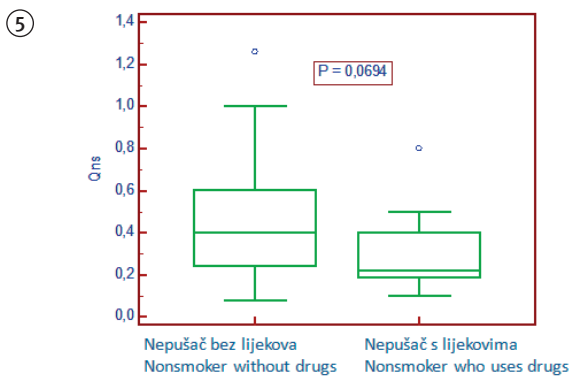
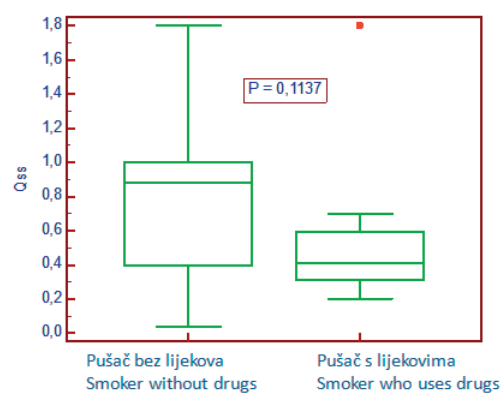
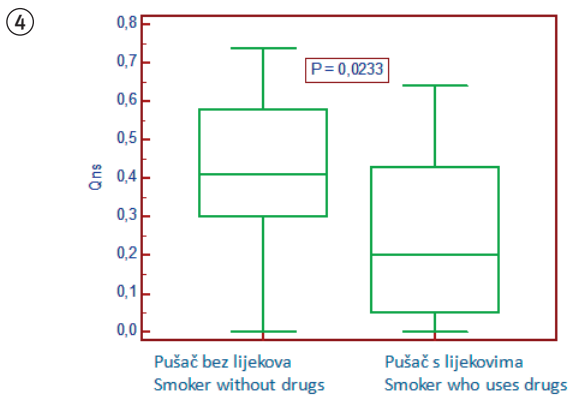
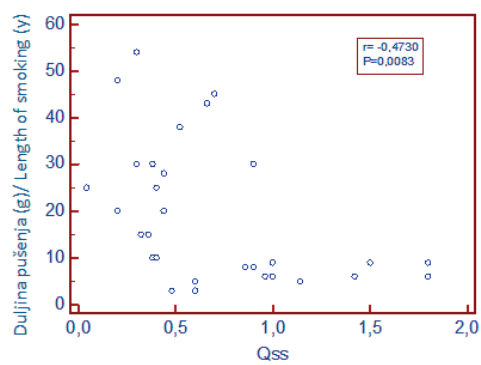
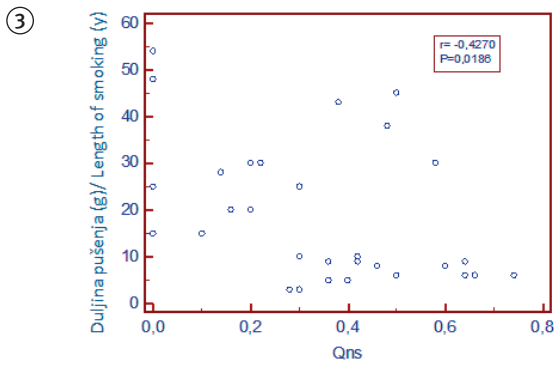
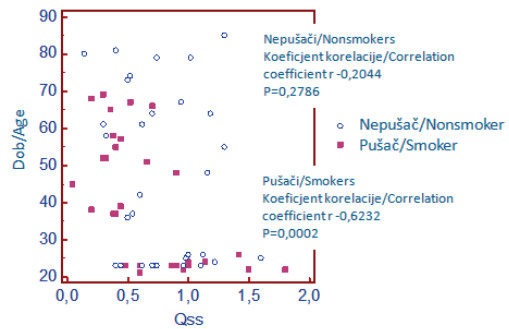
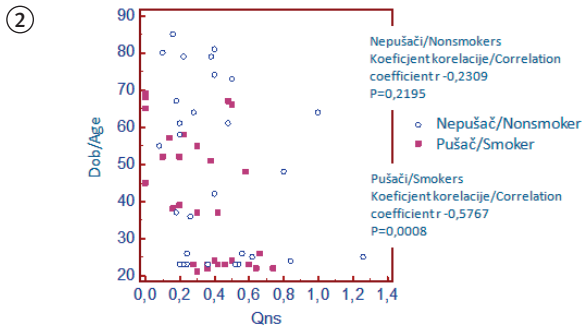
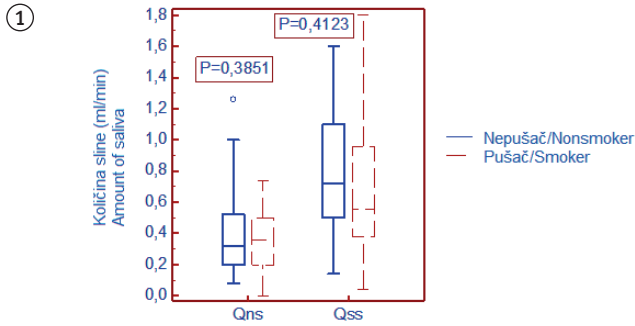
However, the amount of saliva is not significantly associated with the number of cigarettes smoked per day (Qns  $p = 0.6811$ , Qss  $p = 0.5552$ ).

Results show the difference in the quality of saliva. In the group of smokers, the largest number of subjects had thick saliva, while among non-smokers the thin and watery saliva prevailed.

#### The effect of drugs on salivation

Smokers used fewer drugs (40%) than non-smokers (50%). The most commonly used drugs were antihypertensives (51.5%). The average number of drugs per patient in the group of smokers was 0.83, and in the group of non-smokers 1.3.

Comparison of saliva (unstimulated, Qns and stimulated, Qss) of smokers who use drugs and smokers who do not use drugs is shown in Figure 4. Smokers who use medications have significantly less saliva (Qns) compared to smokers who do not use them, while the Qss difference was not significant.



uzimaju. Razlika u količini nestimulirane sline (QNS) nije značajna ( $p = 0,0694$ ), za razliku od stimulirane sline (QSS) gdje postoji značajna razlika ( $p = 0,0186$ ). Kod nepušača lijekovi ne utječu značajno na količinu nestimulirane sline (QNS), ali značajno smanjuju količinu stimulirane sline (QSS).

Usporedba količine sline (QNS i QSS) između pušača koji ne uzimaju lijekove i nepušača koji ih uzimaju, pokazuje da nema statistički značajne razlike u količini sline između pušača koji uzimaju lijekove i nepušača koji ih ne uzimaju ni u QNS-u ( $p = 0,1074$ ) ni u QSS-u ( $p = 0,2411$ ).

### Utjecaj pušenja duhana na higijenu usne šupljine

Prosječna vrijednost indeksa plaka po pušaču veća je od prosječne vrijednosti po nepušaču (1 : 0,8), što upućuje na lošiju oralnu higijenu pušača. Dokazano je također da indeks plaka raste s duljinom pušenja, odnosno da je oralna higijena pušača lošija što dulje puše. Ta je povezanost statistički značajna ( $p = 0,0386$ ). U skupini pušača također je češće opažen obloženi jezik (20 %) i pigmentacija zuba (53,3 %), za razliku od nepušača (30 %)

### Rasprava

Ovim istraživanjem željelo se ispitati utječe li pušenje duhana na izlučivanje sline. Polazeći od pretpostavke da pušenje štetno utječe na cjelokupni organizam, očekivali smo i negativan utjecaj na funkciju žlijezda slinovnica – smanjenu količinu i kvalitetu sline, što smo i dokazali ovim istraživanjem. Osim toga, promatrali smo učinak pušenja na stupanj oralne higijene, pojavu pigmentacije na zubima i obloženost jezika.

Dobiveni rezultati pokazali su da nema statistički značajne razlike u količini nestimulirane i stimulirane sline između pušača i nepušača. To tumačimo time što su ispitanici bili mlađe dobi, kraće su vrijeme pušili i samim time imali bolje očuvanu funkciju žlijezda slinovnica. U literaturi smo pronašli proturječne rezultate sličnih istraživanja. Khan i suradnici istaknuli su kako dugotrajno pušenje ne utječe negativno na salivarni refleksi i salivaciju (5). Također su uočili kratkoročno povećanje količine sline kod pušača nakon stimulacije okusnih receptora nikotinom. Na kratkoročno povećanje količine sline može utjecati mehanička, kemijska i toplinska stimulacija žlijezda slinovnica tijekom pušenja (6). Iida i suradnici objasnili su kemijsku stimulaciju na animalnom modelu i dokazali da nikotin i citizin djeluju na nikotinske re-

Figure 5 shows a comparison of the quantity of saliva (Qns and Qss) of non-smokers who take drugs and those who do not take them. The difference in the quantity of unstimulated saliva (Qns) was not significant ( $p = 0.0694$ ), in contrast to the stimulated saliva (Qss) where there was a significant difference ( $p = 0.0186$ ). Drugs do not significantly affect the amount of unstimulated saliva in non-smokers (Qns), but significantly reduce the amount of stimulated saliva (Qss).

Comparison of the amount of saliva (Qns and Qss) between smokers who do not use drugs and non-smokers who use them, showed no statistically significant difference in the amount of saliva, neither in the Qns ( $p = 0.1074$ ) nor in Qss ( $p = 0.2411$ ).

### The effect of tobacco smoking on oral hygiene

The average value of the plaque index per smoker is greater than the average value per non-smoker (1: 0.8) which indicates a poorer oral hygiene of smokers.

It is evident that the plaque index increases with the length of smoking, meaning that the oral hygiene of smokers is poorer the longer they smoke. This correlation is statistically significant ( $p = 0.0386$ ). Also, teeth staining was found in 53.3% of smokers as opposed to non-smokers among whom 30% had staining. In 20% of smokers the coated tongue was observed.

### Discussion

The aim of this study was to determine whether smoking tobacco affects salivation.

Assuming that tobacco smoking is harmful to the entire organism we expected that it would have a negative impact on the function of the salivary glands in terms of reduced quantity and quality of saliva which was proved in this study. In addition, we observed the effect of smoking on the condition of oral hygiene, appearance of pigmentation on the teeth and coated tongue. The results showed no statistically significant difference in the amount of unstimulated and stimulated saliva in smokers compared to non-smokers. We explain these results by the fact that the majority of smokers were younger and the period of smoking was shorter. Therefore the function of salivary glands was preserved.

In literature, we came across contradictory results of similar research. Khan et al. observed that long-term smoking does not adversely affect salivary reflex and salivation (5). They also noticed that there was a short-term increase in the amount of saliva in smokers by stimulating taste receptors by nicotine. The mechanical, chemical and thermal stimulation of salivary glands by cigarettes during smoking can stimu-

**Slika 1.** Količina nestimulirane (QNS) i stimulirane sline (QSS) između pušača i nepušača

**Figure 1** Quantity of unstimulated (Qns) and stimulated (Qss) saliva between smokers and non-smokers

**Slika 2.** Razlika u količini nestimulirane (QNS) i stimulirane sline (QSS) između pušača i nepušača različite dobi

**Figure 2** Difference in the quantity of unstimulated and stimulated saliva among smokers and non-smokers of different age

**Slika 3.** Usporedba duljine pušenja i količine sline (nestimulirane i stimulirane) kod pušača

**Figure 3** Comparison of duration of smoking and quantity of saliva (unstimulated and stimulated) among smokers

**Slika 4.** Usporedba količine sline nestimulirane (QNS) i stimulirane (QSS) kod pušača koji uzimaju lijekove i pušača koji ih ne uzimaju

**Figure 4** Quantity of unstimulated (Qns) and stimulated (Qss) saliva in smokers who took medications and those who did not take medications

**Slika 5.** Usporedba količine sline nestimulirane (QNS) i stimulirane (QSS) kod nepušača koji uzimaju lijekove i nepušača koji ih ne uzimaju

**Figure 5** Quantity of unstimulated (Qns) and stimulated (Qss) saliva in non-smokers who took medications and those who did not take medications



ceptore kao agonisti i stimuliraju lučenje sline te djeluju kao sijalagozi, pri čemu citizin može biti bolja terapijska opcija kao sijalogog za liječenje suhoće usta (7). Field i Duka pokazali su da postoji i psihološka stimulacija salivacije kod pušača pri pokazivanju pušačkoga pribora: ispitanici su imali bolju sekreciju čim su vidjeli pribor za pušenje, premda su muškarci imali smanjenu sekreciju, a žene povećanu sekreciju sline ali samo u situaciji kada su cigarete bile pokazane, ali nedostupne (8).

Rad i suradnici (9) ustanovili su pak da postoji značajna razlika u količini sline između pušača i nepušača, odnosno da se dugotrajnim pušenjem količina sline značajno smanjuje. To potvrđuju i ovdje dobiveni rezultati koji pokazuju da kod pušača postoji obrnuta korelacija između dobi i količine sline, a kod nepušača ta korelacija ne postoji. Smanjenje količine sline kod starijih pušača povezano je s duljinom pušenja.

Rezultati su pokazali da pušači imaju promijenjenu kvalitetu sline u odnosu prema nepušačima. Većina pušača imala je gustu slinu, a kod nepušača prevladavala je serozna slina. Zbog štetnih utjecaja na slinovnice najprije stradaju doušne žlijezde čija je zadaća izlučivanje seroznog sekreta. Gubitak njihove funkcije kompenziraju podčeljusna i podjezična žlijezda koje izlučuju mukozni sekret (15). To objašnjava gušču slinu kod pušača. Novija istraživanja potvrđuju da pušenje negativno utječe na promjenu kvalitete sline. Tvari iz duhanskoga dima razaraju zaštitne makromolekule sline, enzime i proteine, pa slina gubi svoju protektivnu ulogu i postaje posrednik u razvoju raka usne šupljine i orofarinksa (10 – 12).

Ovo je istraživanje, za razliku od drugih sličnih (9,13,15), uključilo i podatke o lijekovima koje su uzimali ispitanici u obje skupine, a potencijalno mogu smanjiti količinu sline. Više lijekova uzimali su nepušači u odnosu prema pušačima, a od lijekova najzastupljeniji su bili antihipertenzivi za koje je poznato da utječu na salivaciju i djeluju kserostomično. Uvidjeli smo da nema značajne razlike u količini sline između pušača koji ne uzimaju lijekove i nepušača koji ih uzimaju. Iz toga proizlazi da lijekovi i pušenje podjednako utječu na salivaciju i s vremenom pojačavaju suhoću usta. Tome u prilog govore naši rezultati koji pokazuju da je količina nestimulirane sline manja kod pušača koji uzimaju lijekove. Smanjenu količinu sline možemo promatrati kao posljedicu kumulativnog učinka lijekova i pušenja tijekom vremena. Rezultate o utjecaju lijekova na salivaciju kod pušača nismo mogli usporediti sa sličnim istraživanjima drugih autora jer takve podatke nismo našli u nama dostupnoj literaturi.

Opažena lošija oralna higijena kod pušača u skladu je s dosadašnjim istraživanjima (15). Rezultati su pokazali da se dugogodišnjim pušenjem pogoršava oralna higijena i povećava težina gingivitisa (16). Studija Changa i suradnika također pokazuje pozitivnu korelaciju između loše oralne higijene i povećanog rizika od raka usne šupljine čiji nastanak favorizira sinergijski učinak alkohola i duhana (17).

late a short-term increase of the amount of saliva (6). Iida et al. explained chemical stimulation on an animal model and demonstrated that nicotine and cytosine acted on nicotinic receptors as agonists and stimulated the secretion of saliva (7). Nicotine and cytosine also act as sialogogue wherein the cytosine may be a better therapeutic candidate to serve as a sialogogue for xerostomia patients. Authors Field and Duka have shown that there is a psychological stimulation of salivation in smokers displaying smoking requisites: participants also showed salivary reactivity to smoking cues, with males showing a decrease in salivation, and females showing an increase, but only when cigarettes were perceived as unavailable (8). On the other hand, Rad et al. (9) found that there were significant differences in the amount of saliva between smokers and non-smokers, and that long-term smoking causes saliva to significantly decrease. This was confirmed by our results, which showed that in smokers there is an inverse correlation between age and the amount of saliva, while in non-smokers, this correlation does not exist. A decrease in the amount of saliva in older smokers is associated with the duration of smoking. The results have shown that smokers have a modified quality of saliva compared to non-smokers. Most of the smokers had thick saliva while in non-smokers watery saliva prevailed.

When harmful effect of cigarettes impacts the salivary glands, the first to be affected is parotid gland whose role is secretion of watery saliva. The loss of its function is compensated by submandibular and sublingual glands which secrete mucous saliva. This explains thicker saliva in smokers. Recent research confirms that smoking negatively affects the quality of saliva. Substances from cigarette smoke destroy protective macromolecules of saliva, enzymes and proteins, and thus saliva loses its protective role and becomes an agent in carcinogenesis and development of oral and oropharyngeal cancer (10-12).

This study, in contrast to other similar studies (9, 13, 15) included the effect of drugs on salivation in both groups, which could potentially reduce the amount of saliva. Non-smokers took more drugs compared to smokers and the most often used drugs were antihypertensives that are known to affect the salivation and have a xerostomic effect. We observed no significant difference in the amount of saliva of smokers who do not use drugs and non-smokers who use them. Therefore, the usage of drugs and smoking equally affects salivation. Similarly, our results show that the amount of unstimulated saliva is lower in smokers who use drugs. Reduced amount of saliva can be explained as a result of the cumulative effect of drugs and smoking over time. The results of the impact of drugs on salivation in smokers could not be compared with similar studies by other authors since such data were not found in the available literature.

Noticed deterioration of oral hygiene among smokers is consistent with previous research (15). Some results showed that long-term smoking causes oral hygiene to deteriorate and it increases the severity of gingival disease (16). Also, the study by Chang et al. showed positive association between poor oral hygiene and increased risk of head and neck cancer which appeared to differ between alcohol or cigarette consumption (17).

## Zaključak

Na temelju provedenog istraživanja možemo zaključiti da dugotrajno pušenje oštećuje funkciju žlijezda slinovnica, što se očituje u smanjenoj količini i lošijoj kvaliteti sline. Uz to, kod pušača je dokazana lošija oralna higijena.

## Sukob interesa

Nije bilo sukoba interesa.

## Conclusion

Based on our results, we can conclude that long-term smoking compromises the function of the salivary glands which is reflected in the reduced amount and poorer quality of saliva. In addition, poorer oral hygiene has been found in smokers.

## Conflict of Interest

None declared.

### Abstract

**Aim:** The purpose of this study was to examine the detrimental effect of smoking on the function of the salivary glands. **Material and Methods:** The study was conducted on 60 patients who were divided into two groups: a test group which included smokers and control group represented by non-smokers. Each group included 30 patients. General information was collected from all the respondents via a questionnaire as well as the data on the duration of smoking and number of cigarettes smoked per day. Saliva was collected by spitting method in a graduated tube and the amount of unstimulated and stimulated saliva was measured and recorded in ml per minute. Stimulated saliva was collected immediately after rinsing the mouth with a 2% aqueous solution of citric acid which is carried salivary stimulation. The presence of pigmentation on the teeth and coated tongue were recorded during clinical examination. The degree of oral hygiene was determined by plaque index. All the obtained data were statistically analyzed with significance level  $p < 0.05$ . **Results:** The results showed no significant differences in the amount of saliva between smokers and non-smokers, however, the amount of saliva decreases significantly with the duration of smoking and increasing age of smokers. Also proven was the difference in the quality of saliva: smokers have thick saliva and nonsmokers predominantly serous. In addition, smokers have poorer oral hygiene status than non-smokers, and demonstrated a positive correlation between the level of oral hygiene and length of smoking tobacco. **Conclusion:** This study has proven that smoking adversely affects salivation: long-term smoking reduces the secretion of saliva and changes its quality.

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### Key words

Smoking; Tobacco Use Disorder; Saliva; Salivation; Xerostomia

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