

INFLUENCE OF BAD HABIT OF SMOKING ON THE QUANTITY OF SALIVARY SECRETION AND THE SUBJECTIVE FEELING OF DRYNESS IN ORAL CAVITY

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ABSTRACT

Introduction: The bad habit of smoking has a harmful effect on the salivary glands, oral mucous membranes and teeth. Salivary secretion is reduced due to the harmful effect of smoking on salivary glands. No matter how tobacco is consumed, its harmful effects on the oral mucous membranes result from the thermal action caused by tobacco combustion and the chemical action of smoke that the products of tobacco combustion contains. In smokers, the changes occur on the lips, gingiva, buccal mucosa, palatal mucosa, and tongue. The mucous membrane changes its characteristics; it is initially inflamed to be later increasingly keratinized. There is also an increased risk of potentially malignant lesions and oral cavity cancer. There is a dental discoloration where teeth get dark and pigmented as result of an increased amount of dental deposits. Smokers often have a feeling of dryness, bitterness and intense nicotine induced halitosis or bad breath.

Purpose: The purpose of this research is to explore the harmful effects that the bad habit of smoking has on the quantity of salivary secretion (i.e. quantity of saliva/salivary secretion rate) and the subjective feeling of dryness in oral cavity.

Research methods and Materials: The research was conducted as a survey run on a sample of 61 respondents. The average age of the respondents is 24 years (students of the third, fourth and fifth year of the Sarajevo Faculty of Dentistry), of whom 31 are smokers and 30 are non-smokers. The respondents are healthy and show no signs of systemic diseases.

On the basis of this survey, the general anamnestic data was collected, including the data regarding duration of the smoking habit and the number of cigarettes consumed per day. A clinical examination of the oral cavity was also performed in each respondent, focusing on the examination of oral mucosa. To that effect, a qualitative test of *in vitro* adhesion (Vitroadhesion Test) was performed, including an examination of salivary flow aided with the Koebner Phenomenon and a quantitative measuring of the Salivary Secretion Rate (quantity of secreted saliva per time) according to Skaff.

Results and Conclusion: Data obtained from anamnesis, clinical examination and appropriate tests designed for the evaluation of the quantity and quality of saliva were processed statistically.

The results of our survey indicate a statistically significant difference ($p= 0.045$) between the tested groups in one of the applied variables (subjective symptoms detected in the respondents), while the most severe symptom was throat dryness, where out of the 6 respondents who manifested this symptom, 5 were smokers.

Key words: smoking, tobacco, saliva, Vitroadhesion Test, Koebner Phenomenon

Introduction

Saliva is a complex mix of components such as fluids, of watery or viscous consistency, and numerous inorganic ions and organic substances such as hormones, enzymes, antibodies and antimicrobial factors [1, 2]. Human saliva is secreted by three pairs of major salivary glands (parotid, submandibular and sublingual glands) and many minor salivary glands distributed under the oral cavity mucosa [3].

Saliva plays a major role in preservation of oral health and hygiene of the oral cavity, as it lubricates the oral cavity mucosa and helps in protection against mechanical, thermal and chemical irritations, and contributes to unobstructed airflow, speech and swallowing.

Salivation also helps in the removal of pathogenic bacteria and residues of nutrients needed for their metabolism. The saliva enzyme system is responsible for the antimicrobial effect. The creation of unfavourable conditions for development of pathogenic microorganisms is also ensured by a buffer saliva system maintaining an optimal pH level of about 6.5.

Smoking is an addiction and the major cause of diseases and death [1]. Generally speaking, tobacco smoking has a harmful effect on overall and oral health. One third of the adult population are smokers. [5] Saliva is the first biological liquid to confront inhaled cigarette smoke, containing numerous toxic ingredients responsible for the structural and functional changes in saliva. [3] The adverse effects of smoking and other forms of tobacco consumption are numerous and the consumption of tobacco is closely associated with the occurrence of number of changes in oral mucosa and periodontium. [4]

Smoking is one of the major risk factors reducing salivation. [5, 6] Reduced salivation or qualitative salivary changes usually result in a subjective feeling of dryness in the patient's mouth. This condition is described by the term *xerostomy/xerostomia* and it signifies only a symptom, rather than a diagnosis or a specific disease. [10]

Purpose

The purpose of this survey was to explore the harmful effects of the bad habit of smoking on the quantity and quality of salivary secretion and the subjective feeling of dryness in oral cavity.

Materials and methods

This research was conducted on a sample of 61 respondents. The respondents were students of the Sarajevo Faculty of Dentistry, aged 22 to 27. All respondents gave

their written consent to participate in the research and were divided into two groups – Smokers and Non-Smokers. The respondents are healthy. On the basis of a survey, general anamnestic data was collected, including also the data regarding duration of smoking habit and the number of cigarettes consumed per day. Clinical examination of the oral cavity was performed, by focusing mainly on the quantity of salivary secretion and the feeling of dryness, including an examination of the respondents' oral mucosa. A qualitative test of *in vitro* adhesion (*Vitroadhesion Test*) was performed, including an examination of salivary flow aided with the Koebner Phenomenon, and a quantitative measuring of the quantity of salivary secretion per time (*Salivary Secretion Rate*) according to Skaff. The complete anamnestic data and the data obtained by using tests for evaluation of quantity and quality of saliva, as well as the observed pathological changes, were all recorded in a log sheet designed specifically for the purposes of this research.

The Vitroadhesion Test is used to estimate the quality of saliva. The test is carried out on the dorsal side of the tongue, by using a dental mirror, in the way to press the mirror glass surface against the tongue and abruptly remove it from the tongue. If the mirror sticks to the mucosa of the glossal dorsum, the test is considered positive, meaning that the salivary secretion is disturbed and that denser, viscous and sticky saliva is secreted creating the feeling of oral dryness. The test is considered negative if the mirror is removed from the glossal mucosa easily and without resistance.

Measuring the Salivary Secretion Rate (SSR) according to Skaff is a test to determine the quantity of salivary secretion per unit of time. The values reaching ≥ 8 ml within the period of 15 minutes (≥ 8 ml/15min) are considered as physiological. The values of less than 8ml within the period of 15 minutes (< 8 ml/15min) suggest the existence of hyposalivation.

If Salivary Secretion Rate is physiological, a "tiny pond" of saliva is created on the floor of the oral cavity within 2 minutes suggesting the existence of the so-called Kobner Phenomenon.

Results

Data obtained in this research was processed by using **STATISTICA 20.0** software. In order to determine differences between respondents in terms of the answers given to the asked questions, or the differences between Smokers and Non-Smokers, we used the non-parametric *Mann-Whitney U test* for independent samples.

A statistical analysis showed that the female respondents were represented more by 60.66% and the male respondents by 39.34%, while the average age of the

Chart 1

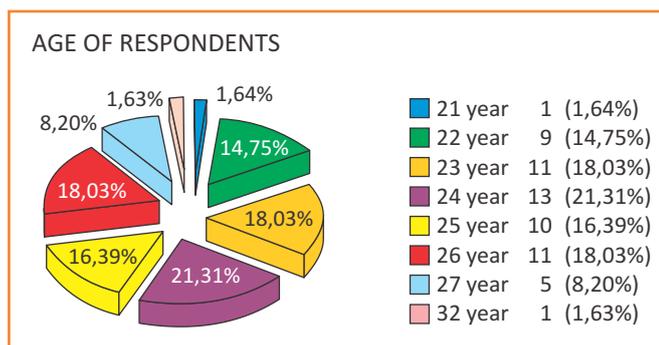


Chart 2

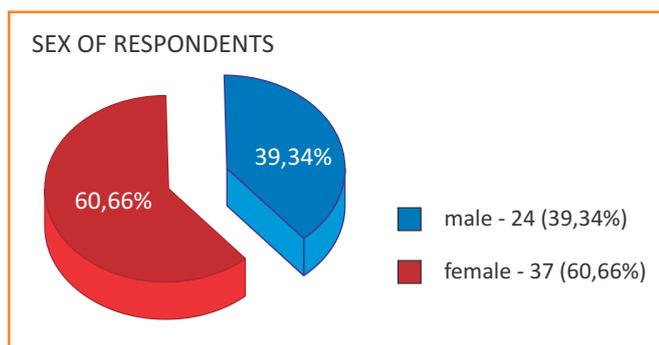


Chart 3

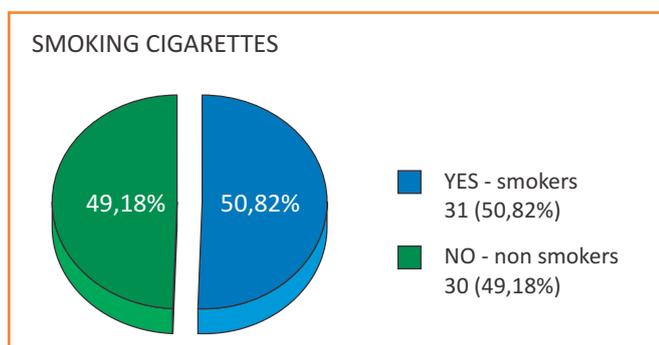


Table 1. Response Frequencies in the Applied Variables of the Subscale Item – Bad Habits and Systemic Diseases (the complete sample)

| Variable | Assertion-Attitude | Frequency (N=61) | Per-cent | Valid Per-cent | Cumulative Per-cent |
|------------|-------------------------|------------------|----------|----------------|---------------------|
| SMOCIG | 1 YES - smokers | 31 | 50,8 | 50,8 | 50,8 |
| | 2 NO- non-smokers | 30 | 49,2 | 49,2 | 100,0 |
| QUANTITY | 1 1 – 10 cigarettes | 8 | 25,8 | 25,8 | 25,8 |
| | 2 box daily | 19 | 61,3 | 61,3 | 87,1 |
| | 3 more than a box | 4 | 12,9 | 12,9 | 100,0 |
| TIMESMOK | 1 < 5 years | 9 | 29,0 | 29,0 | 29,0 |
| | 2 5 – 10 years | 19 | 61,3 | 61,3 | 90,3 |
| | 3 10 years> | 3 | 9,7 | 9,7 | 100,0 |
| CONSALC | 1 YES – cons.alcohol | 30 | 49,2 | 49,2 | 49,2 |
| | 2 NO – non-alcoholics | 31 | 50,8 | 50,8 | 100,0 |
| TYPEALCO | 1 beer | 9 | 30,0 | 30,0 | 30,0 |
| | 2 heavy alc. beverages | 0 | 0 | 0 | 30,0 |
| | 3 combined | 21 | 70,0 | 70,0 | 100,0 |
| TIMCONALC | 1 < 5 years | 10 | 33,3 | 33,3 | 33,3 |
| | 2 5 – 10 yaers | 15 | 50,0 | 50,0 | 83,3 |
| | 3 10 years> | 5 | 16,7 | 16,7 | 100,0 |
| SYSTDISEAS | 1 YES | 9 | 14,8 | 14,8 | 14,8 |
| | 2 NO | 52 | 85,2 | 85,2 | 100,0 |
| NAMEDISEAS | 1 respiratory | 3 | 4,9 | 33,3 | 33,3 |
| | 2 cardiovascular | 2 | 3,3 | 22,2 | 55,6 |
| | 3 alergic | 1 | 1,6 | 11,1 | 66,7 |
| | 4 digestive | 3 | 4,9 | 33,3 | 100,0 |
| TREATED | 1 YES | 11 | 18,0 | 18,0 | 18,0 |
| | 2 NO | 50 | 82,0 | 82,0 | 100,0 |
| KINDTREAT | 1 analgesi/antipyretics | 4 | 6,6 | 36,3 | 36,3 |
| | 2 antibiotics | 3 | 4,9 | 27,4 | 63,7 |
| | 3 internistically | 4 | 6,6 | 36,3 | 100,0 |
| ORTOTREAT | 1 YES | 5 | 8,2 | 8,2 | 8,2 |
| | 2 NO | 56 | 91,8 | 91,8 | 100,0 |
| KINDORTTR | 1 mobile appliance | 2 | 3,3 | 40,0 | 40,0 |
| | 2 fixed appliance | 3 | 4,9 | 60,0 | 100,0 |

respondents was 24.37 years (Charts 1 and 2). Thirty-one (31) respondents or 50.8% of the total number were grouped as *Smokers*, while thirty (30) of them or 49.2% were grouped as *Non-Smokers* (Chart 3).

Table 1 presents the response frequencies in applied variables of the subscale item – Bad Habits and Systemic Diseases for the complete sample, where for the item of the variable called **Cigarette Smoking (CIGSMOK)** it is evident that 31 respondents or 50.8% of the total number of respondents were grouped as *Smokers*, while 30 respondents or 49.2% were grouped as *Non-smokers*. In the *Smokers* group, most prevalent were those respondents smoking one box of cigarettes per day (61.3%). However, as duration of the cigarette smoking habit is concerned, most prevalent are those smoking 5-10 years period (61.3%). Although the focus of the research was not on

alcohol consumption, the respondents answered that 31 of them (50.8%) do not consume alcohol, while 30 of them (49.2%) answered they do. As far as the type of alcoholic beverage is concerned, 70.0% of them have consumed combined beverages for 5-10 years period (50.0%). Out of the total number of respondents, only 9 of them (14.8%) stated that they suffered from some sort of the systemic diseases, mostly respiratory and digestive ones (4.9%). In addition, 11 of them (18.0%) used medications on a short-term basis, most commonly were analgesics/antipyretics and some of prescribed medications (6.6%). Table 1 shows that 91.8% of the respondents did not have orthodontic appliances and 8.2% of them did, while 2 of them (3.3%) had a removable orthodontic appliance and 3 of them (4.9%) had a fixed orthodontic appliance.

Table 2. Response Frequencies in Applied Variables of the Subscale Item – *Changes in the Mucous Membranes.*

| Variable | Assertion-Attitude | Frequency (N=61) | Per-cent | Valid Per-cent | Cumulative Per-cent |
|----------|--------------------------|------------------|----------|----------------|---------------------|
| EFLSLU | 1 YES | 22 | 36,1 | 36,1 | 36,1 |
| | 2 NO | 39 | 63,9 | 63,9 | 100,0 |
| EFLPRO | 1 morsicatio mucosae | 13 | 21,3 | 56,5 | 56,5 |
| | 2 hiperkeratosis | 3 | 4,9 | 13,0 | 69,6 |
| | 3 ectopic changes | 0 | 0,0 | 0,0 | 69,6 |
| | 4 aphtae | 2 | 3,3 | 8,7 | 78,3 |
| | 5 erosio | 5 | 8,2 | 21,7 | 100,0 |
| LOPRSL | 1 Buccal.mucos. unilate. | 10 | 16,4 | 43,5 | 43,5 |
| | 2 bukalna sluzn. bilate. | 9 | 14,8 | 39,1 | 82,6 |
| | 3 tonque | 2 | 3,3 | 8,7 | 91,3 |
| | 4 lips | 1 | 1,6 | 4,3 | 95,7 |
| | 5 more localization | 1 | 1,6 | 4,3 | 100,0 |
| TRPRSL | 1 < 1 month | 6 | 9,8 | 26,1 | 26,1 |
| | 2 1 – 2months | 10 | 16,4 | 43,5 | 69,6 |
| | 3 2 months > | 7 | 11,5 | 30,4 | 100,0 |
| RECPRO | 1 YES | 6 | 9,8 | 26,1 | 26,1 |
| | 2 NO | 17 | 27,9 | 73,9 | 100,0 |
| SUSIPA | 1 YES | 11 | 18,0 | 18,0 | 18,0 |
| | 2 NO | 50 | 82,0 | 82,0 | 100,0 |
| SIMPKO | 1 pain | 1 | 1,6 | 9,1 | 9,1 |
| | 2 baking | 2 | 3,3 | 18,2 | 27,3 |
| | 3 annealing | 2 | 3,3 | 18,2 | 45,5 |
| | 4 dryness | 6 | 9,8 | 54,5 | 100,0 |

Table 2 for complete sample represents the response frequencies in the applied variables of the sub-scale item - *Changes on the Mucous Membranes.*

As for the variable called **Efflorescence Existing on the Mucous Membranes (EFLMUME)**, it is evident that out of the total number of respondents 22 of them or 36.1% of the total number have experienced such changes, while the changes are absent in 39 or 63.9% of the respondents. *Morsicatio Mucosae Oris (MMO)* was observed in 13 respondents (21.3%), *Acid Erosions (AE)* in 5 (8.2%) respondents, *Hyperkeratosis (H)* in 3 (4.9%) respondents, and *Recurrent Aphthous Stomatitis (RAS)* in 2 (3.3%) respondents. The most common locality of these changes is the area of buccal mucosa unilaterally (16.4%), followed by buccal mucosa bilaterally (14.8%). The reported changes were found in 10 (16.4%) respondents lasting for 1-2 months period, in 7 (11.5%) respondents for a period of more than 2 months and in 6 respondents (9.8%) for a period less than 1 month. Out of the total number of those who have experienced the above changes, in 17 (27.9%) respondents there was no recidivism, while in 6 (9.8%) respondents recidivism was verified. As far as the variable called **Subjective Symptoms in Patients/Respondents (SUSYPA/SUSYRE)**, it is evident that 50 (82.0%) respon-

Chart 4

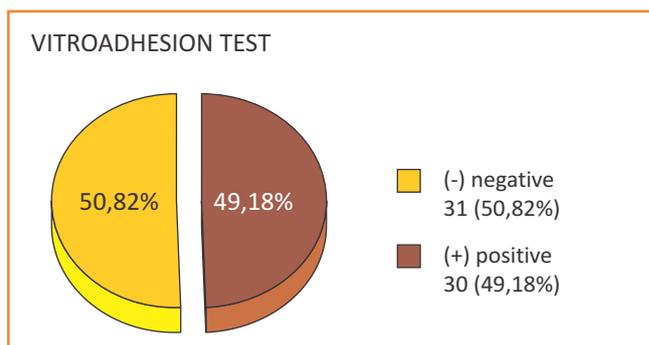


Chart 5

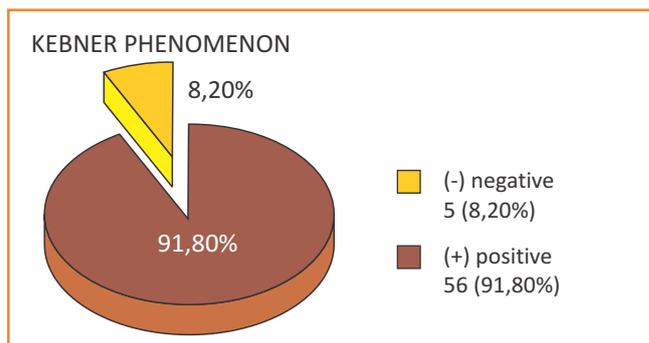
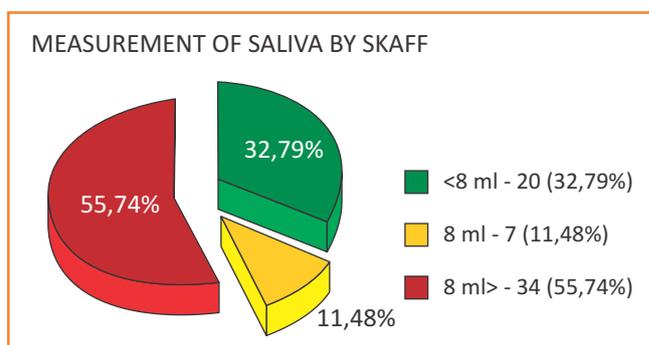


Chart 6



dents did not have even a single subjective symptom, compared to 11 (18%) respondents who confirmed some of the subjective symptoms, out of which 6 (9.8%) respondents reported *Xerostomia* (oral dryness), while burning and tingling sensations were present in 2 (3.3%) respondents and pain in only 1 (1.6%) respondent. From **Chart 4** it is evident that the Vitroadhesion Test is positive in 30 respondents or 49.18% of the total number of tested respondents, while this test is negative in 31 respondents or 50.82% of the total number of tested.

From **Chart 5** it is evident that Koebner Phenomenon is found to be positive in 56 respondents or 91.80% of the total number, compared to 5 respondents or 8.20% of the total number of respondents where Koebner Phenomenon is negative. **Chart 6** shows that the measurements of salivation rate according to Skaff showed that in 34 (55.74%)

| Variable | Mann-Whitney U | Wilcoxon W | Z | Asymp. Sig. (2-tailed) | Mean Rank | Sum of Ranks | Grupa N |
|----------|----------------|------------|-------|------------------------|-----------|--------------|-------------|
| TVITAD | 411,5 | 907,5 | -,891 | ,373 | 29,27 | 907,50 | 1 (pu) = 31 |
| | | | | | 32,78 | 983,50 | 2 (np) = 30 |
| KOBFEN | 448,5 | 944,5 | -,501 | ,616 | 30,47 | 944,50 | 1 (pu) = 31 |
| | | | | | 31,55 | 946,50 | 2 (np) = 30 |
| MPŠKAF | 441,0 | 937,0 | -,389 | ,697 | 30,23 | 937,00 | 1 (pu) = 31 |
| | | | | | 31,80 | 954,00 | 2 (np) = 30 |
| SIMPKO | 6,0 | 21,0 | -1,8 | ,045 | 7,50 | 45,00 | 1 (pu) = 31 |
| | | | | | 4,20 | 21,00 | 2 (np) = 30 |

Table 3. Differences in Applied Variables between the Smoking and Non-Smoking Respondent Groups (Mann-Whitney U test)

respondents the measured salivation rate was higher than 8 ml/15 min, in 20 (32.79%) respondents it was less than 8 ml/15 min, and in 7 (11.48%) respondents it was equal to 8 ml/15 min.

Table 3 shows differences in the applied variables between Smokers and Non-Smokers (Mann-Whitney U test), i.e. the level of statistically significant difference. The level of statistical significance was set at the conclusion error rate ($p = 0.05$). The results obtained show that there are no statistically significant differences in the applied variables for the evaluation of saliva between the Smokers and Non-Smokers respondent groups.

Statistically significant differences between the tested groups exist in one of the applied variables. That is the **SUSYRE** variable (**Subjective Symptoms in Respondents**).

The higher values (*Mean Rank, Sum of Ranks*) reported with regards to the said variable are present in Smokers, while the most pronounced symptom is *throat dryness*, where out of 6 respondents with that symptom 5 of them were among Smokers.

Discussion

Through this research we wanted to examine whether tobacco smoking affects the quantity of salivary secretion and the presence of a subjective feeling of dryness in oral cavity.

Adverse effects of tobacco consumption are numerous and are very often associated with a number of changes detected in oral mucosa. Our research indicates that pathological changes on the mucous membranes were verified in 36.1% of the tested sample. A minor percentage of pathological changes present on the mucous membranes that we could not associate with the tobacco consumption can be explained by making references to the younger age group of respondents with adequate hygiene habits as well as to a shorter period of tobacco consumption.

Numerous studies have shown that cigarette smoking usually causes the noticeable short-term increases in

salivary secretion, since the activity of salivary glands increases with the starting to smoke in those respondents who are new smokers/first-time smokers. It is caused by the chemical stimulation of the gustatory receptors (taste receptors) with nicotine, and the mechanical and thermal stimulations of the glands themselves during smoking [11, 12]; however, over an extended period of tobacco consumption it has been observed that some individuals develop a certain degree of tolerance, as a result of which their salivary secretion has been reduced. Thus, in more experienced smokers smoking cigarettes for a longer period of time the salivary glands produce less saliva. [13]

Smoking is one of the major risk factors contributing to the reduction of salivary secretion and development of xerostomy, as confirmed by Rad M. and Howis S. in their study called *the Effect of Long-term Smoking on Whole-mouth Salivary Flow Rate and Oral Health* [13]. A research by Petrusic N. and Posavac M. [14] also confirmed that smoking tobacco can be one of the contributing causes of reduced salivary secretion and xerostomy. As a result of smoking, the quantity of salivary secretion decreased in the respondents, while the quality of saliva changed. Saliva in Non-Smokers was of more watery consistency, while in Smokers it was of more viscous consistency. With smoking, saliva changes its quality and becomes denser. The reason for this lies in the fact that during the action of harmful noxae from cigarettes, smoking first leads to changes in the parotid glands producing serous secretions, while the loss of their function is compensated by submandibular and sublingual glands secreting the mucous secretion [15]. Similar results were also found by other authors [16], while Kanwar et al. [17] proved the harmful effect of both tobacco smoking and tobacco chewing, although the more harmful effect is attributed to tobacco chewing itself.

The results of our research did not show statistically significant differences in the applied variables for the evaluation of saliva between the Smokers and Non-Smokers respondent groups, which is compatible with the research conducted by Fenoll-Palomares C. et al. [18]. Research conducted by Rooban T. Mishra G. et al. [19] also

did not prove that the bad habit of smoking affects the quantity of salivary secretion. In our research, the Vitro-adhesion Test suggested the presence of saliva of altered quality in 49.18% of respondents, while the quantity of unstimulated salivation and the use of the Koebner Phenomenon did not suggest the existence of hyposalivation explained by referring to the shorter period of tobacco consumption, the younger age group with more adequate hygienic habits and the absence of systemic diseases.

The results of our research indicate a statistically significant difference ($p= 0.045$) between the examined groups in one of the applied variables (Subjective Symptoms in Respondents), while the most pronounced symptom is throat dryness, where out of 6 respondents who were reported to have this symptom 5 were Smokers, which is partly in line with the research results obtained by the above quoted authors [18, 19].

Conclusion

Smoking is one of the major risk factors having harmful effect on oral health. The bad habit of smoking is associated with a subjective feeling of dryness in the mouth. Our research results did not show any statistically significant differences regarding the effects of tobacco on the amount of secreted saliva between the Smokers and Non-Smokers respondent groups. Our research showed that there is very high percentage of smokers (61%) among the overall student population of the average age of 24, and it pointed to the alarming fact that 61% of smokers consume tobacco for a period longer than 5-10 years. This research shows the importance of educating the population and the importance of prevention programs and awareness-raising programs regarding the harmful effects of the bad habit of smoking on the entire organism and the oral mucosa, teeth and periodontium.

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