

## The relationship between oral mucosa diseases and tobacco smoking in the population of northern Poland

### Związek pomiędzy chorobami błony śluzowej jamy ustnej a paleniem tytoniu w populacji Polski północnej

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#### Abstract

**Introduction.** Smoking has a significant influence on oral health. There are many scientific reports about the negative effects of nicotine on oral mucosa conditions and diseases such as black hairy tongue, leukoplakia, oral cancer and nicotine stomatitis.

**Aim.** An analysis of the frequency of oral mucosa diseases and tobacco smoking in the population of northern Poland.

**Material and methods.** The medical history of 15154 patients from the Department of Periodontology and Oral Mucosa Diseases at the Medical University of Gdansk were analysed, with 5179 medical charts of patients who were suffering from oral mucosa diseases and abnormalities being selected. The research group included 3310 women and 1869 men.

**Results.** In a group of 5179 patients with oral mucosa diseases, 1931 (37.3%) were smokers (1214 females – 36.7% and 717 males – 38.4%). Nicotine stomatitis was only noticed in the group of smokers. In this group a high percentage of oral cancer (91% of patients), leukoplakia (83%) and black hairy tongue (79%) was observed. About half of smoking patients had oral candidiasis. Other diseases such as lichen planus and Burning Mouth Syndrome were observed in 18.25%.

**Conclusions.** Smoking was a major risk factor among patients with leukoplakia and oral cancers. The coincidence between smoking and oral candidiasis as well as smoking and black hairy tongue was proved.

**Keywords:** tobacco smoking, oral mucosa diseases, epidemiology.

#### Streszczenie

**Wprowadzenie.** Palenie tytoniu ma istotny wpływ na zdrowie jamy ustnej. Istnieje wiele doniesień o negatywnym wpływie nikotynizmu na stan błony śluzowej jamy ustnej i występowanie niektórych chorób w jej obrębie takich jak: język czarny włochaty, leukoplakia, nowotwory błony śluzowej jamy ustnej, nikotynowe zapalenie jamy ustnej.

**Cel.** Analiza częstości występowania chorób błony śluzowej jamy ustnej w odniesieniu do palenia tytoniu w populacji na terenie Polski północnej.

**Materiał i metody.** Analizie poddano 15154 historie chorób pacjentów, którzy zgłosili się do leczenia w Poradni Chorób Przyzębia i Błony Śluzowej Jamy Ustnej, z czego wyodrębniono 5179 kart pacjentów (3310 kobiet i 1869 mężczyzn) z chorobami błony śluzowej jamy ustnej.

**Wyniki.** W badanej grupie 5179 pacjentów stwierdzono 1931 (37.3%) osób palących papierosy (1214 kobiet – 36.7% i 717 mężczyzn – 38.4%). Nikotynowe zapalenie jamy ustnej stwierdzono wyłącznie u osób palących papierosy. W tej grupie stwierdzono także wyższy odsetek pacjentów z nowotworami jamy ustnej (91%), leukoplakią (83%) i językiem czarnym włochatym (79%). U około połowy osób palących stwierdzano grzybicę jamy ustnej. Inne choroby takie jak liszaj płaski i zespół pieczenia jamy ustnej obserwowano w granicach 18–25%.

**Wnioski.** Palenie tytoniu jest czynnikiem ryzyka u osób z leukoplakią i nowotworami jamy ustnej. Istnieje korelacja pomiędzy paleniem tytoniu a grzybicą jamy ustnej oraz paleniem tytoniu a językiem czarnym włochatym.

**Słowa kluczowe:** palenie tytoniu, choroby błony śluzowej, epidemiologia.

#### Introduction

Smoking has a significant impact on oral health. There are many scientific reports about the negative effects of nicotine on oral mucosa and periodontal tissue conditions [1]. There are about 4,000 chemicals in tobacco smoke, most of which are

poisonous with carcinogenic, mutagenic, cytotoxic and antigenic properties. The World Health Organization recognizes nicotine addiction as a chronically recurrent disease which needs intensive complex therapy [1–3].

Nicotine is the most addictive substance in tobacco products. Cigarette smoking can activate oral mucosa melanocytes to produce melanin. Due to the activity of oral mucosa melanocytes, smoking leads to the formation of melanin stains on the mucosal surface in the oral cavity; and as consequence, to a greater production of melanin. Smoking also modifies normal bacterial flora. It promotes microorganisms which are harmful to periodontal and mucosal tissues; such as *P. gingivalis*, *T. forsythia*, *T. denticola*, and *A. actinomycetemcomitans*. Nicotine addiction also leads to disorders in systemic circulation and the microcirculation in the periodontium. Nicotine generates an increase in the level of catecholamines (adrenaline and noradrenaline), blood hyperviscosity (increased level of prostaglandins), decreased red blood cell production (precursor damage), hypoperfusion, and tissue hypoxia. Some of the degenerative changes in the tissues are consequences of these processes [3, 4]. Smoking also leads to local rises in temperature, which cause micro burns and inflammatory responses in the oral mucosa. In addition, the process of oral mucosae acanthosis can also be disturbed. This pathology is frequently connected with pre-cancerous lesions such as leukoplakia [5, 6]. Untreated, these can become the basis for metaplastic carcinoma in 10–20% of smokers. Tobacco smoke consists of high reactive chemical compounds, such as nicotine metabolites, aromatic and nitro hydrocarbons. Cigarette toxic residues modify proteins and nucleic acids which are the cause of carcinogenesis in the oral cavity [4].

What is more, smoking often leads to xerostomia – a reduction in the salivary flow. Oral health is influenced by the unstimulated and stimulated salivary flow rate. The condition of oral mucosa also depends on the composition of the saliva which forms the environment for many processes. Any changes in composition and/or in hyposalivation destabilize the functions of saliva. This may indirectly make the condition of the oral mucosa and digestive system worse [1–4].

### Aim

The aim of the research was an analysis of the relationship between oral mucosa diseases and tobacco smoking in the population of northern Poland.

### Material and methods

The medical history of 15154 patients (treated between 2003 and 2011) from the Department of Periodontology and Oral Mucosa Diseases at the Medical University of Gdansk were analysed, with 5179 medical records of patients who were suffering

from oral mucosa diseases and abnormalities being selected. The research group consisted of 3310 women and 1869 men. Their age was between 3 months and 102 years (on average 48.6 years).

Data about disease classification, case history, physical examination and supplementary diagnostic procedures were received from the patient's medical history.

This research has been approved by the Bioethics Committee of the Medical University of Gdansk in decision No. NKEBN/266/2011.

The results were statistically analyzed using the computer programs Microsoft Office Excel 2007 and STATISTICA 10 (StatSoftPolska). A statistical formula with Yates's correction for continuity was used. To study risk factors such as disease, sex, age, and others Spearman's rank correlation coefficient was used, with statistical significances of  $p < 0.05$  and  $p < 0.001$ .

### Results

**Table 1** presents the number and the percentage of patients with diagnosed diseases and abnormalities in oral mucosa correlated with tobacco smoking.

In a group of 5179 patients (3310 females and 1869 males) with oral mucosa diseases, there were 1931 (37.3%) smokers [1214 female (36.7%) and 717 male (38.4%)]. In the group of children up to 10 there were no smokers.

Between the ages 11 and 20 there were 257 patients (151 females and 106 males) with oral mucosa diseases and abnormalities, of which 37 (14.4%) were using tobacco products. An interesting fact is that there was a higher percentage of females 25 (16.6%) than males 12 (11.3%).

In the group from 21 to 40 years old, there were 1099 patients (690 females and 409 males). Among them there were 395 (35.9%) smokers (248 women and 147 men), which means it is more than two times more frequent than in the previous group.

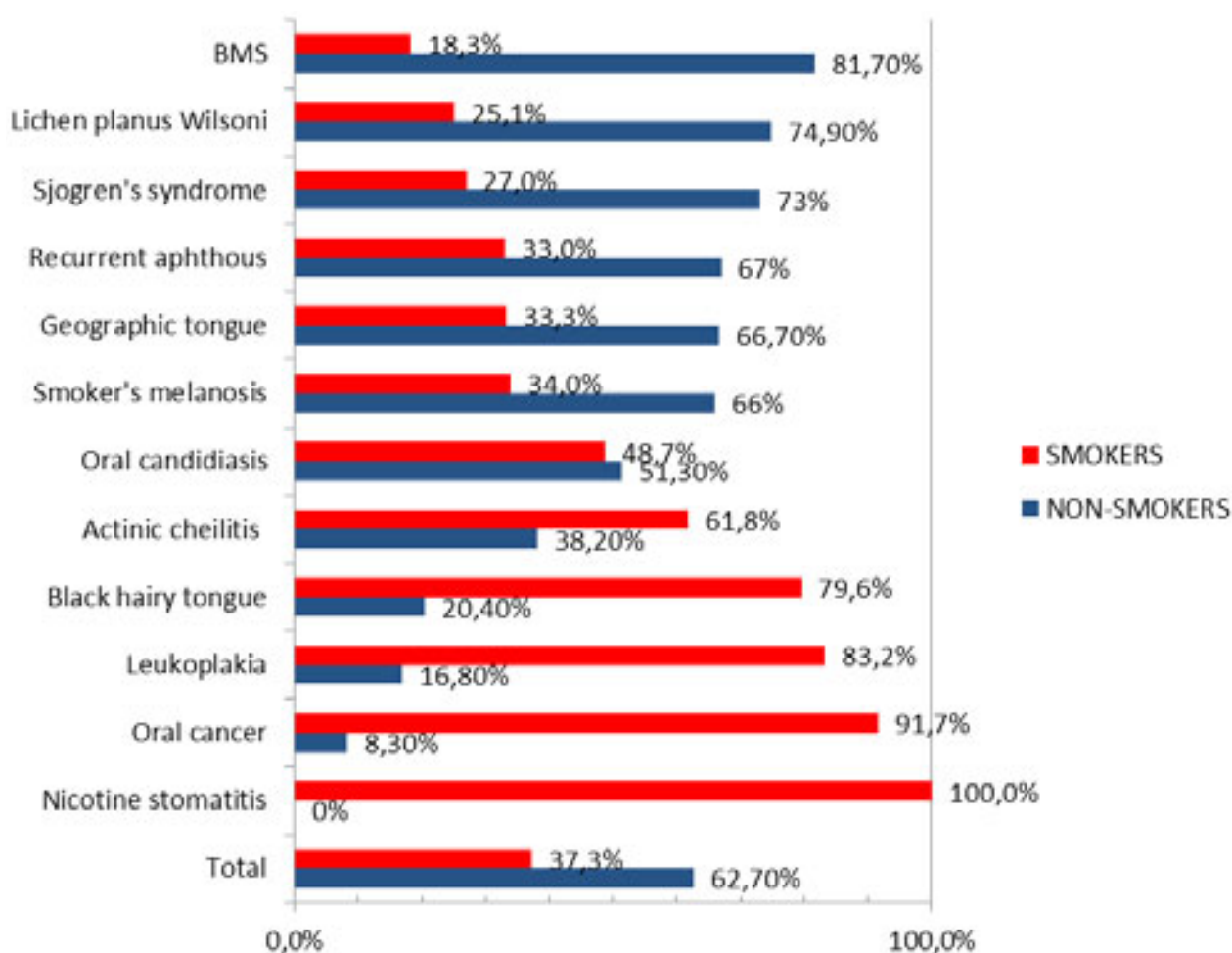
Patients between 41 and 60 years old comprised the most numerous group (1751 people comprising 1147 women and 604 men) with the highest prevalence of smoking. The highest smoker frequency was found in the male group. The number of male smokers was 305, which accounted for 50.5% of patients with oral mucosa diseases in this cohort. In the female group the prevalence of smokers was 44.9% (515 women).

In the oldest group (over 61 years) there was a decrease in the observed frequency or presence of diseases and abnormalities in the oral mucosa. Problems with oral mucosa were diagnosed in 1674 patients (1106 females and 468 males) of this age group. There were 679 smokers (426 females

**Table 1.** The number and the percentage of patients with diagnosed oral mucosa diseases among smokers according to gender and age

**Tabela 1.** Liczba i odsetek pacjentów ze zdiagnozowanymi chorobami błony śluzowej jamy ustnej palących tytoń z uwzględnieniem płci i wieku

Age (In years)	Patients with oral mucosa diseases				
	Total number of patients N	Smokers		Non-smokers	
		n	%	n	%
Females and males					
11–20	655	37	5.6	618	94.4
21–40	1099	395	35.9	704	64.1
41–60	1751	820	46.8	931	53.2
60 >	1674	679	40.6	995	59.4
Total	5179	1931	37.3	3248	62.7
Females					
11–20	367	25	6.8	342	93.2
21–40	690	248	35.9	442	64.1
41–60	1147	515	44.9	632	55.1
60 >	1106	426	38.5	680	61.5
Total	3310	1214	36.7	2096	63.3
Males					
11–20	288	12	4.2	276	95.8
21–40	409	147	35.9	262	64.1
41–60	604	305	50.5	299	49.5
60 >	568	253	44.5	315	55.5
Total	1869	717	38.4	1152	61.6



**Figure 1.** Frequency of particular oral mucosa diseases according to tobacco smoking

**Rycina 1.** Odsetek pacjentów z chorobami błony śluzowej z uwzględnieniem palenia tytoniu

and 253 males) with oral diseases. This means that in this group 40.6% of patients (38.5% of females and 44.5% of males) were smokers.

**Figure 1** presents the frequency of particular oral mucosa diseases according to tobacco smoking.

Nicotine stomatitis was only noticed in the group of smokers. A high percentage of oral cancer (91% of patients), leukoplakia (83%) and black hairy tongue (79%) was observed in this group. About half of smoking patients had oral mucosae candidiasis. Other diseases such as lichen planus and Burning Mouth Syndrome were seldom observed (18–25%).

## Discussion

Smoking is one of the factors causing the risk of many local and systemic illnesses. Nicotinism is a civilisational disorder that affects about 1,300 million people all over the world [2, 7]. Nicotine smoking shortens the lifespan by 15 years on average (in comparison to those who do not smoke) [8, 9]. According to epidemiological research one in three smokers dies because of systemic circulatory diseases [2, 10]. Not only does smoking increase the risk of the occurrence of systemic diseases, but it also gives rise to the risk of the onset of cancer [7, 11, 12]. Exposure to tobacco cancerogens is a high risk factor for the development of lung cancer as well as oral mucosa cancers [2, 8, 9, 13, 14]. Nicotine smoke contains over 4000 substances influencing the human body, 60 of which have proven carcinogenic effects [15]. What is more, the inhaled smoke is rich in many hazardous products from incomplete combustion. The activity of the immunological system is decreased by smoke and, simultaneously, the risk of respiratory system infection is increased, which may lead to the development of cancer [12, 16]. The negative influence on the epithelial cells of the respiratory system is well known [4, 17]. Research on smokers epithelial morphology in the oral cavity proves that the thickness of the oral epithelium is greater, as well as the level of cell cytokeratins, than in the group of non-smokers [7, 18]. During the research a test was undertaken to estimate the frequency of oral mucosa diseases in comparison to smoking frequency among all the diagnosed patients. 12 diseases were analyzed. Among the patients suffering from 6 illnesses (Burning Mouth Syndrome, lichen planus, Sjögren's syndrome, recurrent aphthous stomatitis, geographic tongue, smoker's melanosis) the percentage of smokers was lower than the general population. On the other hand, in the group of patients diagnosed with 6 others diseases (oral

candidiasis, actinic cheilitis, black hairy tongue, leukoplakia, oral cancer and nicotine stomatitis) the percentage of smokers was significantly higher than in the whole population.

According to Balkan researchers, the proportion of smokers suffering from oral candidiasis was almost double (82.5% in comparison to 44%) that of patients without the *Candida albicans* infection, and this was proved in the authors' research. Other scientists also confirm this dependency [19–21]. Darwazeh *et al.* [22] in his experiments demonstrated that smoking has no influence on oral cavity colonization by *Candida* fungi species, which was also noticed by Reichart *et al.* [23]. Their research concerning actinic cheilitis was proved by Cavalcante *et al.* [24] which was further confirmed by Dufresne and Curlin [25]. Smoking is the main factor inducing hypertrophy of tongue papillae and, similarly, the lesions of black hairy tongue [26–29]. It was observed that among smokers two and a half more patients with black hairy tongue were diagnosed. This may lead to the conclusion that it has an impact on these processes. The same was claimed by Turkish researchers who additionally recorded a positive correlation between tobacco users smoking more than 10 cigarettes daily and drinking spirits [40].

Similarly to the earlier discussed lesions, smoking is the main reason for the occurrence of leukoplakia [5, 30, 31–33]. This has been verified by many other researchers [31, 34–39]. The significantly higher risk in the appearance of leukoplakia-character lesions' and later carcinogenic transformations was proved among smokers and people drinking alcohol [38, 39, 40]. The percentage of smokers with oral cancer was much higher, which was proved by the authors' research and by other authors [2, 4, 6, 8, 14, 34, 41].

On the other hand, nicotine stomatitis (localized mainly on the hard palate) is basically a reaction present among smokers only. This has been 100% proved by this research and in other publications [1, 31].

The problem of oral mucosa diseases is very heterogeneous. The complex structure of the stomatognathic system, the multiple architecture of oral mucosa, the closeness to the many head and neck organs, the rich blood supply, multi-functioning, and the co-influence not only on each other but also on the oral mucosa are undoubtedly some of the risk factors which must be taken into consideration when defining the condition of oral mucosa. Oral mucosa is said to be a reflection of the state of a human body, and very often manifests hazardous systemic diseases.

The correlation between oral mucosa and the whole body should motivate dentists to a wider and deeper oral cavity examination. General practitioners should also focus on bodily condition, which depends on the general state of the oral cavity. This should lead to cooperation between general practitioners and dentists. This could provide substantial benefits in the future.

## Conclusions

1. Smoking was a risk factor for leukoplakia and oral cancers.
2. The coincidence among smoking and oral candidiasis as well as smoking and black hairy tongue was proved.

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### Conflict of interest statement

The authors declare that there is no conflict of interest in the authorship or publication of contribution.

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