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SMOKING AND ORAL CAVITY DISEASE DENTAL CARIES

DISSERTATION WORK IN HYGIENE AND PREVENTIVE MEDICINE

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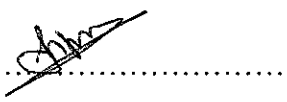
DECLARATION

I hereby declare that this dissertation work was done on my own under the guidance of Assoc. Prof. Ing. Zdeněk Fiala PhD at the Department of Hygiene and Preventive Medicine from the year 2004 to 2007.

Hradec Králové



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Summary

The primary aim of presented cross sectional study was to investigate the influence of tobacco products usage on dental caries in the groups of Indian and Czech respondents. The secondary aim was to compare the results found in the Indian group with those obtained in the Czech group; taking into consideration the differences in culture, race, socioeconomic status, food and drink habits, oral hygiene practices, and the use of tobacco in different forms. Participants in this study were patients of dentists cooperating with authors of the study. Age was principal criterion for their participation (30 – 69 years). Two different sets of questionnaires were prepared; one for the Czech participants, and the another, with minor variations, for the Indian participants. All participants were requested to complete the questionnaire which included questions concerning their personal history, economic status, educational qualification, profession, health status, food habits, frequency of dental visits, brushing habits, dental aids used and a detailed tobacco consumption history. Information concerning the use of tobacco included determination of current tobacco consumption status and form of tobacco use. We found six forms of tobacco consumption in the group of Indian respondents: tobacco with betel nuts and leaves, tobacco alone, bidi/chutta, cigarettes without filters, cigarettes with filters, pipes and other minority forms. Subsequently, the Indian respondents were classified into 5 groups: 1) regular smokers, 2) occasional smokers, 3) ex-smokers, 4) tobacco chewers (tobacco alone or tobacco with betel nuts and leaves), and 5) tobacco non-users. The respondents in the group 1, 3 and 4 are next specified as tobacco users. In the group of Czech respondents, most prevalent form of tobacco consumption was smoking in different forms like cigarettes, pipes and cigars. Thus, the Czech respondents were classified only into 4 groups: 1) regular smokers, 2) occasional smokers, 3) ex-smokers, and 4) non-smokers. In both groups of respondents, intra-oral clinical examination (DMFT index) was used for detailed evaluation of dental health status.

The whole Indian group of respondents comprised 580 men and 225 women. The group of Indian regular smokers was formed mostly of men (98%) while the group of Indian tobacco non-users (73%) and the group of tobacco chewers (75%) was formed mostly of women. The whole Czech group of respondents comprised 339 men and 340 women. The group of Czech regular smokers was formed mostly of men (60%) while the group of Czech non-smokers was formed mostly of women (59%).

In both groups of respondents, the tobacco non-users had higher education when compared to tobacco users. In both groups, the tobacco use was associated with higher intake of alcohol. Smokers from both groups reported frequent intake of sugar rich soft drinks. The group of Czech regular smokers consumed fewer vegetables and fruits than Czech non-smokers while the group of Indian tobacco-users (smokers, chewers) consumed more vegetables and fruits when compared with the Indian group of tobacco non-users. In both groups of respondents tobacco non-users or non-smokers showed better oral health status than tobacco users. The Indian regular smokers and tobacco chewers demonstrated a higher percentage of oral mucosal changes or lesions.

The Indian group of tobacco users-chewers and smokers (regular smokers and ex-smokers) showed more decayed teeth than Indian tobacco non-users and the group of Czech smokers (regular smokers and ex-smokers) showed more decayed teeth than Czech non-smokers. The group of Czech smokers (regular smokers, ex-smokers) had more missing teeth than Czech non-smokers. In the Indian group of respondents, we found no significant association between the tobacco use and the number of missing teeth. Higher number of filled teeth was found in the group of Indian tobacco users when compared with Indian tobacco non-users. We found higher number of filled teeth in the group of Czech tobacco non-smokers when compared with Czech tobacco users (regular smokers and ex-smokers).

Selected factors (variables) which can play the role of "confounding factors" influenced dental health of respondents quite differently in both groups of participants. In the Indian group of respondents, older participants had higher number of decayed, missing and filled teeth. Participants with higher education showed higher frequency of decayed and filled teeth but lower frequency of missing teeth. Surprisingly, attendance of preventive dental check ups increased the number of decayed and filled teeth. Higher brushing frequency decreased the number of decayed, missing and filled teeth.

In the Czech group of respondents the age influenced the number of missing teeth (the number increased according to the age) while sex mostly influenced the number of filling teeth (women had a higher number of filled teeth when compared to men). The level of education particularly influenced the number of missing teeth and decayed teeth (the respondents with lower education had more missing and decayed teeth). Regular attendance of preventive dental check ups reduced the number of decayed teeth and the number of filled teeth (higher number).

Brushing frequency influenced the number of decayed teeth, the number of missing teeth and the number of filling teeth. The respondents with low frequency of brushing showed worse results of DMF index and higher treatment need.

It can be concluded that tobacco using (in all studied forms) influenced negatively all components of DMF-T index in Indian respondents. Smokers and tobacco chewers had higher average number of decayed, missing and filled teeth. In addition, higher number of missing and filled teeth was found even in ex-smokers. Likewise, smoking influenced negatively all components of DMF-T index in Czech respondents. Smokers had higher average number of decayed and missing teeth and lower number of filled teeth. In both groups of respondents, the tobacco non-users had higher education compared to tobacco users. Different effect of income on tobacco status in both groups of respondents can be stated. Except the intake of vegetables, the tobacco non-users in both groups of respondents had better dietary habits.

Finally, we can conclude that our results confirmed the negative influence of tobacco consumption on dental carries in both groups of respondents.

Souhrn

Prvním cílem prezentované průřezové studie bylo sledování dopadu užívání tabákových výrobků na tvorbu zubního kazu u skupiny indických a skupiny českých respondentů. Druhým cílem bylo porovnání výsledků nalezených u indických respondentů s výsledky získanými u respondentů českých. Bylo přitom přihlédnuto k rozdílům v oblasti kultury, rasy, sociálně-ekonomického statutu, dietárních zvyklostí, ústní hygieny a k formám užívání tabáku. Účastníci prezentované studie byli pacienty spolupracujících zubních lékařů. Hlavním kritériem pro jejich účast ve studii byl věk (30 - 69 let). Byly vypracovány dvě verze dotazníků, jeden pro české participanty, a druhý, s malými modifikacemi, pro participanty indické. Všichni participanti byli požádáni o vyplnění dotazníku, který zahrnoval otázky týkající se jejich osobních dat, ekonomického postavení, vzdělání, profese, zdravotního stavu, stravovacích návyků, četnosti návštěv zubního lékaře, frekvence čištění zubů, používaných pomůcek pro čištění zubů a podrobné historie užívání tabákových výrobků. Dotazy týkající se užívání tabákových výrobků zahrnovaly popis aktuálního stavu a formy jejich spotřeby.

Ve skupině indických respondentů jsme nalezli celkem šest forem užívání tabákových výrobků: tabák s betelovými ořechy a listy, samotný tabák, bidi / chutta, cigarety bez filtru, cigarety s filtrem, dýmky a skupinu minoritních forem užívání. Indičtí respondenti byli rozděleni do 5 skupin: 1) pravidelní kuřáci, 2) příležitostní kuřáci, 3) ex-kuřáci, 4) žvýkači tabáku (tabáku samotného nebo tabáku s betelovými ořechy a listy) a 5) ne-konzumenti tabáku. Respondenti ve skupinách 1, 3, 4 jsou dále označeni jako konzumenti tabáku. Ve skupině českých respondentů bylo jednoznačně nejčastější formou užívání tabákových výrobků kouření: cigarety, dýmky a doutníky. Čeští respondenti byli proto zařazeni pouze do 4 skupin: 1) pravidelní kuřáci, 2) příležitostní kuřáci, 3) ex-kuřáci a 4) nekuřáci. V obou skupinách respondentů byl při klinickém vyšetření stavu chrupu použit jako kvantifikátor stavu index DMF-T (Decayed, Missed, Filled – Teeth).

Skupinu indických respondentů tvořilo celkově 580 mužů a 225 žen. Skupinu indických pravidelných kuřáků tvořili převážně muži (98%), zatímco skupinu indických ne-konzumentů tabáku (73%) a skupinu žvýkačů tabáku (75%) tvořily převážně ženy. Českou skupinu respondentů tvořilo celkově 339 mužů a 340 žen. Skupinu českých pravidelných kuřáků tvořili převážně muži (60%), zatímco skupinu českých nekuřáků tvořily převážně ženy (59%).

V obou skupinách respondentů měli ne-konzumenti tabáku (nekuřáci) vyšší vzdělání ve srovnání s konzumenty tabáku (kuřáky). V obou skupinách bylo užívání tabáku spojováno s vyšší spotřebou alkoholu a kuřáci v obou skupinách respondentů vykázali častou konzumaci nealkoholických nápojů s vysokým obsahem cukru. Skupina českých pravidelných kuřáků konzumovala méně zeleniny a ovoce ve srovnání se skupinou českých nekuřáků, zatímco skupina indických konzumentů tabáku konzumovala více zeleniny a ovoce ve srovnání s indickou skupinou ne-konzumentů tabáku. V obou skupinách respondentů ne-konzumenti tabáku (nekuřáci) vykázali lepší zdravotní stav dutiny ústní než konzumenti tabáku (kuřáci). U indických pravidelných kuřáků a žvýkačů tabáku jsme nalezli vyšší procento změn sliznice dutiny ústní.

Indické skupiny žvýkačů tabáku a kuřáků (pravidelných kuřáků a ex-kuřáků) vykázaly, v porovnání se skupinou indických ne-konzumentů, větší počty zkažených zubů. Obdobně, skupina českých kuřáků (pravidelných kuřáků a ex-kuřáků) vykázala, v porovnání s českou skupinou nekuřáků, větší počty zkažených zubů. Skupina českých kuřáků (pravidelných kuřáků a ex-kuřáků) vykázala, v porovnání s českou skupinou nekuřáků, větší počty chybějících zubů. V indické skupině respondentů jsme nezjistili významný vztah mezi užíváním tabáku a počtem chybějících zubů. Ve skupině indických konzumentů tabáku byly nalezeny vyšší počty zubů s výplní, v porovnání se skupinou ne-konzumentů. Vyšší počty zubů s výplní byl nalezen ve skupině českých nekuřáků, v porovnání se skupinou českých konzumentů tabáku (pravidelní kuřáci a ex-kuřáci).

Vybrané faktory (proměnné), které mohou mít úlohu "matoucích faktorů" (confounding factors), měly v obou skupinách odlišný dopad na stav dentice respondentů. V indické skupině vykázali starší respondenti vyšší počty zkažených a chybějících zubů i zubů s výplní. Respondenti s vyšším vzděláním vykázali vyšší počty zkažených zubů a zubů s výplní, ale nižší počty chybějících zubů. Participace indických respondentů na preventivních stomatologických prohlídkách překvapivě zvýšila počty zkažených zubů a zubů s výplní. Vyšší frekvence čištění zubů snižovala počty zkažených a chybějících zubů i zubů s výplní.

V české skupině respondentů věk ovlivňoval počty chybějících zubů (počty se zvyšoval s věkem), zatímco pohlaví většinou ovlivňovalo počty zubů s výplní (ženy vykázaly, v porovnání s muži, vyšší počty zubů s výplní). Úroveň vzdělání ovlivňovala počty chybějících zubů a zkažených zubů (participanti s nižším vzděláním vykázali více chybějících a zkažených

zubů). Pravidelná účast na preventivních stomatologických prohlídkách snižovala u participantů počty zkažených zubů, ale zvyšovala počty zubů s výplní. Frekvence čištění zubů ovlivňovala počty zkažených zubů, počty chybějících zubů i počty zubů s výplní. Respondenti s nízkou frekvencí čištění vykázali vyšší hodnoty DMF-T a vyšší potřebu léčebného zákroku.

Souhrnně lze říci, že konzumace tabáku (ve sledovaných formách) negativně ovlivňovala všechny složky DMF-T indexu indických respondentů. Kuřáci a žvýkači tabáku měli vyšší průměrné počty zkažených a chybějících zubů i zubů s výplní. Vyšší počty chybějících zubů a zubů s výplní byly nalezeny dokonce i u ex-kuřáků. Podobně kouření negativně ovlivňovalo i všechny složky DMF-T indexu českých respondentů. Kuřáci vykázali vyšší počty zkažených a chybějících zubů a nižší počty zubů s výplní. V obou skupinách respondentů měli ne-konzumenti tabákových výrobků obecně vyšší vzdělání než konzumenti. Byl zjištěn odlišný vliv finančních příjmů na úroveň konzumace tabáku v obou skupinách respondentů. Kromě diferencí v příjmu zeleniny, měli ne-konzumenti tabáku v obou skupin respondentů lepší stravovací návyky.

Závěrem lze konstatovat, že naše výsledky potvrdily negativní vliv konzumace tabáku na tvorbu zubního kazu u obou skupin respondentů.

THEORETICAL PART

1. INTRODUCTION

History of tobacco

Tobacco and mankind have been associated in the same way as food and tea since the history has began. *Nicotiana tabacum and Nicotiana rustica* are native plants of the Americas, cultivated in the Andes around Peru (Ecuador). Men came across them (along with more useful plants such as tomatoes, potatoes, maize, cocoa and rubber) just about 18 000 years ago, when they migrated to American continents from Asia across the Bering Straight land bridge. Tobacco is thought to have been cultivated since about 5 000 – 3 000 BC. The use of tobacco was universal throughout the American continents (and Cuba) by the time when Christopher Columbus arrived in North America in 1492 (137).

The practice of smoking appears to have arisen from snuffing, as snuffing instruments are among the most ancient tobacco-related artifacts that have been found. However, tobacco was not only sniffed and smoked but also chewed, eaten, drunk (like tea), smeared over bodies (to kill lice and other parasites), and used in eye drops and enemas. It was blown into 'warriors' face before battle, over field before planting (it is still used as an insecticide in agriculture) and over women before sex. It was used medicinally for its analgesic and antiseptic properties and as a cure for a variety of ailments. It was offered to the gods and used in religious ceremonies. It has both real and mystical qualities. Tobacco had been smoked rolled up in cigars but the most popular method in ancient times was pipe of one sort or other which came to serve both social and ritual functions (137).

The first smoking Europeans were members of Columbus's crew, when they reached Cuba in 1492. Almost from the outset, smoking was described as an evil and harmful practice by Europeans; it seems that spiritual revulsion and danger to health have never been sufficiently long lasting to prevent people from engaging in tobacco use. The first European smoker is reputed to have been imprisoned in a dungeon in Spain for 3 years by the inquisition for smoking in public on his return from America. However, the purported medicinal properties of tobacco resulted in its seeds being brought back to Spain and Portugal for cultivation there, initially in palace gardens, thereby commencing its long association with royalty and with royal endorsement. It is one of the many ironies of tobacco that two of its first claimed medical properties were its potential to cure and also prevent cancer. This latter claim resulted in tobacco

being used by healthy people (initially in France as a snuff) who, like many who have succeeded them, became addicted (137).

The British first obtained their tobacco by plundering Spanish ships on their route back from America. Sir Francis Drake brought tobacco back from his circumnavigation of the globe in 1580 while some tobacco may have been brought back from Caribbean in the 1560. Sir Walter Raleigh brought tobacco back from his Virginian expedition in 1586. Gately states, that by 1571 the tobacco was certainly in use in England by shipmasters and others coming back from the New World (62). Smoking was taken up in the court of Queen Elizabeth I and even by the Queen herself. This fact of course affected English society and anyone who could afford it; tobacco was very expensive so that English started to grow their own. Tobacco use has since spread worldwide as European colonization proceeded during the subsequent centuries (62). King James I of England is famous for his accurate and prophetic description of tobacco smoking as a custom loathsome and harmful to the eye, hateful to the nose, harmful to the brain, dangerous to the lungs and in the black, stinking fume there of nearest resembling the horrible Stygian smoke of the pit that is bottomless (137).

Manufactured cigarettes, made by a combination of hand and machine and later by machine alone, were first marketed in England in the 1850s. Their convenience, especially in the trenches during the First World War has resulted in them being the most popular nicotine delivery device ever since. Their construction with cork tips and then filters and especially their contents can be readily manipulated by the manufactures. Unfortunately, the smoke from cigarettes is more acidic than that from pipes and cigars and requires inhalation into the lungs for effective uptake of nicotine, while the nicotine of pipes and cigars can more readily be absorbed through the oral mucosa. Uptake through the lung provides not only more immediate sense of satisfaction to the smoker (as the nicotine is short-circuited to the brain), but also exposes a much greater surface area of respiratory epithelium to the smoke, which enhances its rapid absorption and the addictive nature of the product (62).

As the most ancient form, tobacco pipe smoking gave way to use of tobacco beside snuff and in time to cigars and cigarettes varying from country to country, until cigarette smoking became the dominant form in most of the developed countries between the two world wars (62). Cigarette smoking has stroke the world like a storm since then and has been described as "a

tragic accident of the history" (52). In the present world, the tobacco is used, in general, as smoking and smokeless tobacco (227).

2. TOBACCO SMOKING

Types of tobacco smoking

Tobacco is usually smoked in the form of cigarettes, cigars, bidis, hookahs, kreteks, cutta and pipe. **Cigarette**, originally called a "cigarrito", is a small cigar made of finely cut tobacco rolled up in a thin paper, tobacco leaf, or a maize husk. At first, the Spanish cigarette employed a maize wrapping, but fine paper was later introduced to hold the tobacco. John A. Bonsack invented the first successful machine to roll cigarettes in 1881. Mass production was off to a flying start after that. The heavy promotion of cigarettes, especially by movie stars and athletes, gradually led to the rising popularity of cigarettes (170).

Cigar is tightly rolled tube of tobacco covered by tobacco leaves, first described by J.Cockburnin in "Journey over Land" (1735): "*These gentlemen (Friars in Nicaragua) gave us some seegar to smoke...These are leaves of tobacco rolled up in such manner that they serve both for pipe and tobacco itself. . . They knew no other way of smoking . . . for there is no such thing as a tobacco- pipe throughout New Spain*". Cigars consist of 85 % cigar filler, 10% cigar binder, and 5% wrapping tobacco (170).

Bidis are handmade cigarettes composed of tobacco hand-wrapped in a dried "tendu" or "termburni" leaf (Diospyros melanoxylon) and tied with a string. Bidis are extremely popular in South Asian countries such as India, Srilanka, Bangladesh, Pakistan and Nepal. Among these countries, India has the highest rate of bidi smoking and production (155).

Hookah is a long-necked water pipe. When smoke passes through the long tube and subsequently through an urn of water, it makes a bubbling noise and therefore an alternative name for a hookah is "hubble bubbles". Although hookah is originated in India, now is more common and quickly spreading in Arab countries (157).

Kreteks, which are also known as clove cigarettes, contain a mixture of Indonesian tobacco. They are wrapped in either an ironed cornhusk or a slip of paper. They are often flavored and spiced and may have an anesthetizing effect, allowing deeper inhalation. The tobacco content in kreteks is about 60 – 70 %, similar to that of regular cigarettes (157).

Chutta is a type of small hand-made cigar, without a wrapper and a single tobacco leaf as a binder. It consists of air-cured and fermented tobacco folded into a dried tobacco leaf. Chuttas vary greatly in form, length, diameter and weight. Chuttas are usually without a filter and characterized by being open-ended and often have tapered mouthpieces. They are frequently associated with the remarkable habits of "reverse" smoking, during which the burning end is held inside the mouth (151). It is used mainly in rural area of India.

Pipe is a thin tube with a bowl for smoking the tobacco (170).

2.1. Smoking – prevalence of use and composition of tobacco smoke.

Among the smoked form of tobacco, cigarettes form the core of mass production of tobacco products that are smoked globally (155). Over 1.1 billion adults (29% of the adult population) are current smokers of cigarettes worldwide (7). Cigarette smoking as well as other tobacco use imposes a huge and growing burden for public health globally. Approximately 5 million people are killed annually by tobacco use. By the year 2030, according to current trends, it is assumed that this number will increase to 10 million with 70% of deaths occurring in low and middle-income countries. Numerous studies from high-income countries, and a growing number from low and middle income countries, provide strong evidence about increasing of tobacco taxes, restrictions on smoking in public places and in work-places, comprehensive bans on advertising and promotion and increased access to cessation therapies are all effective in reducing tobacco use and its consequences. Despite this evidence, tobacco control policies have been applied, partially due to political constraints (97).

Tobacco smoke is highly dynamic and has a complex matrix consisting of a gas phase and a particulate phase with more than 3800 compounds. Among these compounds, 60 of them are well-established carcinogens in animals and 15 of them are carcinogens in humans. The carcinogens, found in tobacco smoke, include polycyclic aromatic hydrocarbons, aldehydes, arsenic, nickel and cadmium (10). Smoking not only harms smokers but also harms the people around them. It causes numerous systemic and oral diseases.

2.2. Smoking and systemic diseases

Presently, cigarette smoking has been found to be associated with nearly of 40 diseases. In some instances the associations are largely or wholly due to confounding but the great majority has been shown to be causal in character (52). Cigarette smoking reduces life span by an average of 7 years, and tobacco consumption accounts for a shortening of life by 14 years (24).

The medical evidence of harm caused by smoking have been accumulated for 200 years, at first in relation to cancers of the lip and mouth, and then in relation to vascular diseases and cancer of the lung. In the beginning, the evidence was ignored until five case-control studies relating smoking to the development of lung cancer were published in 1950 (52,137).

Lung cancer is the most common tobacco-related case of cancer. Statistically, one case of pulmonary carcinoma has been reported for every 3 million cigarettes smoked (158). Cigarette smoke contains several carcinogens that alter biochemical defense systems in the body leading to lung cancer (47). The strongest determinant being the duration of smoking and risk increasing with the number of cigarettes smoked (149).

Smoking causes a wide range of diseases, including many types of cancers, coronary heart disease, stroke and peripheral vascular diseases (59). Smoking also increases the chance of developing cancer of the pancreas, renal pelvis, and urinary bladder. It is also associated with the cancer of the liver, uterine cervix, nasal cavity, pharynx, larynx, esophagus, stomach and kidney (48, 87,223).

Smoking is a known cause of chronic obstructive pulmonary disease (20). Tars produced within tobacco combustion contain irritant agents (acrolein, formaldehyde, etc.) and oxidative substances that are responsible for chronic bronchitis and emphysema (109). It has been observed that 80 % of deaths from heart attacks in individuals under 45 are directly related to smoking. The chances of heart attack are twice as likely among smokers compared to non-smokers. When a smoker quits smoking, his/her chances of heart attack decline to those of a non-smoker in about 6 months (38).

The most harmful compounds in tobacco smoke include carbon monoxide, arsenic, cadmium, cobalt and polycyclic aromatic hydrocarbons. Carbon monoxide is bound with haemoglobine to form carboxyhaemoglobine, which is a major cause of hypoxia and vascular accidents (109). Peptic ulcer is also more common in smokers than in non-smokers (59). Other potentially fatal diseases caused by smoking include respiratory heart disease, pneumonia, aortic aneurysm and

ischemic heart disease, which are the most common causes of death in developed countries (223). There is also a strong association between smoking and a number of common eye diseases, which include Graves' ophthalmopathy, age-related macular degeneration, glaucoma, and cataract (39).

The health effects of smoking are more serious for women than for men. In addition to the general health problems common to both genders, women face additional hazards (118). An example of this situation is the exposure of the fetus to maternal smoking. The exposure of mother to environmental tobacco smoke (ETS) can have a serious, sometimes life-threatening impact on the fetus. Such exposure increases the risk of spontaneous abortion, ectopic pregnancy, intrauterine growth retardation, premature membrane rupture, pre-term birth, retroplacental haematoma, placenta praevia, and sudden infant death (215,229).

Besides women, children are very vulnerable part of the population, particularly during the first year of their life. Their exposure to ETS, or passive smoking, can induce serious short-term as well as long-term health effects (20). It has been reported that 700 million children were exposed to ETS or passive smoking (155). Children exposed to passive smoking have increased chances of chronic middle ear effusion, asthma attack, and changes in pulmonary function (56). Children of parents who smoke are more likely to encounter respiratory infections, pneumonia and bronchitis (122). Children who are exposed to passive smoking are potentially in danger of chronic cough, wheezing, running nose and excessive sneezing (122). Passive exposure of smoking during childhood increases a child's risk of leukemia and lymphoma during adulthood (56). It has been reported that maternal smoking during childhood increased a child's risk to become a young adult smoker (148).

2.3. Smoking and oral diseases

Oral cancer

Cigarette smoking and use of other types of tobacco products cause oral cancer (227). Oral cancer affects mostly middle aged or elderly people and is more common in men than in women. It constitutes 2-3 % of all cancers worldwide (167). Cigarette smokers have two to five times higher risk of oral cancer than that of non-smokers (227), the risk is increasing with the number of cigarettes and years of smoking. On the other hand, cessation decreases the risk (82). Tobacco-specific N-nitrosamines, aromatic amines, and polycyclic aromatic hydrocarbons

presented in mainstream tobacco smoke are considered the major carcinogens contributing to the risk of oral cancer from smoked tobacco products (227).

Although the underlying mechanisms are not known in details, it is said that smoking could lead to cancer because carcinogens in tobacco smoke can induce changes in DNA. In recent years much attention has been given to smoking-related mutations in a tumor suppressor gene coding for p53 protein. This protein is important in regulating cell proliferation and has a role in the repair of DNA damage (145). Smoking-related mutations in the gene may lead to an accumulation of DNA damage in the cells which may play an important role in the development of cancer.

It has been estimated that between 75 – 90 % of all cases of oral cancer can be explained by the combined effect of smoking and alcohol use. This could be because alcohol dissolves certain carcinogenic compounds in tobacco smoke and/or because alcohol increases the permeability of the oral epithelium (167). Smoking and excessive alcohol intake synergistically increases the risk of the development of oral cancer (82).

Oral leukoplakia

Leukoplakia is believed to be a premalignant lesion associated with development of oral cancer (120). Tobacco smoking is the most important known etiological factor in development of oral leukoplakia (19). Cross-sectional studies showed a higher prevalence rate of leukoplakia among smokers, with a dose-response relationship between tobacco use and oral leukoplakia, while intervention studies showed a regression of the lesion after the cessation of smoking (19). Leukoplakias of the floor of mouth appeared to be significantly more often present in smokers than in non-smokers (186). Smokers have a six-fold increase in the risk of developing leukoplakia of the oral mucosa regard to non-smokers (30). Six European studies found smoking to be a cause in 56 – 97 % of leukoplakia patients. One of these studies also showed that the majority of smokers with leukoplakia (74 %) smoked more than 20 cigarettes per day compared to 34.5 % of those without leukoplakia (30).

Palatal leukokeratosis and smoker's melanosis

Palatal leukokeratosis (Smoker's palate) is an asymptomatic lesion associated with heavy pipe and cigar smoking usually appearing as white changes in hard palate, often combined with multiple red dots located centrally in small elevated nodule. It may appear even after smoking cessation (215). It does reveal premalignant potential. Premalignant lesion like palatal keratosis is primarily associated with reverse smoking found mostly in South Asia (129).

Melanin pigmentation of the oral mucosa is normally seen in colored races. Among Caucasian heavy smokers, 30 % prevalence in pigmentation is seen, mostly on the attached gingiva (167). There are no symptoms, the change is not premalignant, and the pigmentation may be reversible upon cessation of smoking habit (215). A recent study in the Indian population showed that smokers were more likely to develop smoker's melanosis compared to other lesions (176).

Oral candidiasis and hairy tongue

Cigarette smoke is associated with a variety of changes in the oral cavity and it has an effect on *oral bacteria and fungi*, mainly *Candida*, which causes oral candidiasis. How cigarette smoke affects oral Candida is still controversial (196). Further studies and research need to find the exact etiology of smoking and oral candidiasis. It has been seen in the clinical experience that some Candida infections disappear following smoking cessation alone (98). Another oral lesion, "hairy tongue" or "black hairy tongue" is a benign condition characterized by hypertrophy of the filiform papillae that give the dorsum of the tongue a furry appearance associated sometimes with heavy smoking (231). Its etiology remains unclear.

Aesthetics, smell and taste

Discoloration of teeth, dental restorations and dentures are very frequent in smokers (98). A recent cross sectional study conducted in British adults showed that 20 % of smokers reported to have moderate and severe levels of tooth discoloration compared to 15 % in non-smokers (15). Discoloration caused by smoking is more severe than that caused by tea and coffee consumption (167). Smoking is found to be associated with halitosis (90, 98). It has been seen that smoking influences the decreased function of smell (98) and it is also associated with worsening of taste perception (178).

Periodontitis

Cigarette smoking is a significant risk factor for periodontal diseases (95,207) for example, increased loss of attachment (166), development and progression of periodontal inflammation (63, 94) and increased gingival recession (136). It has been found that smoking has a direct influence on the periodontal health status, irrespective of the oral hygiene practice, age, race, gender, socioeconomic status or frequency of dental visits (100). Smoking affects various aspects of the host immune response. The mechanisms by which smoking enhances periodontal degradation are said to be the cumulative effect of elevation in levels of periodontal pathogens and modulation of the host immune response (46,219). There is sufficient evidence that shows that smoking affects the innate and specific immune host responses (99,106).

Antibody production is another protective host mechanism that is altered by smoking. Generally, smoking decreases serum IgG concentrations and decreases IgG2 antibody production in patients with early onset periodontitis (77). Smoking does not alter the bacterial plaque composition but on the other hand, it has been observed that the host's response to bacterial plaque is disturbed (121). The severity of alveolar bone destruction was found to be more expressed in smokers than in non-smokers (23,104).

Chemical products and toxins in tobacco smoke may delay wound healing by impairing the biologic progression of healing and by inhibiting the basic cellular functions responsible for its initiation (100). Smokers have a decreased response to periodontal therapy compared to non-smokers (94). Smoking has a strong negative influence on regenerative therapy, which includes osseous grafting, guided tissue regeneration or a combination of these treatments (99). It has been observed that the hemorrhagic response of periodontium is decreased in smokers compared to non-smokers (22). On the whole, smoking related periodontal diseases consist of an increased and accelerated destruction of the supporting tissues of the teeth, with clinical symptoms of bone loss, pocket formation, and finally tooth loss.

Wound healing

Smoking appeared to have an adverse effect on the wound healing in the mouth after periodontal scaling, periodontal surgery or extraction wounds (98). It has been reported that increased frequency of smoking and smoking on the day of surgery significantly increased the incidence of alveolar ostitis, known also as dry socket (14). The mechanism of impaired healing

is likely associated with increased plasma levels of adrenaline and noradrenaline after smoking, leading to peripheral vasoconstriction and also impaired polymorphonuclear neutrophils function (98).

Dental implants

Smoking was found to be one of significant factors predisposing to implant failure. The use of tobacco involves a 15.8 % risk of implant failure and the consumption of more than 20 cigarettes per day increased this risk up to 30.8 % (177). Study has also described an ongoing detrimental effect around the successfully integrated maxillary implants of smokers with significantly greater bleeding 1 index, average peri-implant pocket depth, peri-implant inflammation and radiographically descendible mesial and distal bone loss (76). Studies on fixed implant prostheses proved that smoking correlated more strongly with marginal bone loss around implants (51). Because of all these proved effect of smoking on implant success, latest studies pertaining implants success exclude heavy smokers from their potential participants (195).

Gingivitis

Many earlier studies on smoking and chronic gingivitis have been reported both, more gingival inflammation and more dental plaque and calculus in smokers. However, in recent studies, when the plaque level has been controlled for, smokers have demonstrated less gingival inflammation and less gingival bleeding when compared with non-smokers, indicating a suppressed gingival inflammation (26, 49). These results, which suggest a lower bleeding propensity for smokers, are not surprising given the well known effect of nicotine, exerting local vasoconstriction on peripheral circulation.

Saliva

In the short term, smoking increased the flow rate of parotid gland (27). However, the data on long-term effect on salivary flow rate showed no difference between smokers and non-smokers (147,152).The pH of saliva rises during smoking (105) but over longer time period the smokers had a lower pH (152). Described effect was not found in another study (41). Buffer capacity of saliva was observed to be lower in smokers (98) but another study did not find significant

differences (147). The concentration of thiocyanates (presented in tobacco smoke and in normal saliva) is increased in the saliva of smokers (209).

Acute necrotizing ulcerative gingivitis (ANUG)

Gingival vessel vasoconstriction, emotional stress, poor oral hygiene and smoking may cause loss of vitality to the most vulnerable regions of the gingival epithelium, leading to the onset of ANUG (25). Nicotine, a vasoconstrictor, is absorbed through the oral mucosa during smoking and being toxic to phagocytes. It may impair the phagocyte protective function. ANUG is more common in smokers than in non-smokers. Chronic exposure to nicotine may contribute to ANUG by restricting the delivery of oxygen and nutrients to the affected tissue (25). Individuals who suffer from ANUG are almost exclusively smokers (123). The smoking habits of one hundred patients with ANUG were studied by Kowolik (1983). Ninety-eight of them were smokers. The variables like age and gender were not significant (107).

Apthous ulcers

Apthous ulcers appear to occur less frequently in smokers than in nonsmokers (74). Smoking cessation results in worsening of apthous ulcers, and resumption of smoking improves the condition (21). One explanation is that smoking develops mucosal hyper-keratinization which better protects the mucosal surface from ulceration (21).

3. SMOKELESS TOBACCO

The negative systemic and oral health consequences of smoking were well understood. Due to the decline of smoking in the modern world, the tobacco industry has to look for other products that would keep the old customers and attract new ones. Different forms of smokeless tobacco (ST) are currently massively promoted and are gaining importance (173). The recent trend has been boosted by marketing a few types of ST as a harmless alternative to smoking cigarette (217). Some health scientists in recent years have even suggested ST to be actively promoted among cigarette smokers as a safer (i.e., a harm-reducing product) alternative, for those having difficulty in quitting smoking (141). Some people even think that ST is safe or less harmful than cigarettes. Most people, including smokers, and some health care professionals

know hardly anything about ST products, or even worse, are completely misinformed about the basic characteristics of ST products. Thus, it is important to understand these products, their composition and using and their harm effects. There is also a growing interest in the possible adverse health effect of ST because of the increasing popularity of ST use among young adults.

3.1. Smokeless tobacco - prevalence of use and composition of tobacco

ST is a very broad term that refers to more than 30 different types of products around the world (157). ST products are those in which there is no combustion or pyrolysis at the time of use (217). Types, composition and use pattern of ST products are highly variable in different parts of the world and within regions (43,222). ST is normally consumed orally or nasally, and includes products that are placed in mouth, cheek or lip and sucked (dipped) or chewed (157). ST products exist in two major forms – snuff and chewing tobacco. Snuff may be moist or dry. Moist snuff is usually taken orally (217). The pinch of snuff normally is placed in the gingival fold under the upper lip, close to the "midline frenulum", where it is kept in place for varying period of time and frequently replaced. Total daily exposure can vary from less than an hour to twenty hours. Snuff is considered a safe alternative to smoking and is socially widely accepted in countries like Sweden. Its popularity was further promoted by introduction of the portion-bag pack, which makes the habit more discreet and easier to handle, than the earlier form of loose weight tobacco (217). Dry snuff is usually inhaled through the nose and less commonly used. Chewing tobacco is coarser than snuff and exists in three forms - loose-leaf (sold in a soft package or pouch), plug (sold in small block) and twist (dried tobacco leaves that are twisted into strands). Chewing tobacco is usually placed in the oral buccal vestibule, and it is called as "chaw''or 'quid'. This quid may be retained in mouth for hours, and user expectorates the saliva that mixes with the tobacco extract (217). Other types of ST product include paste or powder that is used on the gums or teeth (157). ST products are placed in contact with oral or nasal cavities against the mucosal site that permit the absorption of nicotine into the human body (222).

Cigarette smoking is pandemic, affecting large proportions of the population worldwide. In contrast, use of ST is endemic, mainly restricted to certain geographical areas such as North America, the Scandinavian countries, India, Bangladesh, Southeast Asia and part of Africa (5, 61). South Asia is the major producer and net exporter of tobacco. Over one-third of tobacco

consumed regionally is ST (69). Oral ST (moist snuff) is popular in Sweden and Norway but it is banned from sale within the most of the European Union countries (192). Use of moist snuff is widespread in Sweden. In 2004 approximately 800,000 of Swedish people were daily users, which correspond to 22% of the male population and 3% of the female population (8). There are approximately 100 million users of ST products in India and Pakistan (193). In developing countries ST is mostly chewed with other ingredients. Chewing is practiced in different ways and the main ingredients are usually areca nut (betel), leaf, lime and tobacco (217). This mixture is referred to as betel quid (222). The main types of ST in western countries are chewing tobacco and oral snuff (43). World wide several names are used to denote different ST products, for example plug, gutkha, khiwan, khani, iq'milk, zarda, naswar, nass, chimo, toobak, shamma, gudhaku, gul, mishri, maras and moist snus (217).

ST is a complex chemical mixture, including not only the components of the tobacco leaf but also chemicals added during the manufacturing process. ST contains the addictive chemical nicotine and more than 20 cancer-causing chemical substances (167), nevertheless, the actual number of carcinogens found is fewer than in cigarette smoke (221). Most important carcinogens identified in ST are tobacco-specific N-nitrosamine (TSNA), N'-nitrosonornicotine (NNN), and 4(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK). NNN and NNK are formed from nicotine during curing, ageing and especially during fermentation of tobacco (85). Moreover, chemicals including radium-226 and lead-210 are also found in ST products (156). Tobacco-specific nitrosamines are the most prevalent strong carcinogens in ST products. Carcinogens and other chemicals present in ST products can vary widely in different parts of the world. It has been reported that level of tobacco-specific nitrosamines in ST products used in India are considerably higher than those found in most ST products marketed in Europe and North America (193). On the base of epidemiological study (Cogliano 2004) the International Agency for Research on Cancer (IARC) concluded that there is 'sufficient evidence' that the oral use of ST is carcinogenic to humans (40).

3.2. Smokeless tobacco and systemic diseases

Generally, the youth start experimenting with the ST products at the age of 9 to 16 and are less possible to start after the age of 20 (217). One of the most important systemic effects of ST is nicotine dependence or addiction, compared to cigarette smoking. Because ST contains higher

levels of addictive nicotine (one can of snuff delivers as much nicotine as 60 cigarettes), prolonged average usage time and can be harder to quit compared to cigarettes (9,154). Withdrawal symptoms such as drowsiness, nervousness, headache, irritability, and cravings have been reported (217). Oral ST causes a duration-dependent increase in oxidative stress (173). ST is a risk factor for osteoporosis in populations where its use is prevalent (162) and also associated with cataract (164), cardiovascular diseases (43) and immediate increase in blood pressure and heart rate (6). A recent work studied the influence of tobacco chewing on cardiovascular risk and found that the risk is similar in both chewing tobacco and cigarette use (68).

Increased risk of mortality and morbidity among ST users include stomach, rectal, prostate (1) and pancreatic cancers (1, 28). Tobacco chewing (mostly tobacco with areca nut/betel quid) is a highly significant risk factor for laryngeal and esophageal cancer (70). Recent study from Pakistan reported that many women with bladder carcinoma had long history of use of smokeless tobacco (163). In a few countries, exposure to ST with extremely high nitrosamine concentrations has been confirmed to induce cancers in the head-neck region (143). The metabolites of nitrosamines, primarily NNN and NNK were found locally in saliva of the oral cavity of ST users, as well as in their body fluids. These agents are known to cause toxic effects, particularly cancer, and next cellular and DNA changes at the local placement site or by indirect systemic effects (221).

In females, adverse effects of smoking over the reproductive system were well documented (159). The same types of adverse effects over the reproductive system were also seen in female ST users as well. The consumption of ST during pregnancy decreases gestational age at birth and birth weight (70) and also increases stillbirth risk (71). Pregnant women in India who used ST have a threefold increased risk of stillbirth and a two-threefold increased risk of having a low birth weight infant (69). Preeclampsia seems to be associated with ST use as well (54). Neurobehavioral signs occur in neonates born to women who use ST (89). In males, a decrease in sperm quality and a lesser extent oligoasthenozoospermia or azoospermia was found in a group of tobacco chewing men, who were undergoing infertility evaluation (172).

In the Indian subcontinent, inhalation of nasal snuff is a common habit (217). Morphological and functional changes in the nasal mucosa happen due to chronic abuse (173) and a form of

chronic rhinitis develops, as a consequence of which the nose is blocked and become stuffy (189).

3.3. Smokeless tobacco and oral diseases

Oral cancer

ST is very strongly related to cancer of the cheek and gums, locations typically in direct contact with the tobacco (221). This association is evident from the studies in the US, Scandinavia and also from Asia and Africa where ST is used extensively. The risk of oral cancer increases with length of exposure, and is the greatest in the place where ST product is held in contact with oral mucosa for the longest time (221).

Carcinogenic tobacco-specific nitrosamines are likely to be the pro-carcinogen agents at the target site (222). ST users are 50 times more likely to get oral cancer than non-users (217). Even ST products that claim to be low in nitrosamines are likely to raise the risk among users up to 30% of risk of oral cancer in smokers (221). It is reported that the chronic stimulation of the lymphatic tissue in oral mucosal membrane may be related to the increase in oral cancer (9). The risk of oral cancer from ST tobacco varies in different parts of the world. One possible explanation for this is the qualitative difference in the production of ST and differing contents of carcinogenic tobacco-specific N-nitrosamines (233). The two most common forms of cancers, found in association with ST use, are verrucous carcinoma and squamous cell carcinoma (221).

Leukoplakia and snuff dipper's lesion

Oral leukoplakia, a precancerous lesion to oral cancer, is strongly linked with ST use (221). Oral leukoplakia occurs in up to 60% of ST users within 6 months to 3 years from starting of ST use. Leukoplakia mostly occurs at the site of ST use as a result of local irritation (193). A typically wrinkled appearance at the site of placement of the moist snuff and chewing tobacco is seen (221). The severity of the leukoplakia lesions associated with ST raises with increasing amount of use and duration of use and suggesting a dose-response relationship (221). Betel quid chewing is a significant risk factor for oral pre-cancerous lesions, oral submucous fibrosis and oropharyngeal cancer in South Asia (69).

Another well-recognized and predictable lesion that appears at the site where ST is held in oral cavity is snuff dipper's lesion. The lesion appears white keratotic in nature and is translucent rather than opaque whiteness (184). The lesion is presents in 15% of chewing

tobacco users and 60% of snuff tobacco users (206). It is reversible when the affected person discontinues the habit (184). This lesion is known by some other names as tobacco pouch keratosis or smokeless keratosis. This lesion is mostly seen in snuff dippers (221)

Other oral effects

In addition to the above-mentioned conditions, ST is found to be associated with periodontal disease (60). Acute Necrotizing Ulcerative Gingivitis (ANUG), gingivitis, and periodontitis were found in ST users. Gingival recession and attachment loss are generally seen in the area adjacent to where the ST is held (156). Cessation of ST use usually does not reverse the gingival recession (206).

Other negative effects include stained teeth, bad breath and mouth sores (217). Use of ST is also associated with tooth abrasion of the incisal and occlusal surface of the teeth (156). Especially tobacco chewing is positively associated with both moderate and severe tooth wear (130). Abrasive materials found in tobacco products like silica or silicon may contribute to dental attrition in chronic users of ST (29).

4. TOBACCO USE AND DENTAL CARIES DEVELOPMENT

The main goal of presented work was to evaluate the relationship (if exists) between tobacco exposure and dental caries. Therefore, it is important to highlight details of tobacco exposures (smoking, smokeless tobacco and environmental tobacco smoke) and factors that can influence incidence of dental caries.

4.1. Smoking and dental caries

Smoking and its relation to dental caries is a subject of many opinions. From early reports in literature, an opinion resulted that smoking actually helps to reduce dental caries (66, 75). Schmidt, in 1951, supported this belief when he reported that increase in tobacco smoking was followed by a decrease in caries rate (181). The concentration of thiocyanates (constituents of tobacco smoke and normal saliva with possible caries-inhibiting effect) was found to be higher in smoker's saliva. (98). So, we might predict less dental caries in smokers. On the other hand, the decreased buffering effect and possible lower pH of smoker's saliva and the higher number

of *Lactobacilli and Streptococcus bacteria* may indicate an increased susceptibility to caries (98,101). In addition, results also showed no significant differences in salivary flow rates between smokers and non-smokers (98,113). To date, quite a few investigators have discovered a correlation between elevated smoking level and dental caries (18, 32, 92,101). For example, in 1952, Ludwick and Massler reported that those who smoked more than 15 cigarettes a day had significantly higher number of decayed, missing, and filled teeth (114). In 1971, Ainamo found that increased smoking resulted in significantly higher number of decayed surfaces per dentition and also noted a trend toward more missing surfaces and fewer restored surfaces in subjects with a high consumption of cigarettes (4). In 1990, Zitterbart confirmed association between smoking and prevalence of dental caries in adult males. Smokers had significantly higher DMF-T (Decayed, Missing, and Filled Teeth) score, untreated decayed surfaces, and missing surfaces. He further concluded that more cigarettes consumed per day resulted in more missing teeth surfaces in a smoker's mouth (235). A Swedish study carried out in 1991 showed that smoking and increased number of cigarettes smoked per day positively correlated with increased number of decayed, missing and filled teeth (84). Even though, a recent study done on American female population in 2006 concluded that cigarette smoking is associated with the prevalence of dental caries, nevertheless, they did not establish a causative relationship (81).

Dental caries have multifactor etiology (180). Studies in this regard have considered multiple variable factors, which can contribute directly or indirectly to increase of incidence of dental caries in smokers. These factors includes age, tobacco habits other than smoking, oral hygiene habits, eating habits, drinking habits, preventive visits to dentist (dental recalls) and overall health standards. Due to these factors, it is difficult to conclude the association between single positive factors, which can cause increase in caries incidence in smokers, or it is not easy to establish the strength of relationship between smoking and dental caries.

Association between smoking and dental caries is well documented in older age groups (96,112). Among middle-age (18) or young adults (182) results are inconsistent. Nonsmokers reported more frequent healthy oral health behavior than did daily smokers (208). Studies indicate that smokers not only had bad oral hygiene and less sophisticated outlook on health, but also had different eating habits, presumably consuming high amount of sugar containing products like soft drinks and snacks (84). Daily smoking was associated with increased use of sugar in tea or coffee, and with more frequent alcohol consumption (208). It is also seen that

smokers have ineffective brushing habits than non-smokers (103,115). The distribution of brushing strokes around the mouth was more uniform in the non-smokers than in the smokers, which may indicate a tendency towards less favorable tooth brushing performance in smokers (116). In addition, current smokers were less likely to report regular preventive visits to dentists and were reluctant to use accessory dental aids such as dental floss. Current smokers also had higher scores on the dental attitudes scale, indicating that a lower value is placed on retaining natural teeth (112).

In natural tobacco, sugar can be presented in a level up to 20%$_{wt}$. In addition, various sugars and sweeteners are added intentionally during tobacco manufacturing process up to 4 - 13%$_{wt}$ (204). Sugars, used as a direct cigarette additive include glucose, fructose, invert sugar (glucose/fructose mixture) and sucrose. Besides, many other tobacco additives contain high amount of sugars. For example, fruit juices, honey, molasses extracts, cones and maple syrup and caramel. The added sugars are usually reported to serve as flavour/casing and humectants. However, sugars also promote tobacco smoking, because they generate acids that neutralize the harsh taste and throat impact of tobacco smoke. Moreover, the sweet taste and the pleasant smell of caramelized sugar flavours are appreciated in particular by starting adolescent smokers (204).

We can conclude that all above mentioned findings can contribute to increased prevalence of dental caries among smokers. However, a direct etiological relation between smoking and dental caries is still missing. The known facts can lead to the assumption that smoking had some influence on dental caries incidence, nevertheless, further studies, clinical trials and experiments are needed to elucidate the independent effect of smoking as one of the inducers of dental caries.

4.2. Smokeless tobacco and dental caries

The literature associating ST use with either increasing or decreasing dental caries incidence is even harder to find than the literature associating tobacco smoking with dental caries. Theories based on limited clinical findings, chemical analysis of the content of various ST products, and in vitro effects of ST on the growth of bacteria implicated in caries development have been postulated.

Evidence linking ST use with increased dental caries prevalence has been reported (188,224). In a case report published by Croft, a 54 years old patient presented "cervical caries" in the area of tobacco placement and he also had gingivitis and recession in that same tooth. (42). In

contrast, Zitterbart and his colleague did not find any evidence of caries in the area of quid placement in their 36-years old tobacco chewer (236). Another study, which was performed among Swedish children, did not report any prevalence of dental caries among snuff users (135). On the other hand, higher prevalence of caries was observed in snuff dippers than in tobacco non-users among teenagers in Gothenburg. Under control for cigarette smoking, a dose-response relationship was shown between caries and the number of years of snuff use (43). A further study was done among baseball players in Phoenix and there were not any differences in dental caries between ST users and non-users even though majority of ST users were snuff dippers rather than chewing tobacco users (43, 57).

Several studies assessed the total amount of sugar and fluoride percentage in commercially available forms of tobacco. They found that the highest amount of caries promoting factor like sugar and caries inhabiting chemical like fluorides was present in non smoking forms of tobacco like pouch and plug than in smoking form (67). The types of sweeteners and sugars commonly found in ST are fructose, glucose, sucrose, maltose, and isomaltose (88). This addition is presumed to be having a neutralizing effect on the bitter taste of tobacco (204). Large variations in sugar and fluoride levels in tobacco products can exist within form-to-form, store-to-store, brand-to-brand, and state-to-state. This may explain the diverse opinions of dental practitioners and investigators, with respect to the concept of tobacco, in increasing or decreasing incidence of dental caries. Generally, non-smoking forms of tobacco are mostly related to promotion of dental caries (67) and present a significant risk factor for development of dental caries (150).

Individuals who chew tobacco appear to have more dental caries than non-users (227). Review of studies conducted from 1988-90 on oral consequences of snuff and chewing tobacco use among professional baseball players in US found that ST use showed a significantly higher prevalence of root caries than did comparable sites in non-smokers (169). Data from the multipurpose health survey (Third National Health and Nutrion Examination Survey) conducted in USA from 1988 to 1994 was used to examine the relationship between chewing tobacco and other forms of tobacco use and decayed or filled coronal or root surface caries (212). Chewing tobacco users had a slightly higher average number of decayed and filled coronal surface than individuals using other forms of tobacco. In addition, the average number of decayed and filled root surface for those who used chewing tobacco was four times higher than for those who did not use tobacco. It is important to note that the decayed or filled surfaces tended to match the

side of mouth on which the ST was used, although this did not reach statistical significance. The results showed that the average number of decayed and filled root surface rose with increasing number of chewing tobacco packages used per week and duration of its use in years (212). A biologically reasonable explanation for an association between chewing tobacco use and dental caries is that the high levels of fermentable sugar in ST products can stimulate growth of *cariogenic bacterias* (67,212).

Users of chewing tobacco have been warned against swallowing it because glucose in chewing tobacco could adversely affect blood glucose level of diabetics (224). The way that chewing tobacco is used creates an environment conducive to dental caries; a wad of tobacco is kept in the oral cavity for 30 minutes on average, and the chewing tobacco is used over an extended period each day (93,212). This assumption is supported by in vitro evidence of stimulated growth of *Streptococcus mutans* and *Streptococcus sanguis* in the presence of smokeless tobacco extracts (212). It has been also found that extracts from chewing tobacco with high sugar content increased in vitro growth of *Lactobacillus casei* (93), a bacterium implicated in root surface caries (146). One in vivo study found that micro-flora associated with root caries comprised a significantly larger proportion of colony-forming units on the root surface of teeth adjacent to the tobacco placement than on the teeth on the contralateral side of the mouth. The study also found significantly high level of collagenase on the side of the mouth where tobacco was placed. It was speculated that increased collagenase activity might interact with specific bacteria to enhance the development of root caries due to the organic nature of cementum (187,212). In another experimental study, the aqueous tobacco extracts were used to supplement a basic salts solution (BSS) and a microbial medium. Thin-layer chromatography revealed sucrose in only one of four extracts. Discs saturated with extracts (0.1-50 mg/ml) failed to inhibit growth of any of the micro-organisms. Supplementation (10 mg/ml) of BSS with the tobacco lacking sucrose resulted in augmented growth of *Streptococcus mutans, Streptococcus salivarius and Streptococcus sanguis,* whereas the sucrose-containing brand augmented only *Streptococcus sanguis* growth. Thus extracts of these smokeless tobaccos would serve as a growth substrate for three species of oral *streptococcus*, which are frequently associated with human dental caries (58).

Another possible contributing mechanism in the development of root-surface caries among snuff/chewing tobacco also results in loss of keratinized gingival and in tooth abrasion,

yielding in a periodontal problem at the site where tobacco is held. A significant part of root surface will be exposed, reflecting the degree of gingival recession and bone loss. The exposed root surface caused by the loss of cementum and some dentin are at increased risk to develop caries (206). ST users are also associated with poor oral hygiene and less sophisticated outlook on heath care (216).

Limited number of epidemiological and experimental results suggests an association between smokeless tobacco usage and dental caries. It seems that smokeless tobacco can play an important role in increased caries activity.

4.3. Environmental tobacco smoke and dental caries

It is interesting to know that the data from UK National Diet and Nutrition Survey (1995) suggested maternal smoking as a significant risk factor for predicting caries in preschool children, even when adjusted for social class, nutritional status, and weekly expenditure on confectioneries (228). Study of Aligne et al. (2003), based on secondary analysis of the data from Third National Health and Nutrition Survey (1988-1994) has provided the strongest evidence of an increased risk of dental caries in the deciduous dentition of children who were 4 to 11 years of age and have been exposed to passive smoking or environmental tobacco smoke (ETS) (11). A recent study done in 2004 also confirmed that children residing in regularly smoking homes had significantly higher prevalence of caries compared to non-regular/non-smoking homes (183).

The reason of high predilection of caries in association with ETS only in children is poorly has been poorly investigated. However, some published data and some hypothesized facts as well as experimental data might support the biological plausibility of causal role of ETS in caries formation in children. It was published that ETS, a common cause of pediatric morbidity and mortality, disproportionately affects children in low socioeconomic status environments. Furthermore, it may be a risk factor for cavities (11, 12). Research indicates that the bacteria responsible for caries formation are acquired in infancy from the saliva of mothers (via kissing, etc). Elsewhere, nicotine has been shown to promote the growth of cariogenic *Streptococcus mutans* bacteria in vitro thus; mothers who smoke may be more likely than non-smokers able to transmit these germs to children (11,110). ETS smoke has immunosuppressive properties and is

a known risk factor for infections of the cranial organs (e.g. otitis media); thus it is probable (not surprising) that it might be risk factor for caries development as well (11,53). In addition, ETS is associated with decreased serum vitamin C levels in children and decreased levels of vitamin C are associated with growth of *cariogenic bacteria* (11,190,218).

It is also possible that ETS may reduce the protective properties of saliva that can operate against caries. Saliva acts as buffering agent when acids are produced. It physically removes debris from the tooth surface, and it has immunological and bacteriostatic properties (11,117). ETS is known to increase inflammation of respiratory tract, producing symptoms of various clinical conditions including allergic rhinitis, which frequently cause mouth breathing and thus result in dry mouth (effective decrease in saliva) (11,230). Thus, ETS could promote dental caries both through a direct effect of nicotine on caries-causing bacterial agents, as well as via other systemic physiological changes in host. Other reason why ETS can cause caries in children is that colonization with the cariogenic *Streptococcus mutans* is thought to occur during a period of vulnerability around one year of age, and primary teeth are particularly susceptible to caries formation soon after their eruption (11,179). Maternal smoking is also a principal risk factor for pre-maturity, low birth weight, and chronic illness in infancy, while these in turn are all associated with generalized enamel hypoplasia in primary dentition (11,36,140,179). Furthermore, in early childhood, when immune system is generally less mature, the saliva is known to be different from that of adult with respect to IgA concentrations. In addition, salivary flow rate in children is lower (2,11). Young children may thus be particularly vulnerable to harmful effect of ETS on immune system and saliva flow. Hence, it is biologically plausible that passive smoking could cause caries, particularly in early childhood.

Unfortunately, a recent study in 2006 failed to demonstrate a positive association between passive smoking and dental caries experience in Japanese children (205). And it is also rather strange that no effect on permanent teeth was observed, as it can be expected that any effect of ETS on the developing dentition would affect both deciduous and permanent teeth in the same way. Similarly, if the main effect of ETS is more related to posterruptive force, then a similar pattern of caries susceptibility in the permanent dentition should be observed. One possible explanation suggests that ETS exposure is more likely to cause dental caries in deciduous teeth rather than permanent teeth because the enamel of deciduous teeth is much thinner compared to that of permanent teeth, and that enamel defects are associated with caries (11). Authors

consider all these findings clearly provocative and suggested further aggressive studies that would elucidate the causative role of ETS in the dental caries of children and adolescents to be carried out.

Summary of major biological effects of tobacco related to dental caries

Forms of tobacco use	Biological effects
Tobacco smoking	Concentration of thiocynate was found to be higher in saliva of smokers and presents caries inhibiting factor (98). Decreased buffering effect and possible lower pH of saliva in smokers may indicate increased susceptibility to caries (98,101). Higher number of *lactobacilli* and *Streptococcus mutans* in smokers may indicate higher caries susceptibility (98,101).
Environmental tobacco smoke (ETS)	Biological plausibility of causal role of ETS in caries formation in children (11,). Immunosuppressive properties of ETS might be a risk factor for dental caries development (11, 53). ETS may decrease serum vitamin C level, which may be associated with growth of cariogenic bacteria in children (11,190). ETS may reduce the protective properties of saliva that can operate against caries (11,117).
Smokeless tobacco (ST)	High levels of fermentable sugar and sweeteners in ST can stimulate growth of cariogenic bacteria (212). Extracts from chewing tobacco with high sugar content increased in vitro growth of *Lactobacillus casei* (212). Extracts of ST may serve as a growth substrate for *Streptococcus mutans, Streptococcus salivarius* and *Streptococcus sanguis* (58).

5. DIFFRENCES IN TOBACCO USE IN INDIA AND THE CZECH REPUBLIC

Presented study includes samples of Indian and Czech population, so it is important to know more about current tobacco prevalence and use in both countries mentioned. The Portuguese introduced tobacco to India 400 years ago. Ever since, Indians have used tobacco in various forms. Two hundred years after the introduction of tobacco to India, the British introduced commercially produced cigarettes to India and established tobacco production in the country. In India, tobacco consumption has been considered to be the major contributor to the total mortality rate and in 1990; 1.5 % of total deaths were tobacco related. Tobacco consumption is growing at the rate of 2-3 % per annum (37). World Health Organization (WHO) assessment estimated that by 2020 tobacco related death may exceed 1.5 million annually or 13% of all deaths in India (165). India is a developing country and cigarette smoking is becoming the popular form of tobacco consumption in rural and urban population. Out of 930 million global tobacco consumers 1.1 billion smokers live in developing countries; India alone has 182 million smokers (199). In India, different forms of tobacco are being consumed. Cigarettes and bidis (hand rolled cigarettes that contain unprocessed tobacco) are the two most common forms of tobacco smoked. Data reported by the Cancer Patients Aid Association of India in 2004 reveal that smoking of cigarettes (prevalence of 20%) and "bidis" (prevalence of 40%), followed by the use of smokeless tobacco (ST) in various forms (prevalence of 40 %) is widespread among both sexes (37). The most common form of ST use is "misri", a black powder obtained by roasting and powdering tobacco, which is then applied to the gum by the use of fingers. Another common form of ST is chewing of betel – quid, a combination of betel – leaves, areca nut, slaked lime, tobacco, and condiments; combination of ingredients are altered according to individual preferences. Documented data of Indian population suggested that 65% of all men and 33% of all women use some form of tobacco (37). However, demographic variation and distribution of forms of tobacco consumption in India are not uniform.

The Czech Republic ranks among ten countries with the highest rate of cigarette consumption worldwide. Recent data of WHO indicate that in the Czech Republic, 31.1 % of males and 20.1 % of females smoke (198). Another recent data state that in the Czech Republic there are about 30% of smokers (35% of men and 27% of women). According to annual estimation, approximately 22,000 of people are dying from diseases caused by smoking (i.e.60 deaths daily). Most of these deaths are in middle age (15000). Other forms of tobacco product

like smokeless tobacco (snuff, chewing tobacco) are banned in EU since 1992, except for Sweden (202).

Along with overall rise in tobacco use, especially cigarette smoking in both of our study populations, there has been a significant increase in the reported cases of oral diseases in these countries. Association between cigarette smoking and various oral diseases such as leukoplakia and oral cancers has been well-documented (215). But the role of cigarette smoking in the causation of dental caries however has not been widely investigated in the Czech Republic and India. For better understanding the epidemiology of smoking and dental caries, it is important to have detailed descriptions of the oral health status of groups with so different genetic and cultural backgrounds, dietary habits and tobacco habits within Indian and Czech population.

PRACTICAL PART

6. AIM OF WORK

The primary aim of the presented cross sectional study was to investigate the influence of tobacco using on dental caries in examined groups of Indian and Czech respondents. The secondary aim was to compare the results found in Indian respondents with those obtained from Czech respondents, taking into consideration the differences in culture and race, socioeconomic status, food and drink habits, oral hygiene practices, and the use of tobacco in different forms.

7. MATERIAL AND METHODS

7.1. Subjects (examined respondents) and methods of examination

The Indian group comprised 805 adult patients (580 men and 295 women). The Czech group comprised 679 adult patients (339 men 340 women). The Indian subjects where randomly selected from patients who visited dental clinics in two south Indian cities (Cochin and Chennai). The Czech group comprised randomly selected patients who visited Department of Dentistry, University Hospital in Hradec Králové and also by three private dental practitioners in Hradec Králové. The data were collected simultaneously from July 2005 to February 2007. Cooperating dentists from both countries were instructed by authors of the study in order to decrease the personal bias. The minimal age for participating in the study was appointed as 30 years, under the assumption that majority of tobacco users has started the habit in their teenage or early adulthood and considering the fact that it takes some time for its destructive effect or clinical manifestation. We fixed the subjects in the age between of 30 – 69. They were selected randomly, their sex being immaterial. The only exclusive criterion was their age.

Examinations consisted of two parts, a self-administered questionnaire and a clinical examination. Self-reported oral health questionnaires are used widely in epidemiological oral health investigations because they are time and cost-effective and provide detailed information on subjects in a single health examination. Certain questions (e.g., regarding medical history, gingivitis) were asked but excluded from the present analysis since these were beyond the scope of this study and are discussed elsewhere.

The questionnaire contained items of a patient's background information (age, sex, education, and income), tobacco habits, eating and drinking habits, oral hygiene practices and participation in dental preventive check-ups. Clinical examination comprised an intraoral examination to find

oral mucosal lesions with particular emphasise on dental caries status in the form of DMF-T (Decayed, Missing, and Filled Teeth) index. Because of the social, life style, cultural difference, difference in tobacco habits and oral hygiene habits in both countries, two different sets of questionnaires were made. The first self-administered part of the questionnaire has minor modifications used in two populations, while the second part, which includes intra-oral clinical examination (DMF-T index), is same for both populations. The participants were informed about the purpose of the study, an informed consent was taken and, at the end of clinical examination, each participant was given instructions regarding dental treatment needs. The copies of the Czech (in Czech language) and the Indian (in English language) questionnaires are added in the Appendix.

7.2. Questionnaire for Indian respondents

Questionnaires were employed to assemble personal data (sex, age), education (no education, basic education, high school, university graduation), income (500-1500 Rs, 1500-3500 Rs, 3500-6500 Rs, 6500-10000 Rs, not willing to disclose) oral health behavior, dietary habits and tobacco habits of patients. Oral hygiene and oral health behavior was classified according to dental aids used for oral hygiene, brushing frequency, frequency of preventive dental visits and consumption of sweets, sweet drinks, fruits and vegetables and alcoholic drinks. Dental aids comprised tooth brush and paste, tooth brush alone, tooth brush and tooth powder, dental floss, mouth wash, motorized tooth brush and tooth pick. Details of brushing frequency were recorded as once a day, two times a day, three times a day or never. The frequency of preventive dental visits was recorded as 2 times a year, once a year, visit only when having a problem or never before. Respondents were asked about the frequency of sweet, sweet drinks, fruits and vegetables and alcohol consumption (daily, several times per week, several times per month, less frequently, never before).

Possible forms of tobacco consumption in India that were considered in this study were: 1) tobacco with betel nuts and leaves, 2) tobacco alone, 3) bidi/chutta, 4) cigarettes without filters, 5) cigarettes with filters, and 6) pipes and other forms. In case of cigarette or bidi/chutta smokers, they were classified into: 1) regular smokers 2) occasional smokers and 3) ex-smokers. Regular smokers were defined as individuals who, at the time of examination, smoked at least one cigarette daily. Occasional smokers were individuals who smoked less than one cigarette per

day. Former or ex-smokers were defined as individuals who smoked at least 1 cigarette per day for 6 consecutive months and don't smoke at least for the past 6 months from the time of the study. Since the use of smokeless tobacco, mostly in the form of chewing tobacco is prevalent in India, we further classified the Indian study population into 'tobacco chewers' and 'tobacco non-users'. Tobacco chewers doesn't smoke but only chew tobacco (alone or tobacco with betel nuts and leaves) and tobacco non-users never used any form of tobacco (smoking or smokeless tobacco).

7.3. Questionnaire for Czech respondents

Questionnaires were employed to assemble personal data (sex, age), education (basic school, skilled, high school, University graduation), income (<5000 CZK, 5000-10,000 CZK, > 10,000 CZK, don't know), oral health behavior, dietary habits and tobacco habits of patients. Oral hygiene and oral health behavior was classified according to dental aids used for oral hygiene, brushing frequency, frequency of preventive dental visits and consumption of sweets, sweet drinks, fruits and vegetables and alcoholic drinks. Dental aids comprised toothbrush and paste, inter dental brush or dental floss and frequency of mouth wash use (regularly, some times, never). The participants were also asked if they abstained from eating anything after evening brushing. Details of brushing frequency were recorded as once a day, two times a day, three times a day or more. The frequency of preventive dental visits was recorded as 2 times a year, once a year, once in 2 years and never. Respondents were asked about the frequency of sweet, sweet drinks, fruit and vegetable and alcohol consumption e.g.; beer and wine, beverages (daily, several times per week, several times per month, less frequently, never).

The only way of tobacco use in the Czech Republic is the smoking form eg: cigarette, pipe. And tobacco status of Czech patients was classified into four groups: regular smoker, occasional smoker, ex-smoker and non-smoker. Regular smoker smokes at least 1 cigarette/day, occasional smoker smokes less than 1 cigarette/day, ex-smoker smoked at least 1 cigarette per day for more than 6 consecutive months and now doesn't smoke at least for last 6 months, and non-smoker who never smoked.

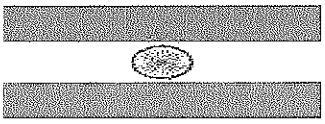
7.4. Oral examination

As caries experience is an important index for assessing oral heath awareness of adult, oral heath examination were performed according to WHO oral examination procedures (226). Oral examinations were performed after the self-administered questionnaire session and before dental treatment and in order to avoid any inference related to answer. The examiners in India and the Czech Republic used a standard examination environment, standard equipment and followed detailed instructions. Four caries score were utilized: decayed teeth (reflecting the more recent untreated disease experience); missing teeth; filled teeth to estimate the caries treatment experience; and decayed, missing, and filled teeth (DMF-T) all together to provide an estimation of accumulated caries experience score. Each clinician carried out all clinical examination using artificial light, a flat surface mouth mirror, gauze, and sponge dry air.

7.5. Statistical analysis

Statistical analysis of the data included the classification of data and calculation of frequencies and was performed by NCSS 2004 program. Mann-Whitney test or Kolmogorov-Smirnov test was used for comparison of the two groups (tobacco users and tobacco non-users or smokers and non-smokers) according to quantitative data (e.g., age) and Kruskal-Wallis analysis of variance with multiple comparison tests was used for the five groups (regular smokers, occasional smokers, ex-smokers, tobacco chewers and tobacco non-users) according to the way of tobacco use. Chi-square test of independence in contingency tables or Fisher's exact test was used for qualitative data. (e.g., DMF-T, income, education, preventive dental visits, brushing habits, food and drinking habits, tobacco habits) In all calculations the level of significance was $\alpha = 0.05$.

8. RESULTS



8.1 Indian results

The examined group of Indian respondents comprised 574 men (72 %) and 225 women (28 %). This group was primarily classified into two sub-groups as tobacco users who used both smoking and chewing tobacco, and tobacco non-users who never used tobacco in any form. Classification of subjects according to the tobacco use by gender and age is shown in table 1. The differences were statistically significant. The majority of the respondents were male tobacco users. The average age of the tobacco users was 47.3 and that of tobacco non-users, 40.3 years.

Table 1. Classification of respondents according to tobacco use and gender

	Males (n)	**Females** (n)	**Total** (n)	**Age** (Average)	**Age** (SD)
Tobacco users	536	121	657	47.3	11.3
Tobacco non-users	38	104	42	40.3	10.4

Sex differences: $p < 0.001$; χ^2 test,

Age differences: $p < 0.001$, Kolmogorov-Smirnov test

For detailed description, tobacco users were divided into four sub-groups: regular smokers, occasional smokers, ex-smokers and tobacco chewers. Table 2 shows the detailed tobacco consumption history of men and women in studied groups. We can observe that regular smokers are mainly men (98 %) while in the sub-group of tobacco non-users were mainly women (73.2 %). We also found that in the sub-group of tobacco chewers, women were in higher percentage (75.2 %) compared to men (24.8 %). The difference was statistically significant ($p < 0.001$).

Table 2. Characterization of respondents according the detailed tobacco consumption

	Males (n)	Males (%)	Females (n)	Females (%)	Total (n)	Total (%)
Regular smokers	433	98.0	9	2.0	442	100.0
Occasional smokers	33	94.3	2	5.7	35	100.0
Ex-smokers	35	89.7	4	10.3	39	100.0
Tobacco chewers	35	24.8	106	75.2	141	100.0
Tobacco non-users	38	26.8	104	73.2	142	100.0

$p < 0.001$; χ^2 test

Table 3. Educational qualification of respondents (%)

	No education	Basic education	High school education	University graduation	Total
Regular smokers	4.8	14.3	30.3	50.7	100.0
Occasional smokers	11.4	11.4	17.1	60.0	100.0
Ex-smokers	5.1	15.4	23.1	56.4	100.0
Tobacco chewers	10.6	16.3	35.5	37.6	100.0
Tobacco non-users	8.5	9.2	22.5	59.9	100.0

$p<0.05$; χ^2 test

Table 3 demonstrates tobacco consumption history and educational qualification of respondents. We found that the educational level had significant influence on tobacco consumption and on the type of tobacco consumption in India. The highest frequencies of regular and occasional smokers as well as tobacco non-users were found in the group of graduates (50.7 %, 60.0 % and 59 .9 % respectively). On the other hand, in this group we found the lowest prevalence of tobacco chewers (37.6 %). The highest frequency of tobacco chewers (10.6 %) was found in the respondents with the lowest education. The differences were statistically significant ($p < 0.05$).

Table 4 shows the number of respondents in given income group. The highest frequency of people with lower middle income (LM) was found in the group of regular smokers. In the group of occasional smokers, there was comparable number of respondents with lower middle income (LM) and with the highest income (H). Most of the ex-smokers belonged to the highest income group (H). In the group of tobacco chewers we found mainly the respondents with lower middle (LM) and middle income (M). Only very few tobacco chewers belonged to the highest income group (H). Tobacco non-users belonged mainly to lower middle (LM) and middle (M) income group. The differences were statistically significant ($p < 0.001$).

Table 4. Number of respondents in given income groups (%)

Income/monthly	(in Indian Rupees)					Not willing to disclose
	500-1500 (L)	1500-3500 (LM)	3500-6500 (M)	6500-10,000 (HM)	Above 10,000 (H)	
Regular smokers	1.8	36.5	23.4	12.9	13.8	11.6
Occasional smokers	5.7	28.6	20.0	14.3	25.7	5.7
Ex-smokers	2.6	12.8	12.8	15.4	25.6	30.8
Tobacco chewers	7.8	27.7	26.2	14.2	5.7	18.4
Tobacco non-users	2.1	22.5	24.6	14.8	7.7	28.2

$p < 0.001$; χ^2 test, L –Lower Income, LM – Lower Middle Income, M – Middle Income, HM – Higher Middle Income, H –Highest Income

Table 5. Number of respondents participating in preventive dental check-ups (%)

	Twice a year	Once a year	Visits only when having problem	Never before
Regular smokers	15.2	15.8	65.8	3.2
Occasional smokers	2.9	25.7	60.0	11,4
Ex-smokers	12.8	23.1	59.0	5.1
Tobacco chewers	7.1	23.4	62.4	7.1
Tobacco non- users	20.4	12.0	65.5	2.1
Total	14.0	17.3	64.6	4.1

$p < 0.001$; χ^2 test

Table 5 shows participation of respondents in preventive check-ups. Irrespective of tobacco consumption, 64.6 % of respondents visited the dentist only when they had some dental problems. Only 14.0 % of all the respondents participated in dental preventive check-up twice a year; these were mostly tobacco non-users (20.4 %). The differences were statistically significant ($p < 0.001$).

Table 6. Brushing frequency and tobacco status (%)

	Type of tobacco consumption					
Brushing frequency	**Regular smokers**	**Occasional smokers**	**Ex-smokers**	**Tobacco chewers**	**Tobacco non-users**	***Total***
Once a day	87.8	71.4	79.5	75.9	75.4	82.4
Twice a day	10.9	22.9	20.5	22.7	20.4	15.6
Three times a day	1.4	5.7	0.0	1.4	4.2	2.0

$p < 0.001$; χ^2 test.

Table 6 shows brushing frequency and tobacco status. The respondents brushed their teeth mostly once a day (82.4 %). In this group of the highest frequency of brushing mostly regular smokers (87.8 %) were presented. Among those, who brushed their teeth twice a day the regular smokers were less frequent (10.9 %). Only a few respondents, represented mostly by occasional smokers (5.7 %) and tobacco non users (4.2 %), brushed their teeth three times a day. The results are statistically significant ($p < 0.001$)

Table 7. Use of various dental aids (%)

	Type of tobacco use						
Dental Aids	**1**	**2**	**3**	**4**	**5**	***Total***	**p-value**
Tooth brush and paste	93.0	91.4	89.7	83.0	92.3	90.9	0.0096
Tooth brush alone	0.2	0	0	0.7	0	1.75	0.783
Tooth brush and powder	4.1	2.9	10.3	7.8	6.3	5.4	0.229
Dental floss	3.4	8.6	12.8	0.7	12.7	5.3	< 0.001
Mouth wash	8.8	14.3	20.5	6.4	14.8	10.3	0.021
Motorized tooth brush	1.1	0	0	0.7	2.1	1.1	0.680
Tooth pick	14.0	20.0	41.0	23.4	11.3	16.8	< 0.001

$\chi 2$ test,1 – Regular smokers, 2 – Occasional smokers, 3 - Ex-smoker, 4 – Tobacco chewers, 5 – Tobacco non- users

Table 7 shows the frequency of various dental aids in relation with the type of tobacco use. Irrespective of tobacco consumption, majority of respondents used tooth brush and paste to clean their teeth (90.9%). The lowest frequency was found among tobacco chewers (83.0 %) ($p = 0.0096$). Among the respondents with tooth brush alone, tooth brush and powder and motorized tooth brush were not used commonly. Dental floss was used by 5.3 % of all participants. It was used mostly by ex-smokers (12.8%) and tobacco non-users (12.7 %), while the lowest frequency of using was found among regular smokers (3.4 %) and tobacco chewers (0.7 %) ($p < 0.001$).

Among those who used mouth wash, highest frequency was found in ex-smokers (20.3 %) while the lowest frequency was found in tobacco chewers (6.4 %) (p = 0.021). Tooth picks are used mainly by ex-smokers (41 %) while the lowest frequency was found in tobacco non-users (11.3%) (p < 0.001).

Table 8 characterizes chosen nutritional habits of the respondents. The highest daily consumption of sweets and sweet drinks was found among regular smokers (12 .4 % and 3.8 % respectively) followed by tobacco chewers (7.1% and 3.5% respectively). Fruits and vegetables were consumed daily by 33.8 % respondents, notably more by regular smokers and tobacco chewers. The highest consumption of alcohol was found in regular smokers (3.8% with daily consumption) followed by occasion smokers (2.9%) and tobacco chewers (2.8 %). The highest percentage of tobacco non-users (81.0%) abstained. The differences were statistically significant (p<0.001).

Table 8. Consumption of chosen food and drinks and tobacco status (%)

	Type of tobacco use					
	1	**2**	**3**	**4**	**5**	**Total**
Sweets	*p < 0.001; χ^2 test*					
Never	2.0	0.0	0.0	5.0	2.1	2.4
Less frequently	47.1	45.7	51.3	59.6	54.9	50.8
Per month*	16.7	22.9	38.5	19.9	27.5	20.5
Per week*	21.1	31.4	5.1	8.5	12.7	17.4
daily	12.4	0.0	5.1	7.1	2.8	8.9
Sweet drinks	*p < 0.001; χ^2 test*					
Never	1.1	5.7	5.1	11.3	6.3	4.3
Less frequently	29.9	37.1	46.2	42.6	38.0	34.7
Per month*	40.5	28.6	28.2	29.8	44.4	38.2
Per week*	24.7	28.6	20.5	12.8	10.6	20.0
daily	3.8	0.0	0.0	3.5	0.7	2.9

Fruits and vegetables				*p < 0.001; χ^2 test*		
Never	0.0	0.0	0.0	3.5	0.7	0.8
Less frequently	15.4	20.0	15.4	17.7	31.7	18.9
Per month*	26.9	17.1	25.6	27.0	32.4	27.4
Per week*	19.7	31.4	33.3	17.0	12.7	19.1
daily	38.0	31.4	25.6	34.8	22.5	33.8
Alcoholic drinks				*p < 0.001; χ^2 test*		
Never	10.2	40.0	59.0	70.9	81.0	37.2
Less frequently	50.9	48.6	25.6	19.1	13.4	37.3
Per month*	19.9	5.7	10.3	2.1	4.2	12.9
Per week*	15.2	2.9	2.6	5.0	0.7	9.6
daily	3.8	2.9	2.6	2.8	0.7	3.0

*1 – Regular smokers, 2 – Occasional smokers, 3 – Ex-smokers, 4 – Tobacco chewers, 5 – Tobacco non-users, * = several times*

Table 9 presents the distribution of respondents in percentage, according to tobacco consumption in relation to oral mucosal findings. The highest prevalence of oral mucosal lesions was found in tobacco chewers (22.7%) followed by regular smokers (12.9%), occasional smokers (8.6%), ex-smokers (5.1%) and tobacco non-users (2.8%). The differences were statically significant ($p < 0.001$).

Table 9. Respondents with oral mucosal lesions (%); $p < 0.001$; χ^2 *test*

	Oral mucosal lesions
Regular smokers	12.9
Occasional smokers	8.6
Ex-smokers	5.1
Tobacco-chewers	22.7
Tobacco non-users	2.8

Table 10. Tobacco status and the number of decayed teeth (DMF – D)

	Regular smokers	Occasional smokers	Ex-smokers	Tobacco chewers	Tobacco non-users
Average	6.44	3.6	5.5	6.96	5.1
SD	3.95	2.68	3.78	4.43	4.24
Median	6	4	4	6	4
25th percentile	3	2	3	4	2
75th percentile	8	5	9	10	6.25

p *<0.001; Kruskal-Wallis One-Way ANOVA*

Table 10 presents the tobacco status and the number of decayed teeth. The average number of decayed teeth was the highest in tobacco chewers (6.96) followed by regular smokers (6.44) and ex-smokers (5.5). The differences were statistically significant (p <0.001).

Table 11 presents the tobacco status and the number of missing teeth. The average number of missing teeth was found to be highest in the group of regular smokers (1.9), followed by tobacco chewers (1.62) and ex-smokers (1.62). The lowest average number of missing teeth was found in tobacco non-users (1.53). The differences were not statistically significant (p = 0.529).

Table 11. Tobacco status and the number of missing teeth (DMF-M)

	Regular smokers	Occasional smokers	Ex-smokers	Tobacco chewers	Tobacco non-users
Average	1.9	1.57	1.62	1.62	1.53
SD	2.14	2.02	1.84	2 .01	1.65
Median	2	0	1	1	1
25th percentile	0	0	0	0	0
75th percentile	3	3	3	3	3

p=*0.529; Kruskal-Wallis One-Way ANOVA*

Table 12 presents the tobacco status and the average number of filled teeth. The average number of filled teeth was the highest in the group of tobacco chewers (3.67) followed by regular smokers (3.29). The differences were statistically significant ($p < 0.001$).

Table 12. Tobacco status and the number of filled teeth (DMF-F)

	Regular smokers	Occasional smokers	Ex-smokers	Tobacco chewers	Tobacco non-users
Average	3.29	1.97	3.23	3.67	2.33
SD	3.19	2.20	3.09	3.61	2.86
Median	2.5	2	2	3	2
25th percentile	1	0	1	1	0
75th percentile	5	3	5	5	3

p *<0.001; Kruskal-Wallis One-Way ANOVA*

Figure 1. Average DMF-T value of tobacco users and tobacco non-users in Indian population; p *<0.001*

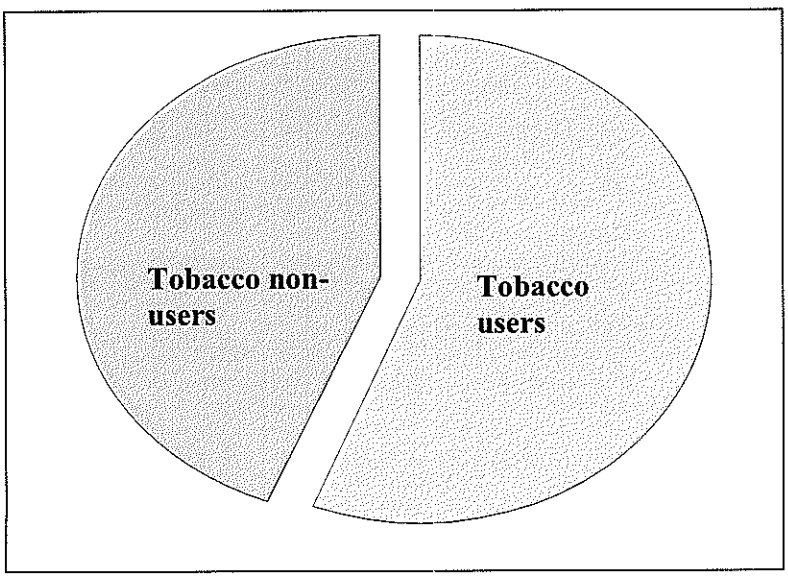
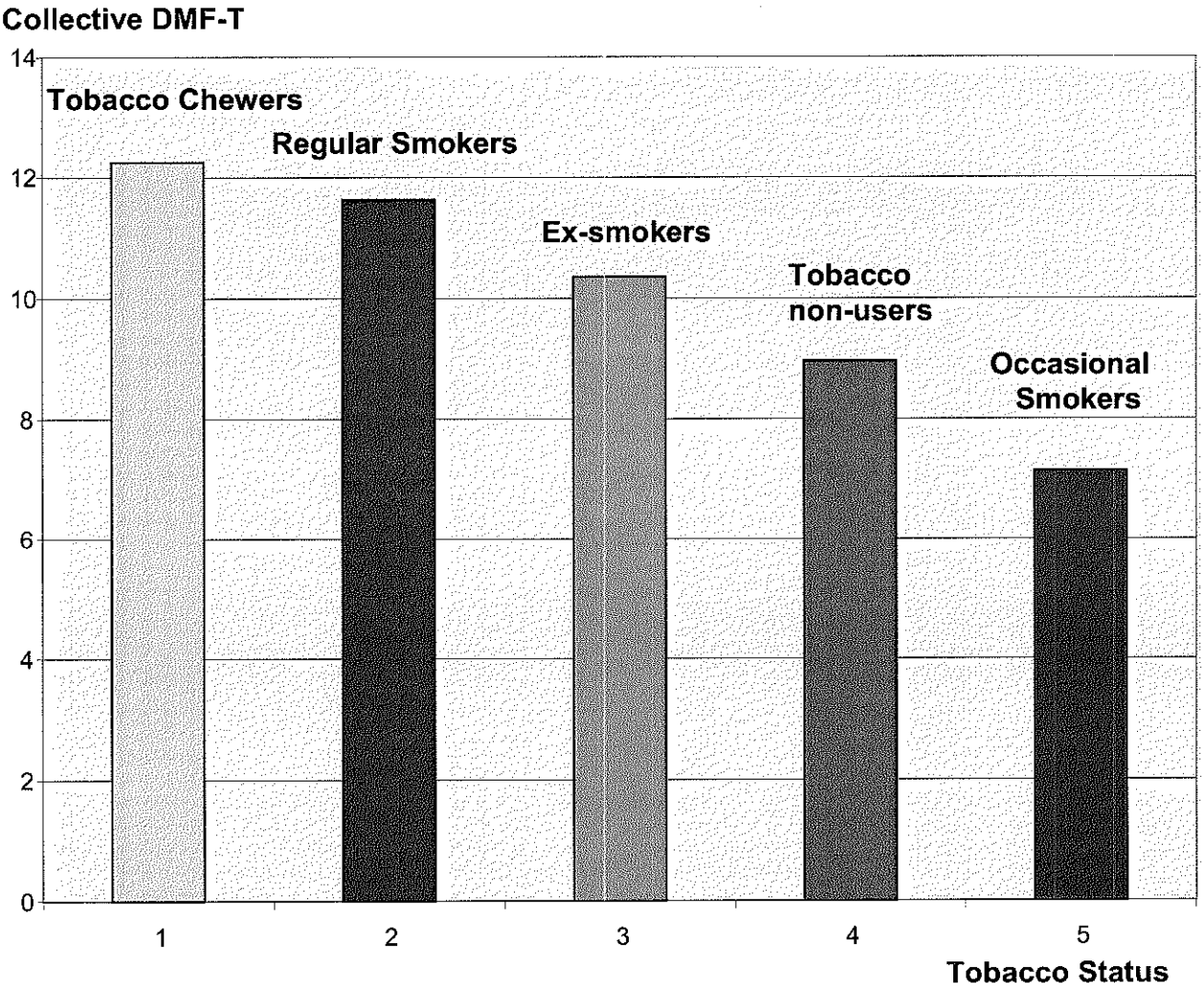


Figure 1 shows the average levels of collective DMF-T (D+M+F=T) values in the two groups of respondents: tobacco users (11.45) and tobacco non-users (8.95). The difference was statistically significant ($p < 0.001$).

Figure 2 shows the differences in the average number of **collective DMF-T value** (D+M+F=T) of our five studied group. We found that tobacco chewers (12.25) had the highest DMF-T value followed by regular smokers (11.63), ex-smokers (10.35), tobacco non-users (8.96) and occasional smokers (7.14). The differences were statistically significant ($p < 0.001$).

Figure 2. Differences in collective DMF-T values according to the group of Indian respondents



In the next part of my dissertation work I analyzed the influence of chosen variables (sex, age, education, participation in dental preventive check-ups and tooth brushing frequency) on DMF-T.

Analyzing the **influence of sex on DMF-T** (table-13), our results showed that average number of decayed teeth was higher in females when compared to males. On the other hand, males had more missing teeth. The average number of filled teeth was higher in females. The differences were not statistically significant.

Tab 13. Influence of sex on the number of decayed, missing and filled teeth

	DMF-D			*DMF-M*			*DMF-F*		
	Average ± SD	**Median**	***p-value***	**Average ± SD**	**Median**	***p-value***	**Average ± SD**	**Median**	***p-value***
Males	6.07 ± 4.01	5 (3 – 8)	**NS (0.709)**	1.82 ± 2.12	1 (0 – 3)	**NS (0.786)**	3.08 ± 3.16	2 (0 – 4)	**NS (0.497)**
Females	6.25 ± 4.36	5 (4 – 8)	**MW**	1.59 ± 1.75	1 (0 – 3)	**KS**	3.25 ± 3.32	2 (1 – 4)	**MW**

KS test = Kolmogorov-Smirnov Test, MW test = Mann-Whitney test, NS = not significant

Tab.14. Influence of age on the number of decayed, missing and filled teeth

	DMF-D			*DMF-M*			*DMF-F*		
	Average ±SD	**Median**	***p-value***	**Average ±SD**	**Median**	***p-value***	**Average ±SD**	**Median**	***p-value***
Age 30-49	5.72 ±3.90	5 (3-8)	0.015 KS	1.53 ±1.88	1 (0-3)	0.0017 KS	2.91 ±3.12	2 (0-4)	0.0064 MW
Age 50-69	6.80 ±4.36	6 (4-9)		2.12 ±2.19	2 (0-3)		3.50 ±3.31	3 (1-5)	

KS test = Kolmogorov-Smirnov Test, MW test = Mann-Whitney test,

Analyzing the **influence of age of on DMF-T** (table-14), the results showed that the respondents of higher age (50-69 years) had higher average number of decayed, missing and filled teeth when compared to younger age group (30-49 years). All differences were statistically significant.

Analyzing the **influence of education on DMF-T** (table-15), the highest number of decayed teeth was observed in the group of University graduates followed by the group of respondents with High school education. The lowest average number of decayed teeth was found in the people with no education. These differences were statistically significant ($p<0.0103$). Average number of missing teeth was the highest in the respondents whose education went no further than Basic school. The lowest number of missing teeth was seen in respondents who were University graduates or had higher education. Average number of filled teeth was the highest in University graduates and the lowest in respondents with no education. These differences were statistically significant.

Tab.15. Influence of education on the number of decayed, missing and filled teeth

	DMF-D			*DMF-M*			*DMF-F*		
	Average ± SD	**Median**	***p-value***	**Average ± SD**	**Median**	***p-value***	**Average ± SD**	**Median**	***p-value***
No education	5.07 ± 3.63	4 (3 – 6)	0.0103	2 ± 1.64	2 (1 – 3)	<0.001	0.83 ± 1.31	0 (0 – 2)	<0.001
Basic – Till 5th. std.	5.48 ± 4.03	4) (2 – 8)		2.45 ± 2.2	2 (0 – 4)		2.22 ± 3.14	1 (0 – 3)	
High school	6.07 ± 4.20	5 (3 – 8)		1.88 ± 1.99	2 (0 – 3)		2.78 ± 2.87	2 (0 – 4)	
University graduation	6.46 ± 4.11	6 (3 – 9)		1.46 ± 1.98	0 (0 – 2)		3.88 ± 3.34	3 (2 – 5)	
(Kruskal – Wallis Test)	Groups: 1 differs from 4 2 differs from 4			Groups: 1 differs from 4 2 differs from 4 3 differs from 4			Groups: 1 differs from 2,3,4 2 differs from 3,4 3 differs from 4		

Analyzing the **influence of participation in preventive check-ups on DMF-T** (Table 16), our result showed that respondents who participated in preventive dental check-ups once a year

had the highest average number of decayed teeth followed by the people who visited a dentist twice a year and the lowest average number of filled teeth was observed in people who have never visited dental clinic before in their life. The differences were statistically significant ($p<0.001$). The highest number of missing teeth was observed more in those respondents who visited dental clinic only when they had some acute problem. The lowest number of missing teeth was observed in those who never visited dental clinic before. The differences were statistically significant ($p<0.001$). The highest number of filled teeth was observed in the group of respondents who practiced preventive dental check-ups once per year followed by the group of respondents who attended twice a year. The lowest number of filled teeth was observed in the respondents who have never visited dental clinic before. The differences were statistically significant ($p<0.001$).

Tab 16. Influence of participation in preventive check-ups on the number of decayed, missing and filled teeth

	DMF-D			*DMF-M*			*DMF-F*		
	Average ± SD	**Median**	***p-value***	**Average ± SD**	**Median**	***p-value***	**Average ± SD**	**Median**	***p-value***
Twice a year	6.59 ± 4.06	6 (4 – 9)	<0.001	1.42 ± 2.14	0 (0 – 3)	<0.001	4.18 ±3.51	3 (2 – 6)	<0.001
Once a year	6.89 ± 4.58	6 (3 – 10)		1.62 ± 2.06	1 (0 – 3)		4.33 ±3.56	3 (2 – 7)	
Having problem	5.94 ± 3.99	5 (3 – 8)		1.93 ±1.99	2 (0 – 3)		2.75 ±2.92	2 (0 – 4)	
Never before	4.09 ± 3.26	4 (2 –5.5)		0.67 ± 1.31	0 (0 –0.5)		0.39 ±1.12	0 (0 – 0)	
(Kruskal - Wallis Test)	Groups: 1 differs from 4 2 differs from 4 3 differs from 4			Groups: 1 differs from 3 2 differs from 4 3 differs from 4			Groups: 1 differs from 3,4 2 differs from 3,4 3 differs from 4		

During analysis of **tooth brushing frequency influence on DMF-T** (Table 17) the results showed that number of decayed teeth was the highest in the respondents who brushed their teeth once a day, followed by those who brushed their teeth twice a day. Lowest number of decayed

teeth showed the respondents brushing their teeth three times a day. These differences were statistically significant ($p<0.0179$). Average number of missing teeth was seen the highest in those who brush their teeth once a day followed by those who brushes teeth three times a day. The lowest number of missing teeth was observed in people who brushed their teeth two times a day. The differences were statistically significant ($p<0.001$). The highest number of filled teeth was observed in the group of respondents who brushed their teeth two times a day while the lowest number of filled teeth was observed in people who brushed their teeth three times a day. In this case the differences were not statistically significant ($p=0.110$).

Tab 17. Influence of tooth brushing frequency on the number of decayed, missing and filled teeth

	DMF-D			*DMF-M*			*DMF-F*		
	Average ±SD	**Median**	**p-value**	**Average ±SD**	**Median**	**p-value**	**Average ±SD**	**Median**	**p-value**
Once a day	6.29 ± 4.10	5 (3 – 8)	0.0179	1.86 ± 2.04	2 (0 – 3)	<0.001	3.05 ± 3.19	2 (0 – 4)	0.110 NS
Twice a day	5.43 ± 4.08	5 (2 – 8)		1.20 ± 1.84	0 (0 – 2)		3.62 ± 3.31	2 (1 – 6)	
3 times a day	4.56 ± 3.92	2.5 (2 – 8)		1.69 ± 1.89	1.5 (0 –3.5)		2.63 ± 2.60	2 (1 – 4)	
(Kruskal - Wallis Test)	Groups; 1 differs from 2			Groups; 1 differs from 2					

NS-*Not significant*

The **influence of variable factors on decayed, missing and filled teeth in Indian respondents** is described in Table 18. Detailed description of relationships between variables has been discussed before and will be summarized in the Conclusions.

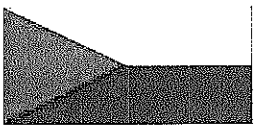
Tab. 18. Analysis of variables

Variable		DMF-D		DMF-M		DMF-F	
		Average ± SD	p-value	Average ± SD	p-value	Average ± SD	p-value
Age	Younger	5.72 ± 3.90	0.015	1.53 ± 1.88	0.0017	2.91 ± 3.12	0.00639
	Older	6.80 ± 4.36		2.12 ± 2.19		3.50 ± 3.31	
Sex	Males	6.07 ± 4.01	0.709 NS	1.82 ± 2.12	0.786 NS	3.08 ± 3.16	0.497 NS
	Females	6.25 ± 4.36		1.59 ± 1.75		3.25 ± 3.32	
Education	No education	5.07 ± 3.63	0.0103	2 ± 1.64	<0.001	0.83 ± 1.31	<0.001
	Basic – Till 5th. std.	5.48 ± 4.03		2.45 ± 2.2		2.22 ± 3.14	
	High school	6.07 ± 4.20		1.88 ± 1.99		2.78 ± 2.87	
	University graduation	6.46 ± 4.11		1.46 ± 1.98		3.88 ± 3.34	
Preventive check-ups	Twice a year	6.59 ± 4.06	<0.001	1.42 ± 2.14	<0.001	4.18 ± 3.51	<0.001
	Once a year	6.89 ± 4.58		1.62 ± 2.06		4.33 ± 3.56	
	Having problem	5.94 ± 3.99		1.93 ± 1.99		2.75 ± 2.92	
	Never before	4.09 ± 3.26		0.67 ± 1.31		0.39 ± 1.12	
Brushing frequency	Once a day	6.29 ± 4.10	0.0179	1.86 ± 2.04	<0.001	3.05 ± 3.19	0.110 NS
	Twice a day	5.43 ± 4.08		1.20 ± 1.84		3.62 ± 3.31	
	3 times a day	4.56 ± 3.92		1.69 ± 1.89		2.63 ± 2.60	

Smoking	**Regular smokers**	6.29 ± 3.95	<0.001	1.9 ± 2.14	0.529	3.29 ± 3.19	<0.001
	Occasional smokers	3.6 ± 2.68		1.57 ± 2.02		1.97 ± 2.20	
	Ex-smokers	5.5 ± 3.75		1.62 ± 1.84		3.23 ± 3.09	
	Tobacco chewers	6.96 ± 4.43		1.62 ± 2.01		3.67 ± 3.61	
	Tobacco non-users	5.1 ± 4.24		1.53 ± 1.65		2.33 ± 2.86	

NS = non significant

8.2. Czech results



The examined group from the Czech Republic comprised 679 respondents; 339 males (49.9%) and 340 females (50.1%). The detailed classification of the subjects according to their smoking history and gender is given in Table 19. Among regular smokers, we found higher frequency of men (60 %), while among non-smokers we found higher frequency of women (59 %).

Tab 19.Classification of respondents according to tobacco use and gender

	Regular smokers		**Occasional smokers**		**Ex-smokers**		**Non-smokers**		**Total**	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Males	91	60.3	26	63.4	61	64.2	161	41.1	339	49.9
Females	60	39.7	15	36.6	34	35.8	231	58.9	340	50.1
Total	151	100.0	41	100.0	95	100.0	392	100.0	679	100.0

$p < 0.0001$; χ^2 test

Age information of the respondents is given in Table 20. We accepted only the participants from 30 to 59 years of age. The average age in the groups of respondents is slightly different. The oldest participants were ex-smokers and the youngest were occasional smokers. These differences were statistically significant (p = 0.00077).

Tab 20. Age characteristics of respondents

	Average ± SD	Median	25th percentile	75th percentile
Regular smokers	43.8 ± 10.6	43	34	52
Occasional smokers	39.1 ± 9.1	36	31.5	45
Ex-smokers	46.9 ± 10.6	46	38	56
Non-smokers	44.3 ± 11.3	42	34	53
(Multiple-Comparison Test)	Group: 1 differs from 2, 3 2 differs from 1, 3, 4		3 differs from 2, 1, 4 4 differs from 2, 3	

P = 0.00077; Kruskal-Wallis One-Way ANOVA

Tab 21. Educational qualification of respondents (%)

	Regular smokers	Occasional smokers	Ex-smokers	Non-smokers	Total
Basic school	41.3	17.1	23.2	22.0	26.1
Skilled	8.7	12.2	7.4	7.2	7.8
High school	40.0	48.8	50.5	42.7	43.6
University graduation	10.0	22.0	18.9	28.1	22.5
Total	100.0	100.0	100.0	100.0	100.0

$p < 0.001$; χ^2 test

In the scientific literature, it has been reported that level of education can influence smoking rate of population. Pursuant to this, we found significant differences in educational qualification of our respondents according to their smoking history (Tab. 21). Among the smokers, the number of participants with basic education was significantly higher and the number of participants with University degree was lower than among non-smokers ($p < 0.001$).

Considering the income of the respondents (Tab. 22) we can see one specific characteristic of the Czech Republic – high tolerance to smoking. Thus, there is no wonder that we found high prevalence of regular and occasional smokers in the group with the highest income.

Tab 22. Respondents in given income group (%)

Income/monthly (In Czech Crowns)	Regular smokers	Occasional smokers	Ex-smokers	Non-smokers	Total
Not willing to disclose	12.7	7.3	8.8	12.1	11.5
< 5000 CZK	6.7	9.8	3.3	2.6	4.0
5000-10,000 CZK	29.3	24.4	31.9	35.9	33.2
> 10,000 CZK	43.3	53.7	54.9	46.0	47.1
Do not know	8.0	4.9	1.1	3.4	4.2
Total	100.0	100.0	100.0	100.0	100.0

$p = 0.035$; χ^2 test

Table 23 demonstrates the distribution of subjects according to their smoking habits in relation to participation in dental prevention. Irrespective of smoking habits, 66.2 % of respondents in the Czech Republic visited dentists for preventive dental check-ups twice a year. From our results we can see that the percentage of the respondents participating in regular dental preventive check-ups (twice a year) was higher among non-smokers than among current

smokers. Our respondents participating in dental prevention "less frequently" or "never" belong mainly to current smokers. The differences were statistically significant (p = 0.0138).

Tab 23. Respondents participating in preventive dental check-ups (%)

	Regular smokers	Occasional smokers	Ex-Smokers	Non-smokers	Total
2 times a year	57.3	61.0	58.9	71.9	66.2
Once a year	22.7	22.0	25.3	18.6	20.6
Once in 2 years	2.7	2.4	5.3	3.6	3.5
Less frequently	8.7	9.8	5.3	3.3	5.2
Never	8.7	4.9	5.3	2.6	4.4

$p = 0.0138$; χ^2 test

Tab 24. Tooth brushing frequency of respondents (%)

	Regular smokers	Occasional smokers	Ex-smokers	Non-smokers	Total
3 times/day or more	9.3	2.4	5.3	13.0	10.5
2 times/day	70.9	82.9	83.2	74.7	75.5
Once a day	15.2	12.2	9.5	11.0	11.8
Less frequently	4.6	2.4	2.1	1.3	2.2

$p = 0.0504$; χ^2 test

Table 24 demonstrates the tooth brushing frequency of respondents. Irrespective of smoking habits, 75.5 % of respondents brushed their teeth twice a day. Nevertheless, the detailed analysis according to the smoking status showed the differences among the studied groups, which were nearly statistically significant. The non-smokers had better brushing habits than the smokers. In the groups of current smokers we found the highest number of those who brushed their teeth

only once a day or even less frequently. On the other hand, we found high frequency of occasional smokers and ex-smokers who brushed their teeth 2 times a day (even more frequent than the non-smokers did).

In table 25 we can see other factors concerning oral hygiene habits. All of our respondents used the tooth brush and paste for cleaning their teeth. 55 % of our respondents used inter-dental brush and/or dental floss, ex-smokers the most frequently, regular smokers less frequently. Differences were statistically significant. Regular use of mouth wash was the least common among current smokers and the most common among ex-smokers. Statistically significant difference was found in eating habits after evening tooth brushing. Non-smokers abstained from eating anything after evening brushing.

Tab 25.Other oral hygiene habits of the respondents (%)

	Regular smokers	Occasional smokers	Ex-smokers	Non-smokers	Total	p – value (χ^2 test)
Tooth brush and paste	100.0	100.0	98.9	99.0	99.3	p = 0,575
Inter-dental brush and/or dental floss	43.7	58.5	62.1	57.7	55.2	p = 0.012
Mouth wash regularly	8.0	7.7	14.6	11.9	11.1	p = 0.746
Mouth wash sometimes	48.6	48.7	48.8	47.2	47.8	
Mouth wash never	43.5	43.6	36.6	40.9	41.1	
Abstained from eating after evening brushing	37.2	43.9	48.9	59.6	52.3	p < 0. 001

Tab 26. Consumption of chosen food and drinks by the smoking status groups (%)

	Regular smokers	Occasional smokers	Ex-smokers	Non-smokers	Total
Sweets			*p = 0.08; χ^2 test*		
Daily	15.0	20.5	12.1	15.3	15.1
Per week*	32.7	41.0	22.0	36.4	33.8
Per month*	24.5	23.1	29.7	26.8	26.4
Less frequently	24.5	15.4	34.1	17.9	21.5
Never	3.4	0.0	2.2	3.6	3.2
Sweet drinks			*p = 0.0012; χ^2 test*		
Daily	31.0	32.5	13.5	18.0	21.2
Per week*	19.3	40.0	20.2	27.5	25.5
Per month*	17.9	10.0	23.6	15.9	17.0
Less frequently	18.6	10.0	27.0	26.7	23.9
Never	13.1	7.5	15.7	11.9	12.4
Fruits and vegetables			*p = 0.006; χ^2 test*		
Daily	37.5	59.0	54.9	61.2	55.0
Per week*	52.8	33.3	36.3	32.3	37.4
Per month*	5.6	5.1	3.3	3.9	4.3
Less frequently	4.2	2.6	4.4	2.1	2.9
Never	0.0	0.0	1.1	0.5	0.5
Beer and wine			*p = 0.028; χ^2 test*		
Daily	8.9	7.7	9.6	5.5	6.9
Per week*	33.6	33.3	31.9	26.6	29.3
Per month*	29.5	30.8	35.1	25.3	27.9
Less frequently	18.5	25.6	19.1	30.8	26.1
Never	9.6	2.6	4.3	11.7	9.7
Beverages			*p < 0.001; χ^2 test*		
Daily	2.8	0.0	2.2	0.3	1.1

Per week*	7.6	2.6	3.3	1.9	3.4
Per month*	20.0	35.9	22.2	10.9	16.0
Less frequently	44.8	56.4	47.8	56.5	52.7
Never	24.8	5.1	24.4	30.5	26.9

* *Several times*

Table 26 shows chosen nutritional habits of our respondents. Sweets intake was generally high. 15% of the respondents eat sweets daily and nearly 34% several times per week. We did not find any significant difference in sweets intake among smokers and non-smokers. Sweet drinks consumption was surprisingly high as well – almost 21% of respondents drank sweet drinks daily and one quarter of them several times per week. In this case the significant difference among smokers and non-smokers was found. Current smokers, mainly occasional smokers consumed sweet drinks more frequently in comparison with non-smokers or ex-smokers. We found an opposite trend in consumption of fruit and vegetables. 55% of respondents consumed fruit and vegetables daily, non-smokers significantly more often than smokers. As for the alcohol consumption, daily or weekly consumption of beer and wine was found in 7, resp. 30% of respondents; significantly more often among regular smokers than among non-smokers. Regular daily or weekly beverages consumption was found in 1.1, resp. 3.4 % of our respondents; significantly more often among regular smokers than non-smokers.

The analysis of data concerning the influence of cigarette smoking on oral mucosa revealed that oral mucosal lesions were relatively rarely found in our respondents ($p = 0.0109$). Table 27 gives more detailed description of this factor. The results do not allow closer conclusion.

Tab 27. Oral mucosal lesions in smokers and non-smokers (%)

Oral mucosal lesions	Smokers	Non-smokers	Total
Absent	96.9	99.5	98.4
Present	3.1	0.5	1.6
Total	100.0	100.0	100.0

$p = 0.0109$; Fisher's Exact Test

Table 28 presents the smoking status and number of decayed teeth. Result shows that the highest average number of decayed teeth was found in occasional smokers, followed by regular smokers. The lowest number of decayed teeth was found in non-smokers. The average number of decayed teeth found in current smokers (regular smokers, occasional smokers) was higher compared to non-smokers. These differences were statistically significant (*p = 0.0339*).

Tab 28. Smoking status and the number of decayed teeth (DMF-D)

	Smokers			Non-smokers
	Regular	Occasional	Ex-smoker	
Average	1.257	1.39	0.947	0.688
SD	2.408	2.246	1.662	1.593
Median	0	1	0	0
25 percentile	0	0	0	0
75 percentile	1	2	2	1

p = 0.0339; Kruskal-Wallis One-Way ANOVA

Tab 29. Smoking status and the number of missing teeth (DMF - M)

	Smokers			Non-smokers
	Regular	Occasional	Ex-smoker	
Average	5.859	2.561	5.979	4.363
SD	7.063	4.615	6.995	6.263
Median	4	2	4	2
25 percentile	1	0	1	0
75 percentile	8	4	9	5

p < 0.001; Kruskal-Wallis One-Way ANOVA

Table 29 presents the smoking status and number of missing teeth. Result shows that the highest average number of missing teeth was found in ex-smokers, followed by regular smokers. The lowest number was found in occasional smokers. The differences were statistically significant ($p < 0.001$). Table 30 presents the smoking status and the number of filled teeth. Result shows that average number of filled teeth was found the highest in a group of non-smokers, followed by ex-smokers. Lowest average number of filled teeth was found in occasional smoker. The differences were statistically significant ($p = 0.0213$).

Tab 30. Smoking status and the number of filled teeth (DMF - F)

	Smokers			Non-smokers
	Regular	**Occasional**	**Ex-smoker**	
Average	9.149	9.122	10.213	10.487
SD	5.353	4.723	5.586	5.162
Median	9	9	10.5	10
25 percentile	5	5	5.75	7
75 percentile	12	12.5	15	14

$p = 0.0213$; Kruskal-Wallis One-Way ANOVA

Figure 3. Average collective DMF-T value of smokers and non-smokers in the Czech respondents; *$p = 0.131$*

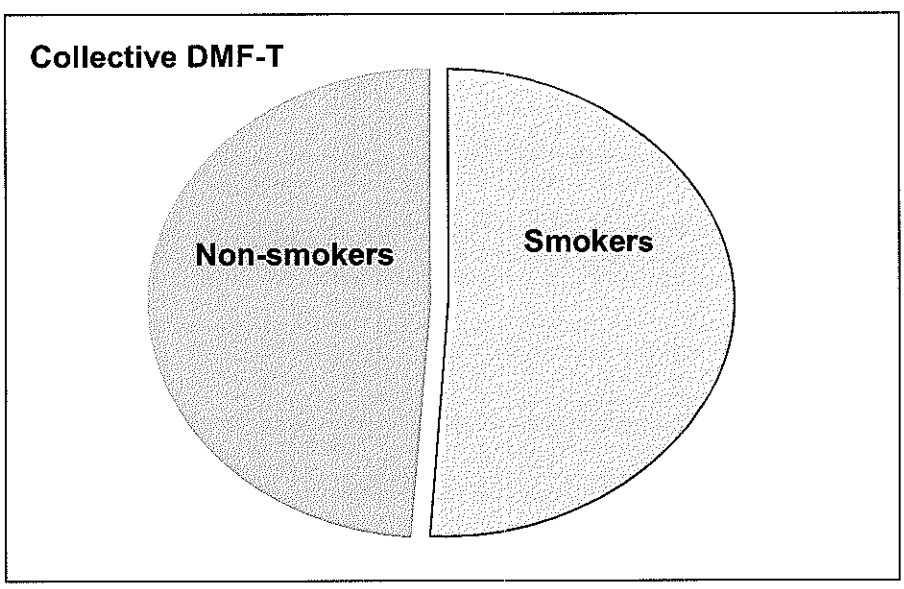
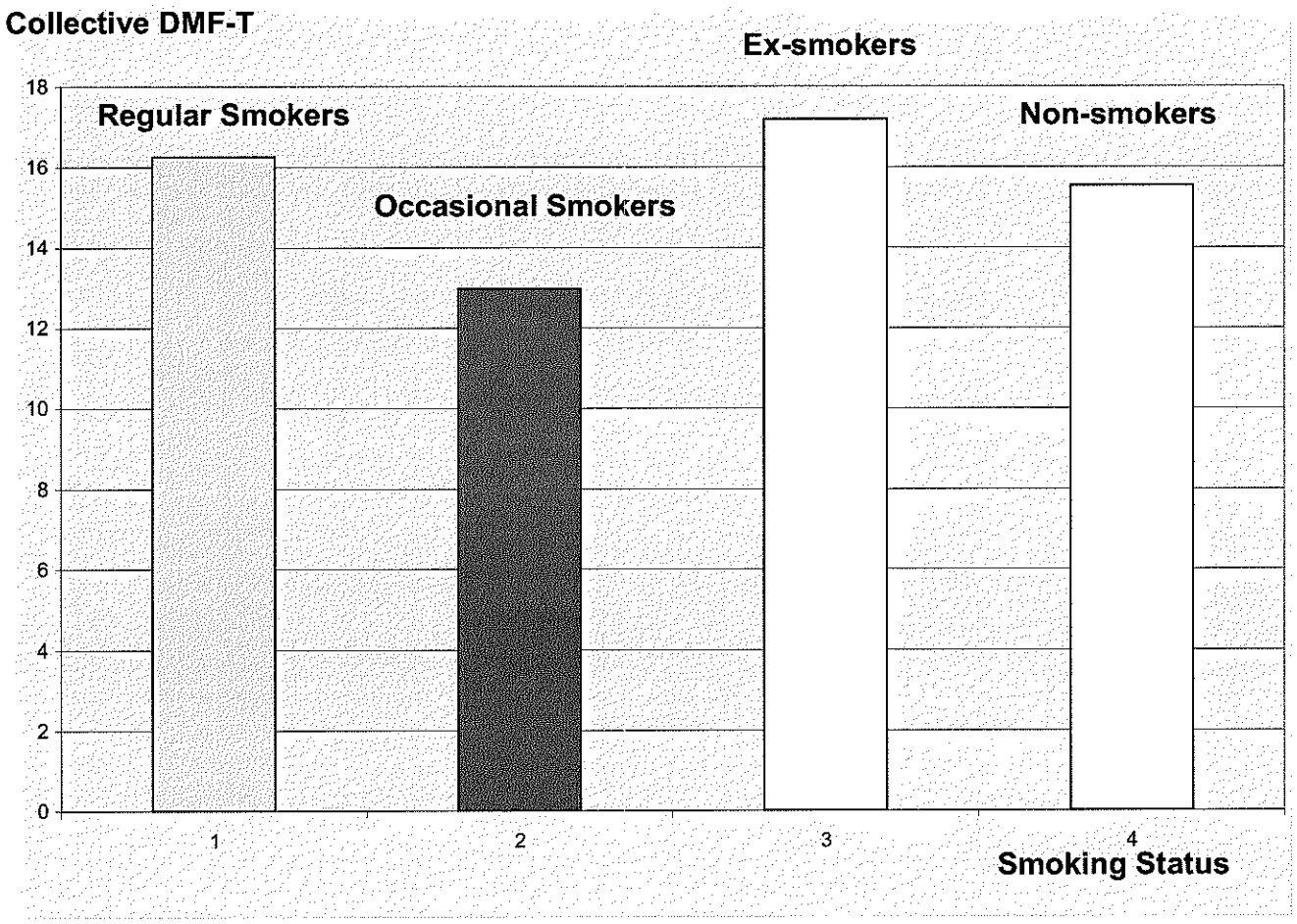


Figure 3 shows the average level of collective DMF-T (D+M+F=T). It is apparent from the picture that the level in the group of smokers (regular smokers, occasional smokers, ex-smokers; 16.09) was higher when compared to non-smokers (15.38). The differences were not statistically significant (p = 0.131).

Figure 4 shows the differences in the average number of collective DMF-T (D+M+F=T) values of the four Czech groups. It was found that ex- smokers had the highest DMF-T value (17.21) followed by regular smokers (16.26), non- smokers (15.58) and occasional smokers (13.07). The differences were statistically significant (p = 0.014).

Figure 4. Differences in collective DMF-T values according to the group of Czech respondents



In the next part of my dissertation work, I analyzed the influence of chosen variables (sex, age, education, participation in dental preventive check-ups and tooth brushing frequency) on DMF-T.

Analyzing the **influence of sex on DMF-T** (Table 31), the results showed that the average number of decayed and missing teeth was higher in males when compared to females. The difference in the average numbers of decayed and missing teeth between males and females was not statistically significant, whereas the average number of filled teeth in females was significantly higher (p = 0.0028).

Tab 31. Influence of sex on number of decayed, missing and filled teeth

	DMF-D			*DMF-M*			*DMF-F*		
	Average ± SD	**Median**	**p-value**	**Average ± SD**	**Median**	**p-value**	**Average ± SD**	**Median**	**p-value**
Males	1.051 ± 2.021	0 (0 – 1)	0.3733 NS	4.901 ± 6.856	2 (0 – 6)	0.6470 NS	9.459 ± 5.178	10 (5 – 13)	0.0028
Females	0.737 ± 1.694	0 (0 – 1)	KS	4.723 ± 6.184	3 (1-6)	MW	10.673 ± 5.282	10 (7 – 15)	t-test

KS = *Kolmogorov-Smirnov test,* MW = *Mann-Whitney test, NS = Not significant*

Tab 32. Influence of age on number of decayed, missing and filled teeth

	DMF-D			*DMF-M*			*DMF-F*		
	Average ± SD	**Median**	**p-value**	**Average ± SD**	**Median**	**p-value**	**Average ± SD**	**Median**	**p-value**
Age 30-49	0.843 ± 1.932	0 (0 – 1)	0.0925 NS MW	2.843 ± 4.347	2 (0 – 4)	p<0.001 KS	10.009 ± 5.017	10 (6 – 13)	0.0831 NS KS
Age 50-69	1.005 ± 1.737	0 (0 – 2)		8.898 ± 8.217	6 (3 – 12)		10.195 ± 5.776	10 (6 – 15)	

KS = *Kolmogorov-Smirnov test,* MW = *Mann-Whitney test, NS-Not significant*

Analyzing the **influence of age on DMF-T** (Table 32), the results showed that the respondents of higher age (50-69 years) had higher average number of decayed and filled teeth compared to younger age group (30-49 years). But the differences were not significant.

Significantly higher average number of missing teeth was found in the high age group ($p<0.001$).

Analyzing the **influence of education on DMF-T** (Table 33), we found that higher average number of decayed tooth was found in respondents who had lower education (Basic school, Skilled). The differences were statistically significant ($p = 0.0061$). The highest average number of missing teeth was found in the group which had low education (Basic school) and low number of missing teeth was observed in the group with higher education (University graduation).These differences were statistically significant ($p = 0.0009$). The highest number of filled teeth was found in highly educated respondents (High school and University graduation) when compared to people who had lower education (Basic school and Skilled). The difference was not statistically significant ($p = 0.0919$).

Tab 33. Influence of education on number of decayed, missing and filled teeth

	DMF-D			*DMF-M*			*DMF-F*		
	Average ± SD	**Median**	**p-value**	**Average ± SD**	**Median**	**p-value**	**Average ± SD**	**Median**	**p-value**
Basic school	1.16 ± 2.52	0 (0 – 1)		6.263 ± 7.46	3 (1 – 9)		9.44 ± 5.81	10 (5 – 14)	
Skilled	1.38 ± 2.35	0 (0 – 2)	0.0061	3.9 ± 5.64	2 (0 – 5)	0.0009	9.5 ± 4.02	9.5 (6.8-12)	0.0919 NS
High school	0.664 ± 1.39	0 (0 – 1)		4.812 ± 6.82	2 (1– 5.5)		10.627 ± 5.29	11 (7 – 15)	
University graduation	0.792 ± 1.23	0 (0 – 1)		3.427 ± 4.89	2 (0 – 5)		9.947 ± 4.83	10 (6-13.3)	
(Fisher's Multiple-Comparison Test)	Group: 2 differs from 3			Group: 1 differs from 4, 2, 3					

NS = non significant,

Analyzing the **influence of participation in preventive check-ups on DMF-T** (Table 34), the results revealed the highest average number of decayed teeth in participants who never attended any preventive check-ups. The lowest number of decayed teeth was observed in respondents who attended preventive check-ups twice a year. These differences were statistically significant ($p = 0.0020$). The highest number of missing teeth was observed in the respondents never participated in preventive check-ups and the lowest in respondents who attended

preventive check-ups twice a year. These differences were not statistically significant (p = 0.0914). Filled teeth were observed the most frequently among people who attended preventive check-ups twice a year, followed by respondents who did so once a year. Less number of filled teeth was observed in respondents who have never attended any preventive dental check-ups. These differences were statistically significant (p<0.001).

Tab 34. Influence of preventive check-ups on DMF-T

	DMF-D			*DMF-M*			*DMF-F*		
	Average ± SD	**Median**	**p-value**	**Average ± SD**	**Median**	**p-value**	**Average ± SD**	**Median**	**p-value**
Twice a year	0.656 ± 1.27	0 (0 – 1)	0.0020	4.381 ± 5.72	2 (0 – 6)	0.091 NS	10.657 ± 5.13	11 (7 – 15)	p<0.001
Once a year	0.964 ± 1.7	0 (0 – 1)		4.551 ± 6.49	2 (0 – 5)		10.109 ± 5.13	10 (6 – 14)	
Once in 2 years	1.435 ± 1.93	1 (0 – 3)		6.913 ± 9.18	2 (0 – 14)		6.783 ± 4.11	6 (4 – 10)	
Less frequently	1.029 ± 1.5	0 (0 – 2)		7.571 ± 9.59	4 (1 – 9)		8.286 ± 5.25	9 (5 – 12)	
Never	3.533 ±5.32	1 (0 – 6)		7.633 ±9.35	5 (1.8-7.8)		5.433 ±4.72	4.5 (1– 10)	
(Kruskal – Wallis Test)	Group: 1 differs from 3, 5 2 differs from 5						Group: 1 differs from 5, 3, 4 2 differs from 5, 3 4 differs from 5		

NS - non significant

Analyzing the **influence of tooth brushing frequency on DMF-T** (Table 35), the results showed that the highest number of decayed teeth was observed among respondents who brushed their teeth less frequently. The lowest number of decayed teeth we found in people who brushed their teeth more times (3times a day/more and 2 times a day). These differences were statistically significant (p = 0.0181). The highest average number of missing teeth was observed in people who brushed their teeth more times a day, the lowest in people who brushed their teeth two times a day. Quite low level of missing teeth was found in respondents who brushed their teeth less frequently. These differences were statistically significant (p = 0.0189). The highest average number of filled teeth was observed the in respondents who brushed their teeth two

times a day. The lowest number of filled teeth was found in people who brushed their teeth less frequently. The differences were statistically significant (P = 0.0485).

Tab 35. Influence of tooth brushing frequency on number of decayed, missing and filled teeth

	DMF-D			*DMF-M*			*DMF-F*		
	Average ± SD	**Median**	**p-value**	**Average ± SD**	**Median**	**p-value**	**Average ± SD**	**Median**	**p-value**
3 times a day/more	0.618 ± 1.60	0 (0 – 1)	0.0181	6.058 ± 8.43	2 (0.5-9.5)	0.0189	9.309 ± 5.53	10 (5 – 13)	0.0485
2 times a day	0.808 ± 1.58	0 (0 – 1)		4.333 ± 5.82	2 (0 – 5)		10.381 ± 5.12	10 (7 – 14)	
Once a day	1.308 ± 2.24	0 (0 – 2)		6.667 ± 8.66	3 (1– 8.3)		9.372 ± 5.55	9.5 (5 –3.3)	
Less frequently	2.933 ± 5.52	1 (0 – 3)		5.933 ± 3.77	5 (5 – 6)		7.267 ± 5.71	8 (3 – 12)	
(Kruskal - Wallis Test)	Group: 1 differs from 3, 4 2 differs from 4			Group: 1 differs from 4 2 differs from 4			Group: 2 differs from 4		

The influence of variable factors on decayed, missing and filling teeth in Czech respondents is described in Table 36. Detailed description of relationships between the variables has been discussed heretofore and will be summarized in the Conclusions.

Tab. 36. Analysis of the variables

Variable		**DMF-D**		**DMF-M**		**DMF-F**	
		Average ± SD	**p-value**	**Average ± SD**	**p-value**	**Average ± SD**	**p-value**
Age	**Younger**	0.843 ± 1.932	0.092 NS	2.843 ± 4.347	<0.001	10.009 ± 5.017	0.083 NS
	Older	1.005 ± 1.737		8.298 ± 8.217		10.195 ± 5.776	
Sex	**Males**	1.051 ± 2.021	0.373 NS	4.901 ± 6.856	0.647 NS	9.459 ± 5.178	0.0028
	Females	0.737 ± 1.694		4.723 ± 4.723		10.673 ± 5.282	

Education	**Basic**	1.16 ± 2.52	0.0061	6.263 ± 7.46	<0.001	9.44 ± 5.81	0.0919 NS
	Skilled	1.38 ± 2.35		3.9 ± 5.64		9.5 ± 4.02	
	High school	0.664 ± 1.39		4.812 ± 6.82		10.627 ± 5.29	
	University graduation	0.792 ± 1.23		3.427 ± 4.89		9.947 ± 4.83	
Preventive check-ups	**Twice a year**	0.656 ± 1.27	0.002	4.381 ± 5.72	0.091 NS	10.657 ± 5.13	<0.001
	Once a year	0.964 ± 1.7		4.551 ± 6.49		10.109 ± 5.13	
	Once in 2 years	1.435 ± 1.93		6.913 ± 9.18		6.783 ± 4.11	
	Less frequently	1.029 ± 1.5		7.571 ± 9.59		8.286 ± 5.25	
	Never	3.533 ± 5.32		7.633 ± 9.35		5.433 ± 4.72	
Brushing frequency	**3 times a day / more**	0.618 ± 1.60	0.0181	6.058 ± 8.43	0.0189	9.309 ± 5.53	0.0485
	2 times a day	0.808 ± 1.58		4.333 ± 5.82		10.381 ± 5.12	
	Once a day	1.308 ± 2.24		6.667 ± 8.66		9.372 ± 5.55	
	Less frequently	2.933 ± 5.52		5.933 ± 3.77		7.267 ± 5.71	
Smoking	**Regular smokers**	1.257 ± 2.408	0.034	5.859 ± 7.063	<0.001	9.149 ± 5.353	0.0213
	Occasional smokers	1.39 ± 2.246		2.561 ± 4.615		9.122 ± 4.723	
	Ex-smokers	0.947 ± 1.6		5.979 ± 6.995		10.213 ± 5.586	
	Non-smokers	0.69 ± 1.59		4.363 ± 6.263		10.487 ± 5.162	

NS = non significant

8.3. Comparative differences between the examined groups of respondents

Figure 5 shows the average level of decayed teeth in Indian tobacco users (tobacco chewers, regular smokers, occasional smokers and ex-smokers; 6.35) and in Czech tobacco users (regular smoker, occasional smoker, ex smokers; 1.17). Both mentioned groups showed more decayed teeth when compared with adequate groups – Indian tobacco non-users (5.09) and Czech tobacco non-users (0.69).

Figure 5. Differences in average DMF-D in Tobacco users and Tobacco non-users in India and the Czech Republic

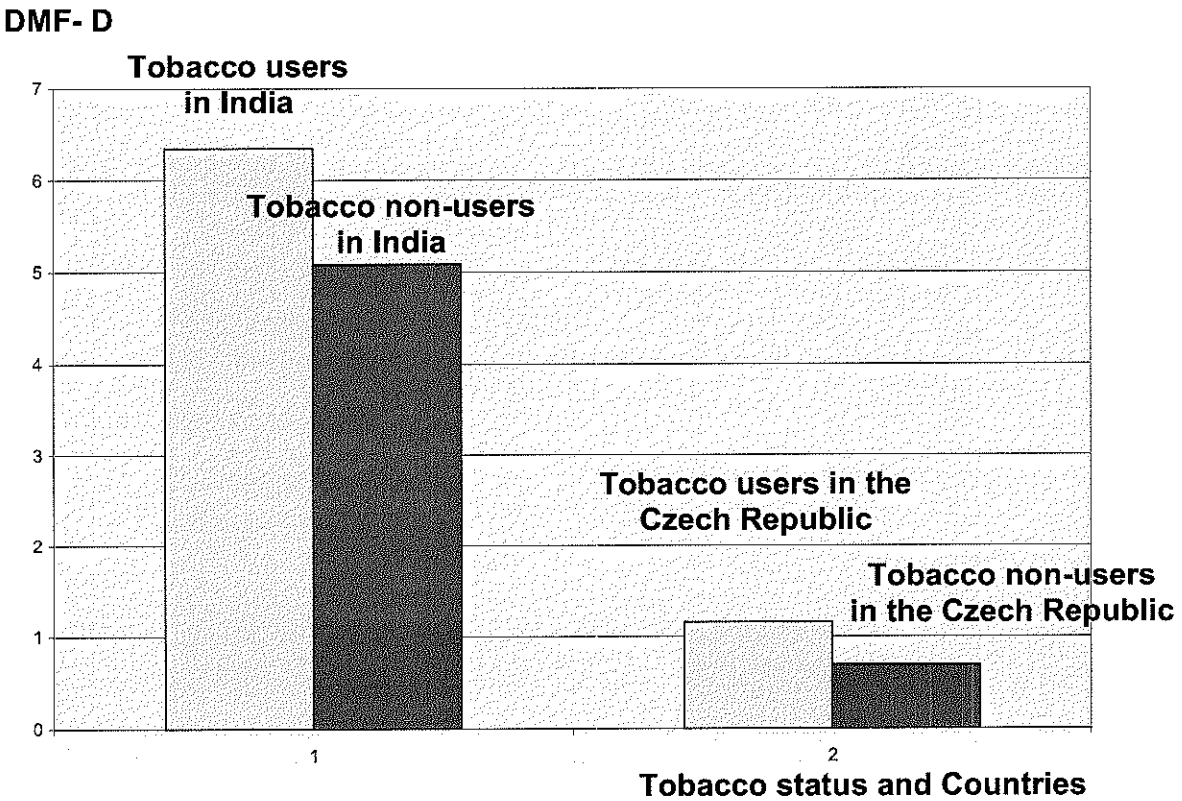


Figure 6 shows higher level of missing teeth in Indian tobacco users (tobacco chewers, regular smokers, occasional smokers, ex-smokers; 1.8) and in Czech tobacco users (regular smokers, occasional smokers, ex-smokers; 5.4) when compared to tobacco non-users of both respective countries (India, 1.5; Czech, 4.4).

Figure 6. Difference in DMF-M in tobacco users and tobacco non-users in India and the Czech Republic

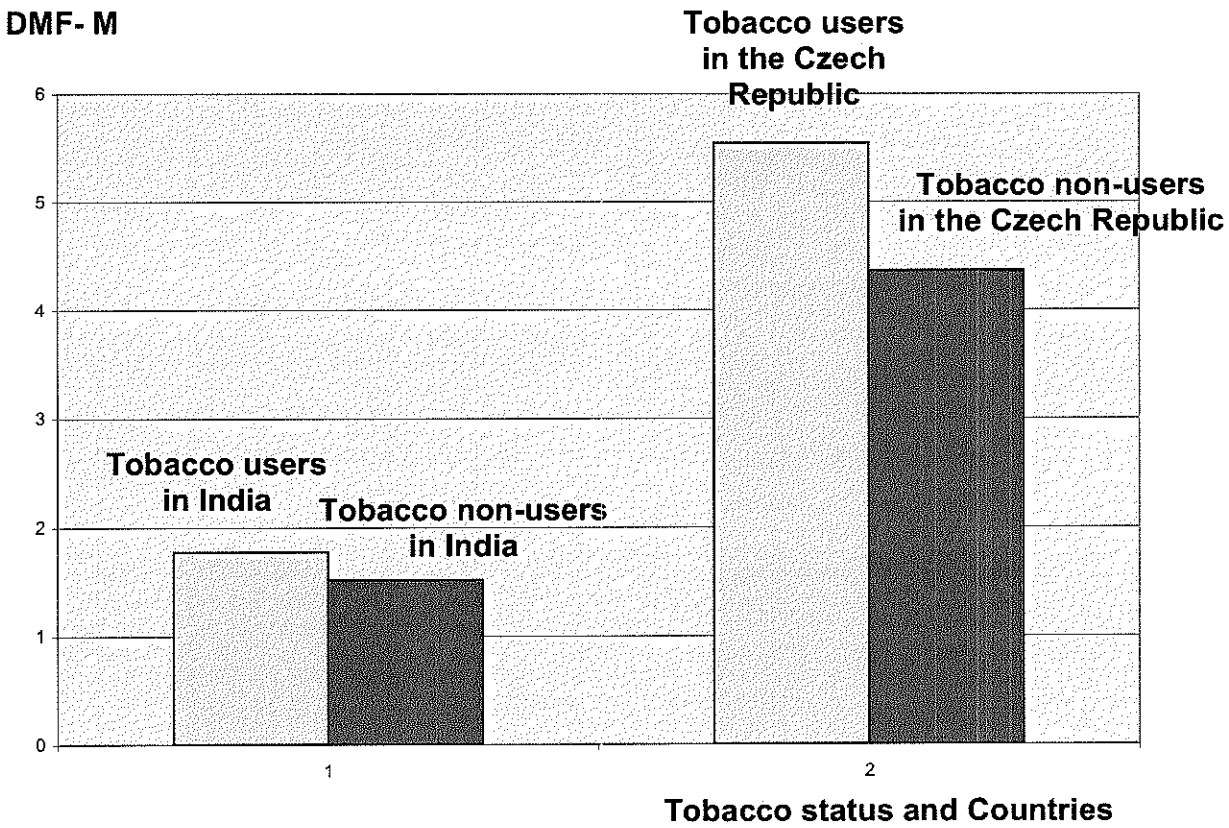
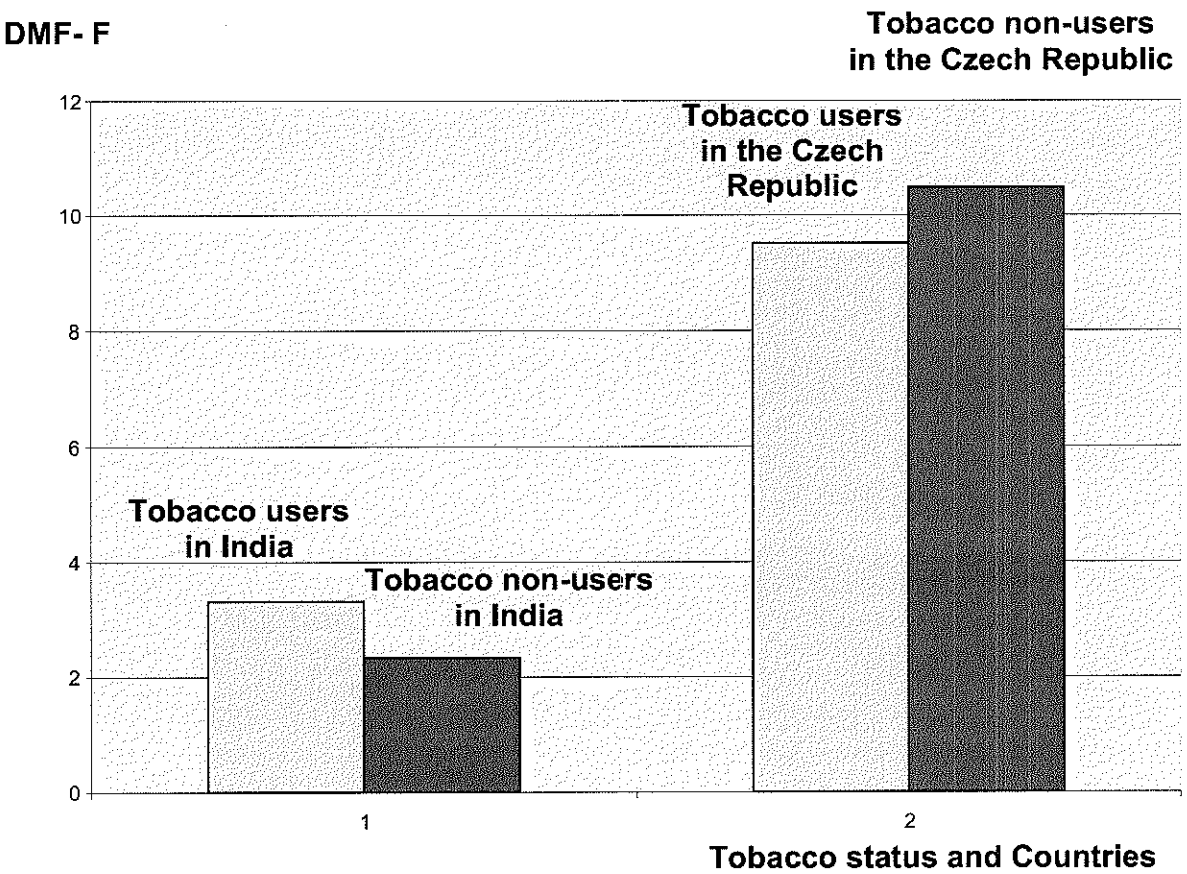


Figure 7 shows higher level of filled teeth in Indian tobacco users (tobacco chewers, regular smokers, occasional smokers, ex-smokers; 3.3) and in Czech tobacco non-users (smokers, occasional smokers, ex-smokers; 10.5) when compared to Indian tobacco non-users (2.3) and Czech tobacco users (9.5).

Figure 7. Differences in DMF-F in Tobacco users and Tobacco non-users in India and the Czech Republic



9. DISCUSSION

9.1. General discussion

Our examined groups present a small fraction of the socio-demographic profile of Indian and Czech population. Generally, males are expected to smoke more than females. Smoking presents mainly as a male problem, especially in developing countries. Prevalence of male smoking in many Asian countries, such as China, Indonesia, Tahiland, Korea and in many countries of Middle East, is ten or more times greater than the female prevalence rate. This pattern contrasts with that one in Europe and in the United states (118). This gender difference in smoking behavior is clearly reflected in our examined Indian respondents, compared to the Czech

respondents. Indian respondents comprised almost 98% of regular male smokers and only about 2% female smokers. Documented data shows the similar trend within the whole Indian population where only very few women smoke compared to men (35% male and 3% female smokers). Nevertheless, both men and women use smokeless products approximately to the same extent (165,185).

One of the most important reasons for lesser female smoking in India is that traditional values do not favour smoking among both youth and women. Nevertheless, there is no such taboo against using smokeless tobacco. Thus, most women who use tobacco use it in smokeless forms. Our study results confirmed such experience. This trend was also observed in the study of metropolitan city of Mumbai (118), which showed strong prevalence of women who use chewing tobacco (56%). In many cultures, particularly in South-East Asia and increasingly in Sweden, the use of ST is more socially acceptable than smoking (119). The main reason of this reality is probably fact that ST is easily to practice with lower risk of detection. However, in the Czech Republic and in the most of European Union countries the use of ST is not legal and is uncommon (216). ST is not banned only in Scandinavian countries, particularly in Sweden, and its usage is very popular among tobacco users. ST ("snus") is used by the Swedish as an alternative nicotine source or as a harm reduction. It is probable, that due to this fact the cigarette use in Sweden has declined dramatically over the time (132,225). Nevertheless, overall tobacco use in Sweden has remained fairly stable (171). The Institute of Medicine (IOM) reported that smokeless tobacco marketed particularly in Sweden and North America is safer than cigarettes when compared with India (194). The reason is lower level of tobacco-specific nitrosamine in ST products that are marketed in Sweden and North America (194). For example, Swedish "snus" contains lower concentration of harmful chemicals than other tobacco products but higher level of nicotine (45).

In the Czech group of respondents, we found approximately 60% of male regular smokers and 40% of female regular smokers. It has been reported that in the Czech Republic there are just about 30 % of smokers in population (35 % of men and 27 % of women) (220). On the basis of the results of the presented study we can see significant difference between male and female regular smokers´ ratio, which is much higher in India (98% of men, 2% of women) than in the Czech Republic (60% of man, 40% of women). One of the reasons for high smoking prevalence in women in the Czech Republic, compared to India, is the social climate which is not against

smoking of Czech women, whereas in India, smoking is a social taboo for women. After the change of the regime in the Czech Republic (1989) a lot of people, especially the young ones, considered smoking a part of the western life style. Documented data suggested that smoking in Czech Republic is slightly decreasing among older men but significantly increasing among teens and youth, particularly women (about 50% of 15-18 years-old women smoke) (220).

People of lower socio-economic status or socially disadvantaged (less educated, poor economic situated and/or less social supported) increasingly use legal as well as illegal drugs; tobacco and alcohol are legal drugs that cause particular concern. For decades it has been known that using tobacco is more prevalent in lower socio-economic level of society. Several reports around the world proved these facts (78,161). Our study result showed similar trend in both examined groups of respondents. Taking into consideration the level of education of the examined groups, the results confirmed that regular smokers in the Czech group and tobacco chewers in the Indian group mostly had lower level of education. These results are consistent with the results of other studies carried out in India (79) and in some developed countries in Europe, like Finland (108) and Germany (78). Similarly, another study from Canada showed that a higher percentage of current smokers have lesser education than high school (131).

Tobacco consumption is often found to be disproportionately higher among lower socio-economic groups (64). For example, a recent study from Australia noted that people living in low socio-economic status areas prone more to smoking (139). However, barring a few local studies from India (72), only a little systemic investigation has been done within problems of how tobacco products are socio-economically and geographically distributed in India. Our study revealed that higher percentages of people with higher education level were tobacco non-users in both examined groups of respondents. We also found that highly educated people mostly abstain from using chewing tobacco in India. In the Indian group, tobacco chewers had the lowest education and lower income than tobacco non-users. This may be probably caused by the fact that chewing tobacco is cheaper compared to cigarettes.

"Guthkas" and "Pan masala" are very popular types of chewing tobacco available in all Indian markets. The products are sold in colorful small sachets for as low price as half a Rupee (approx. 0.01 US$ or 0.009 €) and they are commonly used by the people of lower socio-economic class (185). In the Indian National Family Health Survey (1998-1999) a strong gradient between level of education and chewing was observed; the rate of chewing tobacco

users was 1.84 times higher than that of people with University education (199). Another Indian study confirms the fact that chewing tobacco is more commonly used by the people with lower level of education. They found a strong gradient in tobacco use according to education level among both men and women. The highest rate of smokeless tobacco use was among the illiterate and the lowest rate among those who had college education (197). It has been proved that increased level of education contributes to better understanding of the health risk

Taking incomes of respondents into consideration, regular smokers in the Indian group had lower income when compared with the other groups. This fact is in agreement with the results of other studies of this aim conducted in India. These studies also disclosed that tobacco chewing and cigarette smoking was higher among individuals with lower level of education (79). In the Czech Republic, there is a generally high tolerance to smoking when compared with other developed countries in European Union (108). Probably this is one of the main reasons why we found the highest prevalence of current smokers (regular and even more occasional smokers) among the highest income group in the Czech group of respondents.

Why poor or less educated people consume more tobacco products remains an open empirical question for further investigation. In our study, level of education of Czech and Indian people emerges as a relatively stronger predictor than income. It is likely that less educated people are less aware of the health hazards of tobacco consumption and more likely to find themselves in conditions predisposing them to smoking and tobacco chewing. They are more likely to have high degree of fatalism or high overall risk taking behaviours.

We found out that the majority of Indian respondents visited their dentists only when they had acute dental problems like pain or discomfort. In a recent study from Turkey, almost all subjects who participated in the study also stated that they visited the dentist only when they had difficulties (214). Various studies have shown that socio-economic and cultural factors can influence health by exposition to various physical and social environments (3,160). Lack of awareness about dental health risk may reflect a general attitude towards preventive care, differences in willingness or ability to pay for dental service, high cost of dental treatment, differences in the availability of dental care and also non-inclusion of yearly regular dental check-ups that are required by Medical Health Insurance in India. All these factors may be included in the group of reasons why Indian people visit dentists only when they have some problems. The fact that the majority of Czech respondents visited the dentists twice a year for

dental check-ups can be explained by the truth that the preventive dental check-ups in the Czech Republic are covered by Health Insurance. Our study results showed that tobacco non-users engaged themselves in dental prevention the best; they attended preventive check-ups most frequently. This fact is in agreement with the results of other studies where smokers are generally less willing to attend the regular preventive check-ups when compared with non-smokers (131,208).

When we analyzed the brushing habits in the studied groups we found that in the Indian one, most of participants brushed their teeth once a day, whereas Czech participants brushed their teeth twice a day. In both populations we could see that the tobacco non-users (or tobacco non-users) had better brushing habits when compared to tobacco users. This is also in agreement with the results of other studies where non-smokers or tobacco non-users tended to brush their teeth more than smokers or tobacco users (4,13,103,115). The majority of respondents from both countries used tooth paste and tooth brush as the primary oral hygiene aids. Other oral hygiene aids like floss and inter-dental brush were used more by Czech respondents (55%) when compared to Indian respondents (5.3%). The floss was used more by ex-smokers and tobacco non-users compared to tobacco users in both populations. Tobacco users from both countries used less dental aids like floss and mouth wash when compared to tobacco non-users and ex-smokers. Low frequency of tooth brushing and using of dental aids indicated low level oral hygiene. Tobacco users have a careless attitude or less sophisticated outlook towards their general health care, particularly towards oral health. This may result in periodontal problems and high risk of caries in tobacco users.

Understanding the differences in dietary patterns is important for nutritionists and health educators engaged in help individuals to make healthy dietary and life style choices. Analyses of dietary habits in both studied groups reaffirmed the earlier results that smokers showed greater affinity towards sugar containing products, especially sweet drinks (84) and alcohol (55). Smokers tend to feel dry mouth more frequently than non-smokers (91,175). Thus, frequent intake of soft drinks in smokers can be explained due to feeling of dry mouth. Although the notion of association between unhealthy dietary intake and smoking seems to exist across the populations in several western countries, there is a paucity of information from non-western population (50), especially from India. In the Czech Republic only a few studies has been done in this regard. In our study we found out that Czech smokers eat less vegetables and fruits than

non-smokers. This result is in agreement with several other studies, especially from western countries, where smokers consumed fewer fruits and vegetables than non-smokers (111,133,153). This trend was, however, quite different in Indian group where consumption of fruits and vegetables were higher in tobacco users. There are quite a few reasons for higher consumption of vegetables and fruits in tobacco users in India. For example, meat and fish are more expensive than vegetables and fruits. Tobacco users from Indian group belonged mostly to low social-economic categories. Thus, we can assume that higher consumption of fruits and vegetables could be associated with lower earnings of tobacco users. Some religious traditions, especially among Hindus don't allow eating meat. Even though we didn't ask our respondents about their religion, we can expect high number of Hindus believers in Indian group. On the other hand, food habits of Czech people generally seem to comprise at least some form of meat in the breakfast, lunch, dinner and even in most of the snacks.

Other findings about dietary habits of the Indian and the Czech group are consistent with those obtained in western populations, including the United States, Canada, Europe and Australia. These findings showed that those who have never smoked have healthier dietary and life style patterns compared with smokers (31,50,83,124,125,127,134,144,210). Besides tobacco usage, smokers and tobacco users exhibit likewise other undesirable behaviors with regard to their health (210). Similar results we found in our study as well. Less healthy dietary habits of smokers or tobacco users place them at higher risk for chronic diseases as a result of both dietary and smoking habits. Diet may act as a confounder in smoking-disease relationships.

In the Indian group we found out that tobacco chewers (followed by regular smokers) had the highest rate of recurrence of oral lesions, compared to tobacco non-users. Similar results were also found in the earlier studies in South Indian population (176). Recent study, carried out in India as well, also stated that tobacco chewing is a significant risk factor for multiple oral pre-malignant lesions and may be the major source of oral epithelium cancer (211). Oral mucosal changes or lesions may be due to local irritation or chronic stimulation of the lenfoid tissues in oral mucous membrane, caused by the use of tobacco (217). The absence of any significant effect of smoking on oral mucosa in the Czech respondents may be due to the fact that they were not exposed to other tobacco forms. On the basis of these data, we can assume that tobacco smoking presents lesser risk factor for multiple oral pre-malignant lesions and oral epithelium

cancer, compared to tobacco chewing (closer and longer contact of substances with oral mucosa and teeth).

When we analyzed relations between tobacco status and untreated caries incidence in the Indian group, the highest number of untreated decayed teeth was in the group of tobacco chewers, followed by regular smokers. When we compared the 5 examined groups of Indian respondents, filled teeth also have been found very often in tobacco chewers. This notion of association between tobacco chewing and dental caries is in agreement with data from the multipurpose health survey (Third National Health and Nutrion Examination Survey) conducted in the USA from 1988 to 1994 by Tomar et al. (212). A suitable explanation for observed association between chewing tobacco use and dental caries may be the presence of high levels of fermentable sugar in chewing tobacco products, which can stimulate the growth of *cariogenic bacteria.* Locally prepared and commercially popular chewing tobacco products in India, like *Pan masala* and *Guthkas,* contains areca nut, tobacco, cardamom, lime and very often they are sweetened with unrefined sugar, sugar crystals, coconut or artificial sweeteners and flavors (73,138). The added flavor and sweeteners are used to promote tobacco use and neutralize its harsh taste (138,204). Chewing tobacco, typically used by placing a wad of tobacco between teeth and *buccal mucosa* (and gently chewed or sucked over a period of several hours) is used for a extended time of each day (216,212). This situation can create conducive environment for initiation of dental caries by release of sugars from chewing tobacco to the local environment or oral cavity. Sugars in chewing tobacco can promote caries by bathing the teeth in cariogenic sugars (224). This assumption is supported by in vitro evidence of stimulated growth of *Streptococcus mutants* and *Streptococcus sanguis* in the presence of smokeless tobacco extracts (110).

Local loss of keratinized *gingiva* at the side where chewing tobacco is held can present another possible contributing mechanism in the development of mostly root-surface caries in tobacco chewers. This mechanism induces teeth abrasion yielding in periodontal problems reflecting the degree of gingival recession and bone loss. The exposed root surface, damaged by the loss of cementum and some dentin is at increased risk to develop caries (216). In accordance with given facts, our results in the Indian group revealed that smokeless tobacco users had more caries than smokers. Very low level of sugars in smoking form of tobacco has been confirmed by other studies (216). Generally, non-smoking form of tobacco is mostly related to promotion

of dental caries (216). As we mentioned before, chewing tobacco or use of other types of ST is banned in the Czech Republic. The only form of tobacco which is used in the Czech Republic is the smoking form.

When we compared the number of untreated decayed teeth with smoking status of respondents in the four Czech examined groups, the highest number of untreated decayed teeth was found in the group of occasional smokers, followed by the group of regular smokers. Current smokers (regular and occasional) had more untreated caries than non-smokers (tobacco non-users). In the Indian group, we found that regular smokers had significantly more untreated dental caries than tobacco non-users. Our data gained from both these groups suggested the association between smoking and dental caries. This result is in a good agreement with the results of other studies, where smoking was followed by higher incidence of dental caries (84,102). Decreased buffering effect, possible lower pH of smoker's saliva and higher number of *Lactobacilli* and *Streptococcus mutans* groups may indicate an increased susceptibility to caries in smokers (216). On the other hand, pro-cariogenic factors like poor brushing habits, less frequent use of dental aids and high sugar consumption among tobacco users in both groups also certainly contribute to increasing of dental caries incidence among smokers.

According to the analysis of status of missing tooth among the four Czech groups (regular smokers, occasional smokers, ex-smokers and non-smokers), ex-smokers and regular smokers showed the highest level of missing tooth. On the other hand, in Indian groups, no significant relationship was observed among tobacco use and teeth loss. Nevertheless, Indian chewing tobacco users and regular smokers have more missing tooth than tobacco non-users. An association between smoking and tooth loss has been described heretofore in subjects residing in Sweden (17, 18,148), Australia (201), Jordan (80), Brazil (200) and Kuwait (16).

Unfortunately, only a limited number of studies concerning tobacco use, caries incidence and missing tooth has been done in India and the Czech Republic. As resulted from our study, tobacco users proved poor oral hygiene and bad oral health habits in both groups. One previous study reported that combination of smoking and poor oral hygiene had synergic effect on teeth loss (86). It is probable that smoking causes teeth loss through the combined effect of periodontitis and dental caries, or through joint effect of dental disease and bad health behavioral factors (232). Tobacco use is associated with poor general health behaviors, and it might also reflect a negative attitude towards the preservation of natural teeth. Neglect of caries treatment

brings loss of teeth; this could explain why tobacco users have more missing tooth. Typical situations where tooth extraction is taken into consideration as a form of treatment are larger fractures, profound caries lesion with destruction of a larger part of a crown, an acute pain, and abscess caused by pulpal or periodontal involvement. These situations might be more frequent among tobacco users because of their unhealthy dental behaviors. A neglecting attitude towards the preservation of natural teeth might lead to situations where smokers or tobacco users in general prefer tooth extraction instead of more conservative treatment.

In India, there are no state supported preventive dental visits, which are obliged to all nationals of the Czech Republic. An average age of first dental visit of an Indian could be at adolescent period. Ongoing dental caries lesions are brought into the notice of patients and they are encouraged to restorative dental treatments by the dentists. By that age, there could be more dental caries lesions which require restorative treatments. This fact could explain increased number of filled teeth among tobacco users (regular smokers, ex-smokers, tobacco chewers) in Indian respondents compared with tobacco non-users. In addition, fact could be also attributed to high smokeless tobacco consumption (mainly to chewing). However, quite different situation was found in the Czech groups where tobacco non-users or non smokers had more filled teeth than smokers. In general, current smokers (regular smokers, occasional smokers) in the Czech group had less filled teeth than tobacco non-users.

According to the analysis of the differences between tobacco use and DMF-T in both groups, tobacco users in Indian group (regular smokers, ex-smokers, tobacco chewers and occasional smokers) as well as tobacco users in Czech group (regular smokers, ex-smokers and occasional smokers) had more untreated decayed teeth and missing teeth than tobacco non-users. As it was discussed before, in the case of filled teeth, tobacco users in the Indian group had more filled teeth, while in the Czech group we found more filled teeth in the groups of tobacco non-users or non smokers. One of possible reasons for explanation of higher filling rate in the group of Czech non smokers may be due to the fact that they visit dentists more often than smokers.

Analyzing the influence of sex on DMF-T of our two studied populations, sex has no significant influence on decayed, missing or filled teeth of the Indian group. In the Czech group, sex affected the number of filled teeth (but no influence in decayed and missed teeth was found). Czech women had significantly more filled teeth than men. This is in a good agreement with the study done among an Australian population, which found that women dispose of more filled

teeth than men (33). As well, another studies suggested that women are more likely to receive dental care in insured populations than men (203). In the Czech Republic, the oral health care is state supported and it seems that women visit dentists more frequently than men. This fact could be a substantial reason why women had significantly more filled teeth than men. In the examined Czech group, there were more male smokers than female smokers. As it was discussed hereinbefore, smokers generally proved neglecting attitude towards oral health.

In the Indian group, decayed, missing and filled teeth were observed significantly more often in the group of higher age. The study done by Naseem Shah et al. in India stated that elderly population had significantly more dental caries (202). On the contrary, in the Czech group, only the number of missing teeth was found statistically higher in older age. This result is in agreement with the recent Swiss study that reported an increased number of missing teeth in older age (237). There are quite a few reasons for higher number of caries and missing teeth in elderly people. The teeth of elderly people are exposed to deleterious oral environment for a long time. Psychological problems, mainly depressions due to the loss of spouse, or neglect by the family members, economic dependence, debilitating condition and systemic diseases in some elderly people make simple oral hygiene habits difficult to perform; they neglect their oral hygiene habits. Hence, it can lead to plaque accumulation, periodontitis, and teeth loss and these factors increase the risk for caries. Studies with this regard say that most of elderly people do not regularly practice the dental assessments or care (35).

It is apparent that education had a significant effect on the state of teeth in both Indian and Czech groups. It was rather surprising to find more decayed teeth in the Indian groups with higher education. Different situation was found in the Czech groups, where higher number of decayed teeth was mostly observed in individuals with lower education. These findings related to the results of McGuire et al., who found out that elderly subjects with lower education level were at a higher risk for decayed teeth than well-educated individuals (128). In both our examined groups, the missing teeth were related to those who had lower level of education. Lower level of education was considerably often associated with loss of teeth as well in other studies (65,126) but filled teeth were observed more often among higher educated group in both groups.

We analyzed an effect of preventive medical check-ups on the state of teeth in our respondents. In the Czech group we found, in agreement with other studies (34), significantly

more decayed teeth in individuals who have never participated in preventive medical check-ups. Different results we received in Indian groups where decayed teeth were observed more in people who visited dental clinic more often. Heretofore, we have no reasonable explanation for this phenomenon.

The results from the Indian group revealed that missing teeth were observed more often in people who visited the dentist only when they had problems. Even though the Czech results were not statistically significant, they revealed that missing teeth were observed more in individuals who have visited dentist never before or less frequently, and very few missing teeth in people who visited dentist more frequently (twice a year).

In both groups, the highest number of filled teeth was observed in people who visited dentists most frequently. Earlier studies presented that the frequency of dental visits proved positive correlation with the number of filled teeth (34, 44). It resulted from our study that mostly the Indian respondents visited dentist only when they had some acute problems. On the other hand, almost 66% of the Czech respondents visited dentist in purpose of preventive medical check-ups 2 times a year. This fact could be one of reasons why preventive visits proved positive effect on teeth in the Czech group when compared to the Indian one.

The results from both groups of participants indicated that those individuals who daily brushed their teeth several times had lower number of decayed, missing and filled teeth. This is in agreement with the results of other reports in this regard (142, 34). Significant association between brushing frequency and state of teeth, however, has been found only in the Czech group. No significant association has been observed between brushing frequency and number of filled teeth in the Indian group. Our results revealed that the Czech participants had better brushing habits than the Indian participants. About 75% of the Czech respondents brushed their teeth twice a day but in the Indian group, only 15% of respondents brushed their teeth twice a day; most of them brushed their teeth only once a day.

9.2. Limitations of the study

Certain limitations should be taken into consideration during the interpretation of the results presented in this work. At first, the validity of self-reported smoking is often discussed because of the widespread belief that smokers prone to underestimating of the amount of smoked products or to deny smoking altogether. At second, although general information about tobacco

statues was obtained, other information about tobacco usage, including age of tobacco initiation and duration of tobacco usage, was not taken. At third, we were not able to generalize our findings to Indian and Czech population. Our examined groups were convenient samples and were not randomized. At fourth, an exact comparison of our data with recent studies ware not always possible to carry out because of the differences in methodologies.

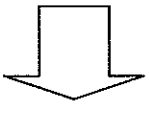
9.3. Tobacco use cessation intervention in dental practice

Number of tobacco using patients visiting dentist for regular dental treatment is quite high. A dental office with suitably motivated dental staff could become a good place for initializing the tobacco cessation intervention. In 1996, he World Dental Federation (FDI) recognized the role of dentists as professional interventionists who can initiate dental health prevention and tobacco use cessation program (167). Recognition of the patients according to their psychological phase of cessation can be divided as pre-contemplation, contemplation, preparation, action, and maintenance (191). Action plan of intervention has to be planned individually, according to the above mentioned patient phases. Dentists and dental hygienists can motivate patients who are adversely thinking about quitting tobacco use. For motivated patients they can create a plan how to desist from the habit with a time frame. Continuous encouragement of such patients can be psychologically rewarding to the patients and dentists would have the opportunity to asses the stages of quitting the habits of the patients.

The five major steps recommended for tobacco cessation activity in dental office are given below. They are generally known as "5 A" (ask – advice – assess – assist – arrange) (191,213). These steps, if followed, can help in effective in cessation of tobacco habit.

Summary of the five major steps recommended for tobacco cessation activity in dental office

ASK Identify tobacco users	Develop one to one relationship Tobacco use assessment questionnaire Recording of the relevant facts Identifying the cessation intervention
ADVICE Urging the tobacco users to quit	Explain the health hazards of tobacco use Personalized strong oral communication Benefits of cessation of tobacco usage Record psychological readiness to cessation of the habit
ASSESS Assessment of willingness of quit attempt (within 30 days)	Assist the patient in attempt to quit Motivate an unwilling patient Provide additional information about adverse effects of tobacco Record the patients decision
ASSIST Help the patient to quit	Creating a time bound plan to quit Specific problem related counseling Providing medical assistance (nicotine withdrawal therapy) Stimulating recall
ARRANGE Designing follow-up Program	Recording and rewarding of the progress Provide unceasing support to continuance of quitting Assessment of medical intervention Referring the patients to more intensive treatment



EFFECTIVE TREATMENT OUTCOME

10. CONCLUSIONS

Within the limitations of this study, the following conclusions were drawn:

Influence of variable factors on decayed, missing and filled teeth in the Indian respondents

The age, level of education, regular dental check-ups, brushing frequency and the form of tobacco use proved significant influence on the number of decayed teeth. Older respondents and respondents with higher level of education, higher frequency of regular dental check-ups, lower brushing frequency, regular smokers and tobacco chewers had higher number of decayed teeth when compared with younger respondents and respondents with lower level of education, lower frequency of regular dental check-ups, higher brushing frequency, occasional smokers, tobacco non-users and ex-smokers.

The age, level of education, regular dental check-ups, brushing frequency and the form of tobacco use proved significant influence on the number of missing teeth. Older respondents and respondents with lower level of education, lower frequency of regular dental check-ups, lower brushing frequency, regular smokers, tobacco chewers and ex-smokers had higher number of missing teeth when compared with younger respondents and respondents with higher education, higher frequency of regular dental check-ups, higher brushing frequency, occasional smokers and tobacco non-users.

The age, level of education, regular dental check-ups and the form of tobacco use proved significant influence on the number of filled teeth. Older respondents and respondents with higher level of education, higher frequency of regular dental check-ups, regular smokers, tobacco chewers and ex-smokers had higher number of filled teeth when compared with younger respondents and respondents with lower level of education, lower frequency of regular dental check-ups, occasional smokers and tobacco non-users.

Selected factors (variables) which can play the role of "confounding factors" influenced dental health of respondents quite differently. Statistical analysis disclosed that older respondents had higher number of decayed, missing and filled teeth. Respondents with higher level of education proved higher number of decayed and filled teeth but lower frequency of missing teeth. Regular participation on preventive dental check ups influenced the number of decayed teeth and filled teeth (higher number). Higher brushing frequency decreased the number of decayed, missing and filled teeth. The respondents with low frequency of brushing proved

worse results of DMF-T index and higher treatment need. Smoking influenced negatively all components of DMF-T index. Smokers and tobacco chewers had higher average number of decayed, missing and filled teeth. In addition, higher number of missing and filled teeth was found even in ex-smokers.

Influence of variable factors on decayed, missing and filled teeth in the Czech respondents

The level of education and attending regular dental check ups proved to have the highest influence on the number of decayed teeth. The participants with higher education and participants who visited dentists regularly had lower number of decayed teeth, when compared to lower educated respondents and to respondents who ignored regular dental check ups.

The age, level of education and smoking proved to have the highest influence on the number of missing teeth. Elderly respondents, respondents with lower education and regular smokers (resp. ex-smokers) had higher average number of missing teeth when compared with younger respondents, respondents with higher education and occasional smokers (resp. non-smokers).

Sex in connection to attending regular dental check ups proved the highest influence on the number of filled teeth. Woman had higher number of filled teeth, probably also due to their more frequent attending regular dental check ups.

Selected factors (variables) which can play the role of "confounding factors" influenced quite differently dental health of the respondents. Statistical analysis disclosed high influence of age to the number of missing teeth (the number increased according to the age) while sex influenced mostly the number of filled teeth (woman had higher number of filled teeth when compared with man). The level of education influenced particularly the number of missing teeth and decayed teeth (the respondents with lower level of education had more missing and decayed teeth when compared with participants with higher level of education). Regular attending preventive dental check ups influenced the number of decayed teeth (lower number) and the number of filled teeth (higher number). Brushing frequency influenced the number of decayed teeth, the number of missing teeth and the number of filled teeth. The participants with low frequency of brushing proved worse results of DMF-T index and higher treatment need. Smoking influenced negatively all components of DMF-T index. Smokers had higher average number of decayed and missing teeth and lower number of filled teeth.

Better oral health status of tobacco non-users

Tobacco use was associated with higher prevalence of dental caries within the both examined groups.

The Indian tobacco users - chewers and smokers (regular smokers and ex-smokers) had more decayed teeth than tobacco non-users. The Czech smokers (regular smokers and ex-smokers) had more decayed teeth than non-smokers.

The Czech smokers (regular smokers, ex-smokers) had more missing teeth than Czech non-smokers. In Indian group no significant association between tobacco use and the number of missing teeth was found.

Higher number of filled teeth was found in Indian tobacco users. Major responsibility for this fact could be attributed to high smokeless tobacco consumption (mainly to chewing). In the Czech group, higher prevalence of filled teeth was found in tobacco non-users. This fact could be explained by fractional consumption of smokeless tobacco by tobacco users and by high interest of non-smokers to preventive dental check-ups.

The Indian regular smokers and tobacco chewers demonstrated a higher percentage of oral mucosal changes or lesions. Smoking in the case of the Czech respondents had no significant influence on oral mucosa.

Higher education of tobacco non-users

In both examined groups of respondents, the tobacco non-users had higher education compared to tobacco users.

Different effect of income

The Indian regular tobacco users (chewers) had lower income when compared to other Indian groups. The Czech group with the highest income showed high prevalence of current smokers (regular and occasional).

Better dietary habits of tobacco non-users

Tobacco use was associated with alcohol consumption in both examined groups of respondents.

Smokers from both populations reported frequent intake of sugar rich soft drinks.

The Czech regular smokers consumed fewer vegetables and fruits than tobacco non-users (non-smokers).The Indian tobacco users consumed more vegetables and fruits than tobacco non-users. These facts could be explained on the basis of prices of meat, vegetables and fruits in India and in the Czech Republic and on the basis of different level of income of tobacco users and tobacco non-users in each country.

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APPENDIXES

APPENDIX -I

Czech questionnaire

Dotazník pro účastníky studie zabývající se vlivem kouření na orální zdraví

Respondent číslo

(Zaškrtněte laskavě políčko □ u vybrané odpovědi či doplňte údaj na vytečkovaný řádek.)

1. Osobní údaje

1.1. Pohlaví: □ Muž □ Žena

1.2. Věk: .....

1.3. Ukončené školní vzdělání: 1.3.1. □ základní/vyučen

1.3.2. □ vyučen s maturitou

1.3.3. □ středoškolské s maturitou

1.3.4. □ vysokoškolské

1.4. Čistý měsíční příjem na člena Vaší rodiny činí přibližně:

1.4.1. □ do 5 tisíc Kč 1.4.2. □ 5 – 10 tisíc Kč 1.4.3. □ nad 10 tisíc Kč

1.4.4. □ nevím 1.4.5. □ odmítám odpovědět

1.5. Zaměstnání/profese (např. učitel, dělník, úředník): .....

2. Zdravotní stav

2.1. Trpíte nějakou chronickou chorobou? 2.1.1. □ ano 2.1.2. □ ne

2.2. Jestliže ano, kterých orgánů se potíže týkají?

2.2.1. □ srdce a cév 2.2.2. □ ledvin a močového ústrojí

2.2.3. □ dýchacího ústrojí 2.2.4. □ psychiky

2.2.5. □ pohybového ústrojí 2.2.6. □ cukrovka

2.2.7. □ trávicího ústrojí 2.2.8. □ jiných orgánů, kterých .....

2.2.9. □ prodělal(a) jsem nádorové onemocnění léčené cytostatiky či ozařováním

2.2.10. □ odmítám odpovědět

2.3. Užíváte dlouhodobě nějaké léky? 2.3.1. □ ano, jaké .....

2.3.2. □ ne

3. Jak často chodíte na preventivní prohlídky k zubnímu lékaři?

3.1. □ 2x ročně 3.2. □ 1x za rok 3.3. □ 1x za 2 roky

3.4. □ méně často 3.5. □ nechodím na preventivní prohlídky

4. Hygiena dutiny ústní

4.1. Zuby si čistím: 4.1.1. ☐ dutiny 3x denně a častěji 4.1.2. ☐ 2x denně

4.1.3. ☐ 1x denně 4.1.4. ☐ méně často

4.2. Uveďte, jaké pomůcky ústní hygieny pravidelně používáte:

4.2.1. ☐ zubní kartáček 4.2.2. ☐ mezizubní kartáček

4.2.3. ☐ dentální nit 4.2.4. ☐ ústní vody

4.2.5. ☐ jiné, jaké .....

4.3. Zaškrtněte, která z následujících vět je ve Vašem případě pravdivá:

4.3.1. ☐ Po vyčištění zubů večer již nikdy nic nejím (ani jablko) ani nepiji sladké nápoje či pivo nebo mléko.

4.3.2. ☐ Po vyčištění zubů večer již většinou nic nejím.

4.3.3. ☐ Po vyčištění zubů večer jím pouze ovoce.

4.3.4. ☐ Po vyčištění zubů večer ještě konzumuji nějaké jídlo nebo piji sladké nápoje.

4.4. Napište, jak často konzumujete následující potraviny či nápoje:

	Pravidelně denně	Několikrát týdně	Několikrát do měsíce	Méně často	Nikdy
Cukrovinky (dorty, čokoláda, sušenky, bonbóny)					
Slazené nápoje (limonáda, kola, džus)					
Tučné výrobky					
Ovoce a zelenina					
Pivo a víno					
Destiláty					

5. Kuřácká anamnéza

5.1. ☐ Pravidelný kuřák *(Kouří pravidelně minimálně 1 cigaretu denně.)*

Kouřím … let … cigaret denně.

5.2. ☐ Příležitostný kuřák *(Kouří méně než 1 cigaretu denně.)*

Kouřím … let … cigaret za týden.

5.3. ☐ Bývalý kuřák

Kouřil(a) jsem … let … cigaret denně (… cigaret týdně) minimálně 6 měsíců po sobě jdoucích a nyní již 6 měsíců nekouřím

V případě, že jste kouřil(a) kratší dobu než 6 měsíců a nyní již nekouříte, zaškrtněte bod 5.4.

5.4. ☐ Nekuřák

Nikdy jsem nekouřil(a) déle než 6 měsíců.

Výsledek preventivní prohlídky (vyplní lékař)

Respondent číslo: .....

Nález na ústní sliznici: ☐ normální

☐ abnormální (jaký .....)

Zánětlivé změny na dásních: ☐ ano ☐ ne

Stav dentice (DMF-T Index)

Počet zkažených zubů (D) .....

Počet chybějících zubů (M) .....

Počet zubů s výplní (F) .....

APPENDIX II

Indian questionnaire

Questionnaire for respondents participating in the study about influence of smoking on oral health

Respondent no:……..

(Kindly fill in the box □ with appropriate answer.)

1. Personal data

1.1. Sex: □ Male □ Female

1.2. Age: ……..

1.3. Educational qualification: 1.3.1. □ No education

1.3.2. □ Basic-Till 5th std.

1.3.3. □ High school-Till 10th std.

1.3.4. □ Graduation

1.4. Income (per month in Indian Rupees):

1.4.1. □ 500-1500 1.4.2. □ 1500-3500 1.4.3. □ 3500-6500

1.4.4. □ 6500-10,000 1.4.5. □ above 10,000

1.4.6. □ Not willing to disclose

1.5. Profession (example: teacher, doctor, house-wife, laborer…): ……

2. Health status

2.1. Are you suffering from any chronic diseases? 2.1.1. □ Yes 2.1.2. □ No

2.2. If yes, which?

2.2.1. □ Hypertension 2.2.2. □ Diabetes

2.2.3. □ Astma 2.2.4. □ Chronic lung diseases (T.B., Pneumonia)

2.2.5. □ Urinary tract infection 2.2.6. □ Neurological diseases

2.2.7. □ Gastro-intestinal diseases 2.2.8. □ Hepatic diseases

2.2.9. □ Bone and joint diseases 2.2.10. □ Malignant diseases

2.2.11. □ Any other diseases……

2.3. Are you on any long term medication? 2.3.1. □ Yes 2.3.2. □ No

2.3.3. □ If Yes, which drug?……

2.3.4. □ Yes, but I don't know the name of the drug

3. How often do you visit a dentist?

3.1. □ 2 times/year 3.2. □ once/year 3.3. □ visit only when I have problem

3.4. □ never before

4. Brushing habits

4.1. Frequency of brushing teeth:

4.1.1. □ once daily 4.1.2. □ twice daily 4.1.3. □ 3 times a day

4.1.4. □ never

4.1.5. □ Do you take any food/drinks after brushing in the night? □ Yes □ No

4.2. Dental aids used for oral hygiene:

4.2.1. □ tooth brush and tooth paste 4.2.2. □ tooth brush alone

4.2.3. □ tooth brush and tooth powder 4.2.4. □ dental floss

4.2.5. □ mouth wash 4.2.6. □ motorized tooth brush

4.2.7. □ tooth pick

4.2.8. □ Any other aids (example: neem stick, charkcoal...) .....

4.4. Details of food and drinking habits:

	Regularly/ daily	Several times/week	Several times/month	Less frequently	Never
Sweets (cakes, chocolates, biscuits, ice cream etc)					
Sweet drinks (coke, fruit juices etc)					
Fruits and vegetables					
Alcoholic drinks					

5. Form of tobacco consumption:

5.1. □ tobacco with betel nut and leaves 5.2. □ tobacco alone

5.3. □ bidi/chutta etc 5.4. □ cigarettes without filters

5.5. □ cigarettes with filters 5.6. □ pipes/other forms

6. Smoking history

6.1. □ **Regular smokers** *(Smokes minimally one cigarette per day.)*

I smoke……years……cigarettes per day.

6.2. □ **Occasional smoker** *(Smokes less than one cigarette per day.)*

I smoke……years……cigarettes per week.

6.3. □ **Ex-smoker**

I smoked…..years…..cigarettes per day (…..cigarettes per week)

6.4. □ **Never smoked**

Clinical data (to be filled by dentist)

Respondent no: ……..

Oral mucosal findings: □ normal

□ abnormal (findings ……..)

Gingivitis: □ Yes □ No

Dental status (DMF-T Index)

Number of decayed teeth (D) .....

Number of missing teeth (M) .....

Number of filled teeth (F) .....

ABBREVIATIONS

ANUG - Acute Necrotizing Ulcerative Gingivitis

BSS - Basic Salts Solution

COPD - Chronic Obstructive Pulmonary Disease

DMF-T - Decayed, Missing, and Filled Teeth

DNA - Deoxyribonucleic acid

ETS - Environmental Tobacco Smoke

EU - European Union

FDI - World Dental Federation

IARC - International Agency for Research on Cancer

IgG - Immunoglobulin G

IgA - Immunoglobulin A

IOM - Institute of Medicine

NNN - N-nitrosonornicotine

NNK - 4-methyl-N-nitrosamino-1-(3-pyridyl)-1-butanone

PH - Potential of hydrogen

ST - Smokeless Tobacco

TSNA - Tobacco-specific N-nitrosamines

WHO -World Health Organization

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