

Prevalence of Dental Caries among Smoking and Smokeless Tobacco Users Attending Dental Hospital in Eastern Region of Uttar Pradesh

Neelam Mittal, Nidhi Singh, P. G. Naveen Kumar¹

Departments of Conservative Dentistry and Endodontics and ¹Public Health Dentistry, Faculty of Dental Sciences, IMS, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Abstract

Introduction: The relationship of tobacco use to dental caries is still unclear. The aim of this study is to assess the relationship between smoking and smokeless tobacco usage and prevalence of dental caries and its pattern in the Varanasi population. **Materials and Methods:** In this study, 472 elderly dentate and consenting individuals were included. Individuals were examined with the aid of mouth mirror, No. 23 explorer, and cotton rolls. The age of the study group ranged from 16 years to 75 years. Individuals were categorized as smoking tobacco users, smokeless tobacco users, and the combination of these two. Frequency and dosage of tobacco usage was recorded. Dental caries was measured using decayed, missing, and filled teeth (DMFT) index. Oral hygiene practices such as mode, material, and frequency of brushing were also recorded. Data were assessed using SPSS 17.0 using Chi-square, *t*-test, ANOVA test, and binary regression. **Results:** Caries rate was similar in both males and females (2.57 and 2.70), and the difference was not statistically significant. Caries was higher in individuals with habits when compared to those who were not having habits. There was no statistically significant association between individuals who were smokers, using smokeless tobacco, frequency, mode, and material of brushing with caries pattern. Among smokers, DMFT increased with frequency and duration of smoking, and it was statistically significant; however, in smokeless tobacco users, this was not the case. There was a positive correlation with DMFT and frequency of smoking. **Conclusion:** The study has shown that tobacco habit is a risk factor for increased caries activity, and it is higher in smokers as compared to smokeless tobacco chewers.

Keywords: Decayed-missing-and-filled teeth index, dental caries, smokeless tobacco, smoking tobacco

INTRODUCTION

In many Asian countries including rural areas of India, tobacco in smoking and chewing has been practiced for a long time.^[1] Tobacco is the agricultural products of leaves of the plant of genus “*Nicotiana*,” species “*Nicotiana tabacum*.” Tobacco usage has imposed a huge and growing burden on the public, resulting in increased mortality and morbidity rate. Tobacco kills 5 million people annually. According to current trends, mortality rate is expected to reach 10 million by the year 2030, with 70% of deaths occurring in low- and middle-income countries. It is mainly used in smoking and smokeless form. Cigarettes, cigars, beedis, and pipe tobacco are the main types used in smoking tobacco.^[2] Cigarettes are the core of the mass production of tobacco products.^[3] Globally, smokers comprise 29% of the adult population (1.1 billion).^[4] Gutkha, khaini,

gul, pan masala, and plain tobacco are the main smokeless tobacco products.

Medical problems caused by smoking are very well known, major of them being lung cancer and cardiovascular disorders. Oral health is also negatively affected. Oral problems include staining of teeth and dental restorations, reduction of ability to smell and taste, development of diseases such as smoker’s palate and melanosis, coated tongue, precancerous lesions

Address for correspondence: Dr. Nidhi Singh,
Faculty of Dental Sciences, IMS, Banaras Hindu University,
Varanasi - 221 005, Uttar Pradesh, India.
E-mail: drnidhiconsendo@gmail.com

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Mittal N, Singh N, Naveen Kumar PG. Prevalence of dental caries among smoking and smokeless tobacco users attending dental hospital in Eastern region of Uttar Pradesh. Indian J Community Med 2020;45:209-14.

Received: 12-06-19, **Accepted:** 09-03-20, **Published:** 02-06-20.

Access this article online

Quick Response Code:



Website:
www.ijcm.org.in

DOI:
10.4103/ijcm.IJCM_245_19

and cancer, oral candidiasis, periodontitis, implant failure, and dental caries.^[5] Recent studies demonstrated an increased prevalence of caries in smokers,^[6] in contrast to early literature which thought that smoking helps in reducing caries.^[7-9] Since caries is a multifactorial disease of lifestyle, socioeconomic, and sociodemographic gradients, tobacco usage acts as a confounding variable rather than a direct etiological factor.^[10,11]

In India, tobacco use is characterized by the use of both smoking and smokeless tobacco. The prevalence of smokeless tobacco is highest in India. Its usage is among both males and females. According to the survey conducted by the Union Ministry of Health and Family welfare, in Uttar Pradesh, there is a 7% prevalence rise in tobacco usage among males. In Uttar Pradesh, 56% of males consume tobacco according to the latest Global Adult Tobacco Survey.^[12] The corresponding survey for 2010 stated 49% of men to be consuming tobacco in one form or another.^[12] In Uttar Pradesh, 34% tobacco is chewed in forms like plain tobacco, khaini, gutkha, and pan masala, and the other 22% use cigarettes, hookah, chilam, and bidis.

Many studies have explained the relationship between tobacco users and precancerous, cancerous, and oral mucosal lesions, but there is a scarcity of literature about the relationship between dental caries and tobacco users.

Hence, this study was conducted to unfold the relationship between smoking and smokeless tobacco usage and prevalence of dental caries in the population of Varanasi. Null hypothesis is that there is no association between tobacco usage and dental caries.

MATERIALS AND METHODS

Varanasi is a city located in Eastern Uttar Pradesh also known as Purvanchal region. This city is known as the cultural and religious capital of India; many people of this region utilize the medical facilities provided by Banaras Hindu University Hospital.

This study is a hospital-based survey. All the individuals had given their consent for examinations. It was carried out in the period of July–September 2018. Calibration sessions for the examiner were conducted before the beginning of the study to ensure that there was no error in recording dental caries. All the individuals were screened by a single trained examiner. The intraclass calibration coefficient (Kappa statistics) for intraexaminer reliability was 0.91 which indicates that the examiner was trained sufficiently. This was achieved when around 25 individuals were blindly re-examined. Decayed, missing, and filled teeth (DMFT) index was used to record the dental caries, and a briefcase history was taken to record tobacco habits for both smoking as well as smokeless tobacco users like quantity, frequency, and the number of years they were using the tobacco. Mode of brushing, material used, and frequency of brushing were also recorded.

As the examination was hospital-based American Diabetes Association, Type IV examination was followed in the

recording of dental caries and its pattern except for radiograph (that is, the individuals were examined on a dental chair with light using appropriate diagnostic aids). The time required for clinical examination and recording varied from 5 to 10 min.

A pilot study was conducted to know the prevalence of tobacco chewing habits among 25 individuals in the outpatient department.

Based on the prevalence rate, substituting in the formula $n = Z \cdot Pq/L^2$, the sample size was calculated at 450 which were increased to 472 to rule out error.

All the data were entered into Microsoft Excel and analyzed using SPSS version 17.0 (SPSS Inc., Chicago, IL, USA).

Descriptive statistical analysis, Chi-square *t*-test, and ANOVA and binary regression analysis were used.

$P < 0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

In the present study, caries rate was higher in individuals with tobacco habits than individuals without tobacco habits, but the difference was not statistically significant (it was 2.92 in individuals with tobacco habits and 2.44 in nontobacco users) [Table 1]. Evidence linking smokeless tobacco use with increased dental caries prevalence has been reported.^[13,14] Individuals who chew tobacco appear to have more dental caries than nonusers.^[2] In a case report published by Croft, a 54-year-old patient presented “cervical caries” in the area of tobacco placement.^[14,15] In contrast, Zitterbart *et al.* did not find any evidence of caries in the area of quid placement in their 36-year-old tobacco chewer.^[14,16]

Caries pattern

In the present study, there was no association between gender, smoking, tobacco chewing, and a combination of smoking

Table 1: Dental caries in relation to gender and tobacco habits

	DMFT	P
Gender		
Male	2.57±1.94	0.514 (NS)
Female	2.70±2.05	
Habit (any form)		
Absent	2.44±1.86	0.068 (NS)
Present	2.92±2.10	
Smoking		
Present	2.84±2.33	0.27 (NS)
Absent	2.57±1.88	
TC		
Present	2.75±1.86	0.18 (NS)
Absent	2.56±2.00	
Smokers and TC		
Present	3.23±2.10	0.66 (NS)
Absent	2.57±1.95	

TC: Tobacco chewer, NS: Not significant, DMFT: Decayed, missing, and filled teeth

Table 2: Association of caries pattern with gender, tobacco usage, and oral hygiene measures

	No caries	Occlusal caries	Proximal caries	Occlusal caries + proximal caries	χ^2, P
Gender					
Male	48 (12.9)	112 (30.1)	128 (34.4)	84 (22.6)	4.346,
Female	4 (4.0)	28 (28)	36 (36)	32 (32)	0.226 (NS)
Habit					
Absent	34 (11.3)	92 (30.5)	102 (33.8)	74 (24.5)	0.228,
Present	18 (10.6)	48 (28.2)	62 (36.5)	42 (24.7)	0.973 (NS)
Smokers					
Present	10 (12.8)	28 (35.9)	24 (30.8)	16 (20.5)	1.277,
Absent	42 (10.7)	112 (28.4)	140 (35.5)	100 (25.4)	0.735 (NS)
TCs					
Present	10 (7.8)	42 (32.8)	54 (42.2)	22 (17.2)	4.463,
Absent	42 (12.2)	98 (28.5)	110 (32.0)	94 (27.3)	0.216 (NS)
Smokers and TCs					
Absent	52 (11.9)	122 (27.9)	152 (34.7)	112 (25.6)	6.591,
Present	0	18 (52.9)	12 (35.3)	4 (11.8)	0.086 (NS)
Frequency among smokers					
No habits	42 (10.6)	112 (28.1)	142 (35.7)	102 (25.6)	8.084,
<3	8 (15.4)	18 (34.6)	16 (30.8)	10 (19.2)	0.526 (NS)
3-5	2 (12.5)	8 (50.0)	6 (37.5)	0 (0.0)	
>5	0 (0.0)	2 (33.3)	0 (0.0)	2 (66.7)	
Duration among smokers (years)					
No habits	42 (10.5)	112 (28.0)	142 (35.5)	104 (26.0)	12.237,
<5	8 (17.4)	14 (30.4)	18 (39.1)	6 (13.0)	0.200 (NS)
5-10	2 (14.3)	10 (71.4)	2 (14.3)	0 (0.0)	
>10	0 (0.0)	4 (33.3)	2 (16.7)	6 (50.0)	
Frequency among TCs					
No habits	44 (12.4)	102 (28.8)	114 (32.2)	94 (26.6)	7.995,
<3	4 (6.3)	18 (28.1)	32 (5.0)	10 (15.6)	0.535 (NS)
3-5	4 (10.5)	16 (42.1)	12 (31.6)	6 (15.8)	
>5	0 (0.0)	4 (25.0)	6 (37.5)	6 (37.5)	
Duration among TCs (years)					
No habits	44 (12.4)	102 (28.8)	114 (32.2)	94 (26.6)	4.701,
<5	2 (4.2)	16 (33.3)	20 (41.7)	10 (20.8)	0.860 (NS)
5-10	2 (12.5)	6 (37.5)	6 (37.5)	2 (12.5)	
>10	4 (7.4)	16 (29.6)	24 (44.4)	10 (18.5)	
Mode of cleaning					
No brushing	0 (0.0)	2 (50.0)	2 (50.0)	0 (0.0)	15.777,
Tooth brush	52 (12.0)	136 (31.5)	148 (34.3)	96 (22.2)	0.202 (NS)
Datum	0 (0.0)	2 (14.3)	4 (28.6)	8 (57.1)	
Finger	0 (0.0)	0 (0.0)	2 (33.3)	4 (66.7)	
Combination	0 (0.0)	0 (0.0)	8 (50.0)	8 (50.0)	
Material used for cleaning					
Nothing	0 (0.0)	2 (50.0)	2 (50.0)	0 (0.0)	18.563,
Toothpaste	52 (12.0)	134 (30.9)	152 (35.0)	96 (22.1)	0.100 (NS)
Tooth powder	0 (0.0)	2 (8.3)	8 (33.3)	14 (58.3)	
Gul	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)	
Other	0 (0.0)	2 (25.0)	0 (0.0)	6 (75.0)	
Frequency of brushing					
No brushing	0 (0.0)	2 (50.0)	2 (50.0)	0 (0.0)	11.361,
Once a day	32 (8.5)	112 (29.6)	136 (36.0)	98 (25.9)	0.252 (NS)
Twice a day	20 (23.3)	26 (30.2)	24 (27.9)	16 (18.6)	
Thrice a day	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)	

TCs: Tobacco chewers, NS: Not significant

and tobacco chewing with caries pattern, and also, there was no significant association between caries pattern and mode of brushing, material used for brushing, and frequency of brushing [Table 2].

Dental caries (decayed, missing, and filled teeth)

Individuals consuming more number of cigarette were found to have more dental caries, and it was statistically significant ($P = 0.019$). Similarly, in individuals as the duration of smoking increases, they were more prone for dental caries which was also statistically significant ($P = 0.037$). Similar results were found in Ainamo in 1971,^[17] Williams *et al.* in 2000,^[18] Sgan-Cohen *et al.* in 2000,^[19] Aguilar-Zinser *et al.* in 2008,^[20] Yanagisawa *et al.* in 2009,^[21] Golpasand Hagh *et al.* in 2013,^[22] and Ludwick and Massler in 1952.^[23] There was no significant difference in DMFT among tobacco chewer when their frequency and duration was considered ($P = 0.704$ and 0.362 , respectively) [Table 3]. The reason for this might be that due to continuous chewing of tobacco; there was wear of occlusal surface which accounts for less dental caries.

There was a statistically significant difference in DMFT in relation to the mode of brushing ($P = 0.001$). The results showed that individuals brushing with toothbrush had significantly lesser caries than individuals using datun, fingers, and who were not brushing. The results of the present study were similar to the result of Kuriakose and Joseph in 1999,^[24] and the contrasting result was observed in a study conducted by Ahmad *et al.* in 2009.^[25]

Similarly, individuals using dentifrices had least DMFT when compared to individuals who were using gul, powder, not brushing, etc., ($P = 0.001$). A similar result was found in a study conducted by Soroye and Braimoh in 2017.^[26] The reason for this might be the addition of active ingredients to dentifrices to give the benefits of anti-caries, anti-gingivitis, anti-plaque, anti-calculus, and anti-sensitive teeth benefits; for example, fluoride is added to dentifrices formulation to reduce the incidence of dental caries.^[27] Contrasting results were seen in 2009 by Ahmad *et al.*^[25]

When the frequency of brushing was considered, the least caries was observed in individuals brushing twice, followed by once a day and no brushing. Similar results were found by Soroye and Braimoh in 2017.^[26] However, in the present study, the difference was statistically not significant ($P = 0.313$). Similar results were observed by Kuriakose and Joseph in 1999^[24] and Chang *et al.* in 2013.^[28] They concluded that there was no relationship between the frequency of daily toothbrushing and caries.

Correlation

In the present study, as the frequency of smoking increased, caries (DMFT) also increased ($r = 0.125$, $P = 0.05$), and it was statistically significant. However, there is no significant co-relationship between the duration of smoking and DMFT [Table 4]. The results of study were found similar to many studies such as Ainamo in 1971,^[17] Williams *et al.* in 2000,^[18] Sgan-Cohen *et al.* in 2000,^[19] Aguilar-Zinser *et al.* in

Table 3: Dental caries in relation to frequency, duration of tobacco usage, and oral hygiene measures

	DMFT	F, P
Frequency among smokers		
No habits	2.57±1.88	3.38, 0.019 (S)
<3	2.38±1.79	
3-5	3.12±2.69	
>5	6±4	
Duration among smokers (years)		
No habits	2.58±1.88	2.87, 0.037 (S)
<5	2.52±2.25	
5-10	2.00±1.29	
>10	4.833±2.99	
Frequency among TCs		
No habits	2.53±1.99	0.470, 0.704 (NS)
<3	2.906±1.94	
3-5	2.84±2.03	
>5	2.87±1.35	
Duration among TCs (years)		
No habits	2.53±1.99	1.072, 0.362 (NS)
<5	2.75±1.67	
5-10	3.75±2.60	
>10	2.74±1.81	
Mode of cleaning		
No brushing	4.500±0.707	6.971, 0.000 (S)
Toothbrush	2.44±1.89	
Datum	4.71±1.60	
Finger	6.66±2.51	
Combination	3.37±1.30	
Material of cleaning		
Nothing	4.500±0.707	7.373, 0.000 (S)
Toothpaste	2.43±1.87	
Tooth powder	4.75±1.76	
Gul	8.00	
Other	3.75±1.70	
Frequency of brushing		
No brushing	4.500±0.707	1.193, 0.313 (NS)
Once a day	2.66±1.93	
Twice a day	2.32±2.12	

TCs: Tobacco chewers, DMFT: Decayed, missing, and filled teeth, NS: Not significant, S: Significant

2008,^[20] Yanagisawa *et al.* in 2009,^[21] Golpasand Hagh *et al.* in 2013,^[22] Ludwick and Massler in 1952 who reported that those who smoked more than 15 cigarettes a day had a significantly higher number of DMFT.^[23] The contradicting results were obtained in studies conducted by Hart in 1899,^[7] Gibbs in 1952,^[8] Schmidt in 1951,^[29] and Hugoson *et al.* in 2012,^[30] suggesting that smoking actually helps to reduce dental caries. The reason might be smoking increases the thiocyanate level in saliva. Thiocyanate is a normal constituent of saliva that inhibits the possible caries effect.^[31] On the other hand, the decreased buffering effect and possible lower pH of smoker's saliva and the higher number of Lactobacilli and *Streptococcus mutans* may indicate an increased susceptibility to caries.^[31] Few studies like Heng *et al.* in 2006^[32] and Tanaka *et al.* in 2010^[33] reported their association between smoking and dental caries.

Table 4: Correlation of dental caries with frequency and duration of tobacco usage among smoking and smokeless tobacco users

	Frequency (smokers)	Duration (smokers)	Frequency (TCs)	Duration (time)	DMFT	Frequency
Frequency (smokers)						
<i>r</i>	1	0.885	0.075	0.074	0.125	0.085
<i>P</i>		0.000	0.252	0.255	0.05	0.196
Duration (smokers)						
<i>r</i>	0.885	1	0.105	0.080	0.100	0.001
<i>P</i>	0.000		0.106	0.222	0.125	0.987
Frequency (TCs)						
<i>r</i>	0.075	0.105	1	0.886	0.066	0.015
<i>P</i>	0.252	0.106		0.000	0.311	0.815
Duration (TCs)						
<i>r</i>	0.074	0.080	0.886	1	0.067	0.004
<i>P</i>	0.255	0.222	0.000		0.304	0.949
DMFT						
<i>r</i>	0.125	0.100	0.066	0.067	1	0.100
<i>P</i>	0.055	0.125	0.311	0.304		0.125
Frequency						
<i>r</i>	0.085	0.001	0.015	0.004	0.100	1
<i>P</i>	0.196	0.987	0.815	0.949	0.125	

TCs: Tobacco chewers, DMFT: Decayed, missing, and filled teeth

Table 5: Binary regression analysis

Group	B	Odds ratio	<i>P</i>
Smokers	0.209	1.232	0.694
TCs	-0.495	0.609	0.342
Combination	0.172	0.89	0.73

TCs: Tobacco chewers

Binary regression analysis showed the odd's ratio of 1.232 (that is, smokers were 1.23 times more prone to get dental caries than nonsmokers), and in tobacco chewers, the odd's ratio was 0.609 (that is, tobacco chewers were 0.609 times more prone to get dental caries than nontobacco chewers) [Table 5].

Various studies and research have shown a significant relationship between smoking and dental caries, using large sample sizes. The use of tobacco in any form is directly related to a variety of medical problems including cancer, low birth weight, and pulmonary and cardiovascular diseases. It is evident that smoking has many negative influences on oral cavity. Intraorally, it causes xerostomia,^[34] and xerostomia has a relationship to caries which is well-documented.^[35-37] Further, studies recommended that smoking could increase the effect of caries lesions via the suppression of ascorbic acid. Väänänen *et al.* in 1994 found that there was a statistically significant difference between the study group (with low levels of plasma ascorbic acid) and the control group (with higher levels of plasma ascorbic acid) in the prevalence of caries lesions but not in the number of mutans streptococci.^[38] It also increases the risk of orogastrointestinal disease in both protective (ulcerative colitis) and inductive (squamous tumors of the head, neck, and esophagus) roles. Barton *et al.* in 1990 measured the effects of smoking on mucosal immunity and

salivary immunoglobulins, in pure parotid saliva from groups of healthy nonsmokers, smokers, and ex-smokers and from patients with epithelial head-and-neck tumors, both untreated and after radiotherapy. Of the healthy individuals, smokers had significantly lower salivary IgA and higher IgM concentrations than did nonsmokers. The effect on IgA was dose-related and reversible after cessation of smoking. Likewise, in patients with head-and-neck tumors (the majority being smokers), salivary IgA concentration was reduced and IgM increased when compared with nonsmoking controls. The results were similar before and after radiotherapy. This study provided evidence of the effects of smoking on mucosal immunity as evaluated by parotid salivary immunoglobulins.^[39] Another study was done by Golpasand Hagh *et al.* in 2013 which showed that low concentrations of salivary S-IgA are correlated with a higher prevalence of dental caries in smokers.^[23] Zitterbart *et al.* confirmed the relationship between smoking and the prevalence of dental caries in adult males. Smokers had significantly higher DMFT score, untreated decayed surfaces, and missing surfaces. They further correlated that in a smoker's mouth, consuming more cigarettes per day resulted in more missing tooth surfaces.^[9]

In 2007, Dietrich *et al.* studied the tobacco use and the incidence of tooth loss among US male health professionals. They found that the data on the dose-dependent effects of smoking and smoking cessation on tooth loss are scarce. They hypothesized that smoking has both dose- and time-dependent effects on tooth loss incidence.^[40]

Studies in this regard have considered multiple variable factors which increase the incidence of dental caries in smokers either directly or indirectly such as age, tobacco habits other than smoking, eating habits, drinking habits, oral hygiene habits,

preventive visits to the dentist (dental recalls), and overall health standards. Due to these factors, it is difficult to conclude the association between a single positive factor which can cause an increase in caries incidence in smokers; therefore, it is not easy to establish the strength of relationship between smoking and dental caries.

In the present study, caries rate was higher in smokers when compared to individuals with no habits, but caries rate was lower in tobacco chewers when compared with individuals having no habits. Earlier literature had not shown clear relationship between tobacco chewing, smoking and dental caries, but the present study shows tobacco habit is a risk factor for increased caries activity and it is higher in smokers as compared to smokeless tobacco chewers. However, the exact association of dental caries with tobacco smoking and smokeless tobacco chewers still remains unknown. Further studies are needed to confirm the direct etiological relationship between smoking and smokeless tobacco with dental caries.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Mishra GA, Pimple SA, Shastri SS. An overview of the tobacco problem in India. *Indian J Med Paediatr Oncol* 2012;33:139-45.
- Winn DM. Tobacco use and oral disease. *J Dent Educ* 2001;65:306-12.
- Prokhorov AV, Winickoff JP, Ahluwalia JS, Ossip-Klein D, Tanski S, Lando HA, *et al.* Youth tobacco use: A global perspective for child health care clinicians. *Pediatrics* 2006;118: E890-903.
- Anderson P. Global use of alcohol, drugs and tobacco. *Drug Alcohol Rev* 2006;25:489-502.
- Reibel J. Tobacco and oral diseases. Update on the evidence, with recommendations. *Med Princ Pract* 2003;12 Suppl 1:22-32.
- Vellappally S, Fiala Z, Smejkalová J, Jacob V, Shriharsha P. Influence of tobacco use in dental caries development. *Cent Eur J Public Health* 2007;15:116-21.
- Hart AC. Prevention of decay of the teeth. *Dent Items Interest* 1899;21:153-63.
- Gibbs MD. Tobacco and dental caries. *J Am Coll Dent* 1952;19:365-7.
- Zitterbart PA, Matranga LF, Christen AG, Park KK, Potter RH. Association between cigarette smoking and the prevalence of dental caries in adult males. *Gen Dent* 1990;38:426-31.
- Hanioka T, Ojima M, Tanaka K, Yamamoto M. Does secondhand smoke affect the development of dental caries in children? A systematic review. *Int J Environ Res Public Health* 2011;8:1503-19.
- Cinar AB, Christensen LB, Hede B. Clustering of obesity and dental caries with lifestyle factors among Danish adolescents. *Oral Health Prev Dent* 2011;9:123-30.
- Singh A, Ladusingh L. Prevalence and determinants of tobacco use in India: Evidence from recent Global Adult Tobacco Survey data. *PLoS One* 2014;9:e114073.
- Sitzes L Jr. On chewing tobacco [letter]. *ADA News* 1977;8:6.
- Weintraub JA, Burt BA. Periodontal effects and dental caries associated with smokeless tobacco use. *Public Health Rep* 1987;102:30-5.
- Croft L. Smokeless tobacco. Case report II. *Tex Dent J* 1983;100:14-5.
- Zitterbart PA, Marlin DC, Christen AG. Dental and oral effects observed in a long-term tobacco chewer: Case report. *J Indiana Dent Assoc* 1983;62:17-8.
- Ainamo J. The seeming effect of tobacco consumption on the occurrence of periodontal disease and dental caries. *Suom Hammaslaak Toim* 1971;67:87-94.
- Williams SA, Kwan SY, Parsons S. Parental smoking practices and caries experience in pre-school children. *Caries Res* 2000;34:117-22.
- Sgan-Cohen HD, Katz J, Horev T, Dinte A, Eldad A. Trends in caries and associated variables among young Israeli adults over 5 decades. *Community Dent Oral Epidemiol* 2000;28:234-40.
- Aguilar-Zinser V, Irigoyen ME, Rivera G, Maupomé G, Sánchez-Pérez L, Velázquez C. Cigarette smoking and dental caries among professional truck drivers in Mexico. *Caries Res* 2008;42:255-62.
- Yanagisawa T, Marugame T, Ohara S, Inoue M, Tsugane S, Kawaguchi Y. Relationship of smoking and smoking cessation with number of teeth present: JPHC Oral Health Study*. *Oral Dis* 2009;15:69-75.
- Golpasand Hagh L, Zakavi F, Ansarifard S, Ghasemzadeh O, Solgi G. Association of dental caries and salivary sIgA with tobacco smoking. *Aust Dent J* 2013;58:219-23.
- Ludwick W, Massler M. Relation of dental caries experience and gingivitis to cigarette smoking in males 17 to 21 years old (at the Great Lakes Naval Training Center). *J Dent Res* 1952;31:319-22.
- Kuriakose S, Joseph E. Caries prevalence and its relation to socio-economic status and oral hygiene practices in 600 pre-school children of Kerala-India. *J Indian Soc Pedod Prev Dent* 1999;17:97-100.
- Ahmad MS, Jindal MK, Khan S, Hashmi SH. Oral health knowledge, practice, oral hygiene status and dental caries prevalence among visually impaired students in residential institute of Aligarh. *J Dent Oral Hygiene* 2009;1:22-6.
- Soroye MO, Braimoh BO. Oral health practices and associated caries experience among secondary school students in Lagos State, Nigeria. *J Oral Res Rev* 2017;9:16-20.
- Petersen PE, Ogawa H. Prevention of dental caries through the use of fluoride – The WHO approach. *Community Dent Health* 2016;33:66-8.
- Chang YS, Park EJ, Kim HJ. Correlation co-efficient between the toothbrushing frequency or caries activity and the dental caries or periodontal state. *Int J Clin Prevent Dent* 2013;9:225-30.
- Schmidt HJ. Tobacco smoke and the teeth. *Stoma (Heidelberg)* 1951;4:111-25.
- Hugoson A, Hellqvist L, Rolandsson M, Birkhed D. Dental caries in relation to smoking and the use of Swedish snus: Epidemiological studies covering 20 years (1983-2003). *Acta Odontol Scand* 2012;70:289-96.
- Johnson NW, Bain CA. Tobacco and oral disease. EU-Working Group on Tobacco and Oral Health. *Br Dent J* 2000;189:200-6.
- Heng CK, Badner VM, Freeman KD. Relationship of cigarette smoking to dental caries in a population of female inmates. *J Correctional Health Care* 2006;12:164-74.
- Tanaka K, Hanioka T, Miyake Y, Ojima M, Aoyama H. Association of smoking in household and dental caries in Japan. *J Public Health Dent* 2006;66:279-81.
- Billings RJ, Proskin HM, Moss ME. Xerostomia and associated factors in a community-dwelling adult population. *Community Dent Oral Epidemiol* 1996;24:312-6.
- Rose LE. April issue of Compendium of Continuing Education in Dentistry. *Compend Contin Educ Dent* 2008;29:129.
- Bowen WH, Pearson SK, Young DA. The effect of desalivation on coronal and root surface caries in rats. *J Dent Res* 1988;67:21-3.
- Mandel ID. The functions of saliva. *J Dent Res* 1987;66:623-7.
- Väänänen MK, Markkanen HA, Tuovinen VJ, Kullaa AM, Karinpää AM, Luoma H, *et al.* Dental caries and mutans streptococci in relation to plasma ascorbic acid. *Scand J Dent Res* 1994;102:103-8.
- Barton JR, Riad MA, Gaze MN, Maran AG, Ferguson A. Mucosal immunodeficiency in smokers, and in patients with epithelial head and neck tumours. *Gut* 1990;31:378-82.
- Dietrich T, Maserejian NN, Josphipura KJ, Krall EA, Garcia RI. Tobacco use and incidence of tooth loss among US male health professionals. *J Dent Res* 2007;86:373-7.