Clin Oral Invest (2014) 18:909–915
DOI 10.1007/s00784-013-1036-x

ORIGINAL ARTICLE

Assessment of smoking behaviour in a dental setting: a 1-year follow-up study using self-reported questionnaire data and exhaled carbon monoxide levels

Odette Engel Brügger · Marc Frei · Pedram Sendi · Peter A. Reichart · Christoph A. Ramseier · Michael M. Bornstein

Received: 23 November 2012 / Accepted: 2 July 2013 / Published online: 20 July 2013

Abstract
Objectives This study analyses the changes in smoking habits over the course of 1 year in a group of patients referred to an oral medicine unit.
Materials and methods Smoking history and behaviour were analysed at baseline and after 1 year based on a self-reported questionnaire and on exhaled carbon monoxide levels [in parts per million (ppm)]. During the initial examination, all smokers underwent tobacco use prevention and cessation counselling.
Results Of the initial group of 121 patients, 98 were examined at the follow-up visit. At the baseline examination, 33 patients (33.67 %) indicated that they were current smokers. One year later, 14 patients (42.24 % out of the 33 smokers of the initial examination) indicated that they had attempted to stop smoking at least once over the follow-up period and 15.15 % (5 patients) had quit smoking. The mean number of cigarettes smoked per day by current smokers decreased from 13.10 to 12.18 ($p=0.04$). The exhaled CO level measurements showed very good correlation with a Spearman's coefficient 0.9880 for the initial visit, and 0.9909 for the follow-up examination. For current smokers, the consumption of one additional cigarette per day elevated the CO measurements by 0.77 ppm ($p<0.0001$) at the baseline examination and by 0.84 ppm ($p<0.0001$) at the 1-year follow-up.
Conclusions In oral health care, where smoking cessation is an important aspect of the treatment strategy, the measurement of exhaled carbon monoxide shows a very good correlation with a self-reported smoking habit.
Clinical relevance Measurement of exhaled carbon monoxide is a non-invasive, simple and objective measurement technique for documenting and monitoring smoking cessation and reduction.

Keywords Smoking · Self-reported · Exhaled carbon monoxide · Smoking cessation · Dental setting

O. E. Brügger · M. Frei · P. A. Reichart · M. M. Bornstein (✉)
Department of Oral Surgery and Stomatology,
School of Dental Medicine, University of Bern,
Freiburgstrasse 7, CH-3010 Bern, Switzerland
e-mail: michael.bornstein@zmk.unibe.ch

P. Sendi
Institute for Clinical Epidemiology and Biostatistics,
Basel University Hospital, Basel, Switzerland

C. A. Ramseier
Department of Periodontology, School of Dental Medicine,
University of Bern, Bern, Switzerland

Introduction

According to the World Health Organization (WHO), smoking continues to be the leading global cause of preventable death. Each year, it kills nearly six million people and causes economic damage worldwide [1]. In Switzerland, 27 % of the population are current smokers (30 % of the males and 24 % of the females), consuming on average 11.5 cigarettes per day [2].

As there is a strong dose–response relationship between the use of tobacco and the development of oral pathologies such as oral cancer, tobacco use cessation or reduction is a main goal in public health [3]. It has been reported that intervention delivered by oral health care professionals increases the odds of quitting tobacco consumption [4]. Therefore, there have been numerous efforts to promote tobacco use prevention and cessation counselling (TUPAC) in the field of dental medicine [5, 6].

In the dental setting, smoking habits are mainly self-reported using questionnaires, as most oral health professionals do not have the necessary equipment to perform objective analyses of smoking habits and/or exposure to tobacco smoke, such as measurement of cotinine levels in saliva, blood or urine [7, 8] or spirometry [9]. As self-reporting of tobacco use has been reported to underestimate the true amount of smoking in comparison to biochemical methods [10, 11], there is a need for a non-invasive, simple and objective measurement technique to document and monitor smoking cessation and reduction in patients at risk.

The primary objective of the present study was to document the evolution and changes of smoking habits of patients treated in an oral medicine unit over the course of 1 year using TUPAC combined with measurements of exhaled carbon monoxide (CO) levels.

Material and methods

Study sample and clinical examination

This study was designed as a follow-up study investigating the smoking behaviour and the effect of TUPAC combined with measurement of exhaled CO levels on patients referred to an oral medicine unit at the University of Bern with various lesions of the oral mucosa ranging from benign/reactive to premalignant lesions and conditions between September and December 2010. The primary outcome parameters included the smoking cessation rate, the changes of measured exhaled CO levels over the course of 1 year, and the correlation between self-reported smoking status and exhaled CO levels in the two examinations. The secondary outcome parameters included dynamic changes in questionnaire data analysis such as number of cigarettes consumed per day or the mean pack-year value. A previous paper compares the initial data of this group to results of a group of patients recruited from daily outpatient service [12]. All patients examined in the oral medicine unit for the first study were scheduled for a follow-up visit to reassess their smoking habits 1 year later.

At the initial examination and at the follow-up examination, patients filled in a questionnaire about their smoking behaviour. Specifically, patients were asked at the initial examination about their awareness of a potential benefit of smoking cessation and willingness to quit smoking during the next 6 months. Afterwards, at each time point, two measurements of their exhaled CO levels were taken (piCO+ Smokerlyzer, Bedfont Scientific Ltd., Kent, UK). Besides these examinations, all patients referred with stomatological lesions were examined following the protocol of the oral medicine unit of the University of Bern (thorough medical history, recent dental/stomatological history, extra- and intraoral examination, oral biopsy and radiographic imaging when necessary). All smokers underwent TUPAC stage 2 (further basic care) as proposed by the Consensus Report of the Second European Workshop on Tobacco Use Prevention and Cessation for oral health professionals, including brief intervention (assess tobacco use and readiness to quit, brief counselling for smoking cessation/behavioural intervention and request permission to re-address tobacco use at the subsequent visit) and provision of support for cessation [6]. The study protocol was approved by the standing ethics committee for clinical studies in the state of Bern.

Assessment of smoking status and questionnaire data

Before commencement of the follow-up examination, all patients filled in a standardised questionnaire regarding their smoking habits for comparison with their initial anamnestic data. This questionnaire asked whether patients were never smokers, former smokers or current smokers. The current and former smokers had to indicate the number of cigarettes smoked per day (including the time period since they started smoking) to allow for calculation of a pack-year value. Additionally, smokers were asked to indicate if they had tried to quit smoking since the initial examination.

Exhaled carbon monoxide levels

Exhaled carbon monoxide (CO) levels were measured in all patients using a specialised monitoring device. To ensure that measurements were standardised, patients were asked to exhale completely, take a deep breath, and hold it for 15 s before exhaling fully and slowly into the mouthpiece of the monitor. Furthermore, patients were instructed to seal their lips tightly around the mouthpiece so that no air escaped from the measuring device while they were exhaling [13, 14]. The device measures the exhaled CO concentration in parts per million (ppm) with a range from 0 to 100. The manufacturer states that the device is accurate to ±2 % based on the repeatability of readings (http://www.bedfont.com/smokerlyzer/pico+). The CO measurements were classified into four groups: three are based on recommendations of the manufacturer: 0–10 ppm, non-/former smokers; 11–25 ppm, light smokers and >25 ppm, heavy smokers. The first group was additionally divided into two groups (0–6 and 7–10 ppm), as some studies propose a cutoff level of 5 ppm [15] or 6 ppm [14] between smokers and non-smokers. For all study participants, a total of four CO values were measured—two at the initial and two at the follow-up examination—to validate the reproducibility of the method. The CO monitoring device was calibrated every 6 months over the course of the study according to manufacturer instructions. All CO level measurements were taken by two experienced senior residents (OEB and MF). The CO measurements were scheduled between 10:00 a.m. and

noon for all patients, and were performed prior to any further clinical examination or intervention.

Statistical analysis

First, all data were analysed using descriptive statistics. Between-group differences in continuous and categorical variables were compared using the *t* test or chi square test where appropriate. The association between exhaled CO levels and current smoking status, cumulative pack-year values, and number of cigarettes per day was evaluated using a linear regression model, adjusted for age and sex, both at baseline and follow-up examination.

The significance level chosen for all statistical tests was $p \leq 0.05$. All statistical analyses were performed using the software package Stata 11.1 (StataCorp, College Station, Texas, USA).

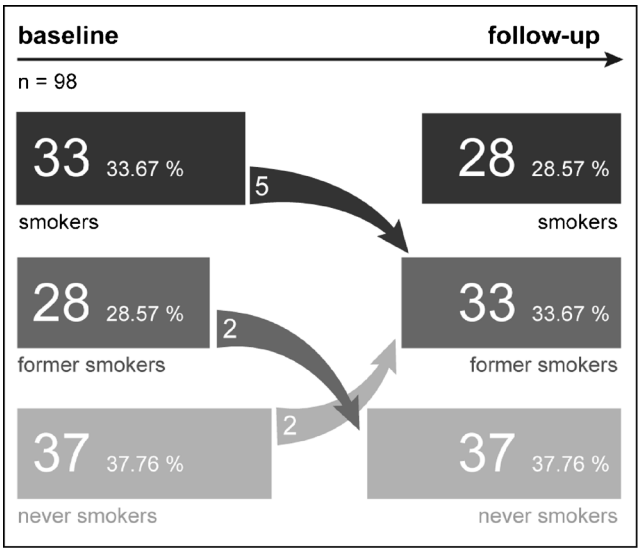

Fig. 1 Smoking behaviour of the included patients over the course of 1 year as assessed using self-reported questionnaire data

Results

Study population

A total of 121 patients were included in the initial examination, with 98 re-examined at a follow-up exam 1 year later. The initial group comprised 77 patients with benign/reactive lesions, and in 44 subjects premalignant lesions and conditions were present. No malignant mucosal disease was diagnosed in any of the included patients. Twenty-three members of the initial group were lost to follow-up: three patients had died since the initial examination, two were hospitalised and could not come to the clinic, two had moved abroad, seven could not be reached (phone or mail), and nine declined to come for the follow-up visit. The group analysed in the present study comprised 33 male and 65 female subjects with a mean age of 59.4 years (minimum, 17 years; maximum, 84 years).

Questionnaire analysis

The patient pool was devided into three groups according to smoking behaviour at baseline: 33 patients (33.67 %) reported that they were current smokers, 28 patients (28.57 %) were former smokers and 37 (37.76 %) had never been smokers. At the follow-up visit 1 year later, 28 patients (28.57 %) indicated that they were current smokers, 33 (33.67 %) were former smokers and 37 (37.76 %) had never been smokers (Fig. 1).

Among the smokers, five patients reported to have stopped smoking since the initial evaluation resulting in a 15.15 % cessation rate. Out of these five patients, four were initially diagnosed with benign/reactive lesions, and one patient presented with a premalignant lesion (oral leukoplakia). For 12 patients, the amount of cigarettes consumed per day remained unchanged, 10 had reduced and 6 had increased their amount of cigarettes smoked per day. The mean number of cigarettes per day among current smokers decreased from 13.10 to 12.18 over the course of 1 year, which proved to be statistically significant ($p=0.04$). The mean pack-year value among current smokers and former smokers increased from 22.23 to 22.91 ($p=0.3313$; Table 1).

At the initial examination, 24 patients (72.72 % out of 33 current smokers) indicated to be aware of a potential benefit of smoking cessation, and 16 patients (48.48 %) were willing to stop smoking during the next 6 months. During the follow-up examination, 14 patients (42.24 % out of the 33 smokers of the initial examination) indicated that they had attempted to stop smoking at least once over the follow-up period (Table 2).

Exhaled CO level analysis

The mean value of the two exhaled CO measurements for the 98 patients was 6.46 ppm at the initial examination and 7.00 ppm at the 1-year follow-up visit. The data exhibited very good correlations for the two exhaled CO measurements taken for each patient, with a Spearman's coefficient of 0.9880 for the initial visit, and 0.9909 for the follow-up examination. Because almost identical exhaled CO values were measured during the same visit, only the initial measurement was used for further analyses. The difference between these CO values from the two examinations was not statistically significant ($p=0.4535$).

At the initial examination, current smokers exhibited a mean exhaled CO level of 14.24 ppm (Table 3). This value slightly increased at the 1-year follow-up visit (16.14 ppm). For former smokers, the mean exhaled CO level increased from 2.96 to 3.30 ppm during the period of the baseline and the follow-up

Table 1 Characteristics of the patients examined in 2010 and 2011 regarding self-reported data on smoking habits (smoking status, cumulative pack-year value and number of cigarettes smoked per day)

	Never smokers (% in group)	Current smokers (% in group)	Former smokers (% in group)	Mean py (95 % CI)[a]	Mean number of cigarettes per day (range)[b]
Initial visit (2010)	37 (37.76)	33 (33.67)	28 (28.57)	22.23 (16.56–27.91)	13.10* (0–40)
Follow-up (2011)	37 (37.76)	28 (28.57)	33 (33.67)	22.91 (16.91–28.92)	12.18* (0–40)

py cumulative pack-year value, *95*% CI 95 % confidence interval

*$p=0.04$ (statistically significant difference)

[a] Current and former smokers

[b] Current smokers

examination. For people who had never smoked, the mean exhaled CO level increased without significance from the baseline to the follow-up examination (from 2.24 to 3.37 ppm).

Correlation between self-reported data and exhaled CO levels

In both examinations, the highest exhaled CO values were found for current smokers, which proved to be statistically significant in comparison to former smokers and never smokers ($p<0.001$ for both visits; Table 4). Furthermore, the CO measurements were statistically significantly influenced by the pack-year values ($p=0.005$ for the initial visit; $p=0.006$ for the 1-year follow-up visit), and the number of cigarettes smoked per day for the initial visit ($p<0.001$). For current and former smokers, the consumption of 1 pack-year more resulted in an increase of the exhaled CO value by 0.15 ppm (95 % CI, 0.05–0.26 ppm; $p=0.005$) for the baseline examination, and by 0.15 ppm (95 % CI, 0.05–0.26 ppm; $p=0.006$) for the 1-year follow-up examination. For current smokers, the consumption of one additional cigarette per day elevated the CO measurements by 0.77 ppm (95 % CI, 0.64–0.90 ppm; $p<0.0001$) for the baseline examination, and by 0.84 ppm (95 % CI, 0.70–0.98 ppm; $p<0.0001$) for the 1-year follow-up examination.

Discussion

At the initial examination of the present study, the percentage of patients indicating they were current smokers (33.67 %) was slightly higher than the prevalence reported in Switzerland (27 %) [2]. This may be due to the fact that all patients had been referred by dental professionals or physicians for further evaluation and therapy of suspected pathologies of their oral mucosa, which are often related to present or former smoking habits [16]. At the follow-up examination after 1 year, the percentage of current smokers had decreased to 28.27 %. Of the initial 33 smokers, five (15.15 %) had stopped smoking in the year between the two exams.

Despite dental professionals' known discomfort over offering smoking cessation during routine dental care [17, 18], it is now widely recognised that the dental professional plays a major role in tobacco use prevention and cessation counselling, also when compared with the role of general healthcare practitioners [4, 19]. In previous studies, smoking habits were mainly recorded using only self-reported data, which is likely to be subjective and unreliable. It has been shown that self-reported data often underestimate the true prevalence of tobacco consumption [8, 10], even more when the patients analysed had been specifically motivated for smoking cessation (pregnant women [20] or patients suffering from chronic obstructive pulmonary disease [11]). The lack of reliability of anamnestic data on smoking habits is also demonstrated in our study, where the data collected for calculation of a pack-year value at baseline and at the follow-up examination showed a lack of congruence, e.g. initial never smokers reported they were former smokers and former smokers reported they were never smokers at the follow-up visit.

The most objective and accurate method of evaluating tobacco use is biochemical measurement of cotinine (a metabolite of nicotine) levels in saliva or urine [21]. Tests using

Table 2 Questionnaire data evaluating willingness to quit smoking, awareness of a potential benefit of smoking cessation, and attempts to quit smoking for current smokers in the initial and follow-up examination

	No	Yes	Missing
Awareness of a potential benefit of smoking cessation (2010, $n=33$)	7 (21.21 %)	24 (72.72 %)	2 (6.06)
Willingness to quit smoking in the next 6 months (2010, $n=33$)	17 (51.51 %)	16 (48.48 %)	–
Attempts to quit smoking during the last year (2011, $n=33$[a])	18 (54.55 %)	14 (42.42 %)	1 (3.03 %)

[a] $n=33$: 28 smokers and 5 patients that stopped smoking during the follow-up period

Table 3 Exhaled CO values (ppm) for current smokers, former smokers and never smokers examined in 2010 and 2011

	Never smokers	Current smokers	Former smokers
Initial visit (2010)	(n=37)	(n=33)	(n=28)
Mean	2.24*	14.24	2.96
Maximum	10	43	15
Minimum	1	2	1
95 % CI	1.73–2.75	10.67–17.80	1.87–4.05
Follow-up (2011)	(n=37)	(n=28)	(n=33)
Mean	3.37*	16.14	3.30
Maximum	10	41	8
Minimum	1	1	1
95 % CI	2.86–3.89	12.29–19.99	2.64–3.95

*p<0.05 (statistically significant difference)

cotinine levels provide high sensitivity (93–95 %) and specificity (100 %). Furthermore, cotinine has a long half-life (15–20 h) and is specific to tobacco use.

The measurement of exhaled CO levels provides an acceptable degree of discrimination of current smokers and is considerably cheaper and simpler to use when compared to cotinine measurements [21]. The level of exhaled CO is in equilibrium with the level of carboxyhaemoglobin in arterial blood (COHb). When the patient is breathing room air, the half-life of COHb is 5 to 6 h [14]. This explains why recording smoking habits using the measurement of exhaled CO is vulnerable to external sources of CO such as environmental pollution, passive smoke, occupational exposure or occult CO poisoning, and to the time since the last cigarette has been smoked. The measurement of exhaled CO levels has the advantage of showing an immediate result without being invasive, and with high sensitivity (94 %) and specificity (96 %) [14].

Table 4 Correlation between self-reported smoking status and corresponding exhaled CO values (in ppm) in the patients examined in 2010 and 2011

	Never smokers	Former smokers	Current smokers	Total
Initial visit (2010)				
CO values				
0–6 ppm	36	25	9	70
7–10 ppm	1	2	6	9
11–25 ppm	0	1	13	14
>25 ppm	0	0	5	5
Total	37	28	33	98
Follow-up (2011)				
CO values				
0–6 ppm	36	29	6	71
7–10 ppm	1	4	4	9
11–25 ppm	0	0	13	13
> 25 ppm	0	0	5	5
Total	37	33	28	98

To obtain comparable results in the present study, all exhaled CO level measurements were taken between 10:00 a.m. and noon. Studies show that the measurement of exhaled CO levels gives a more accurate indication of the current smoking status if the last cigarette has been smoked 5 [15] to 8 h [22] before the measurement is taken. Therefore, clinicians should be aware of the risk that patients could have smoked their last cigarette in the evening/night prior to the scheduled appointment, thus resulting in low CO values that could wrongfully be interpreted as measurements from a never or former smoker due to the short half-life time of CO [23].

The results of the present study show a strong association between self-reported smoking habits and the measurement of exhaled CO levels (Tables 3 and 4). The present study corroborates data from a previous study [12], assessing exhaled CO levels of patients from an oral medicine unit and daily outpatient service upon initial presentation. Nevertheless, exhaled CO levels were not yet analysed over a defined period of time in a dental setting, thus also exhibiting the dynamic changes of measured CO levels within the same patients. In the present study, all but one of the patients indicating to be never smokers or former smokers exhibited exhaled CO values under or equal to 10 ppm, which is the threshold recommended by the manufacturer between non-/former smokers and light smokers. Possible explanations for the higher CO level (15 ppm) found in one of the former smokers at the initial examination include exposure to an external CO source or a persisting smoking habit. The same patient showed an exhaled CO value of 3 ppm at the follow-up examination 1 year later.

Compared with other studies assessing the results of TUPAC showing cessation rates between 7 and 36.4 % for high-intensity interventions, and between 4 and 13 % for brief interventions [24–28], the 15.15 % cessation rate found in the present study at the 1-year follow-up after only a brief intervention including the measurement of exhaled CO levels is quite promising. For the smokers included in the present study, the data on awareness of a potential benefit of smoking cessation (72.72 %) and on the willingness to quit smoking during the next 6 months (48.48 %) are comparable with findings of a previous study from Bornstein and coworkers [29]. This study demonstrated that patients diagnosed with benign/reactive lesions show less willingness to quit smoking than patients with premalignant or malignant diseases of the oral mucosa. This could not be confirmed in present study, where 4 out of the 5 patients that reported to have stopped smoking since the initial evaluation in the current analysis were initially diagnosed with benign/reactive lesions. Nevertheless, the exact reason or motivation for smoking cessation for each individual patient was not evaluated in the present study.

That smoking cessation needs to be an integral component to effectively manage patients attending an oral medicine clinic has been clearly stated in the literature [30]. The results regarding willingness to quit (48.48 %) and the smoking cessation attempts (42.42 %) during the last year in a dental setting are clearly higher than data reported for the whole Swiss population [2]. For this general population, a willingness to quit in the next 6 months of 26 % was documented, and 19 % of the subjects reported smoking cessation attempts during the last year. For the present study, having been referred by dental professionals or physicians for further evaluation and therapy of suspected pathologies of the oral mucosa may have influenced this increased awareness of potential harmful effects of tobacco and the willingess to quit smoking. Combined with the brief intervention, all smokers received at the initial examination, this could have resulted in the high smoking cessation rate of 15.15 %.

The effect of the feedback and motivation the patients got from the repeated objective measurements of exhaled CO has not yet been analysed successfully in the literature and should be addressed in future studies [31]. Only with a clear added value of motivating smokers to quit, the additional costs for the acquisition of a CO measurement device can be justified for daily practice in a dental medicine setting. A study evaluating the effect of the measurement of salivary cotinine levels as a motivational tool included in TUPAC showed a strong association between the use of the biochemical method for assessment of smoking behaviour and increased quit rates (23 versus 7 % for controls) after 8 weeks [32].

One limitation of the present study is that the number of patients lost to follow-up was quite high (19 %). This problem is widely recognised in smoking cessation trials. The studies cited above reported lost-to-follow-up rates of 24.33 [24], 50.84 [25], 28.89 [26], 51.95 [27] and 26.78 % [28]. Another important limitation of the study is that the group of current smokers presenting at both visits (initial and follow-up) was small, thus the percentage of quitters (15.15 %, five patients) could be overestimated. One reason is that out of the 23 members of the initial group that were lost to follow-up, 11 had been current smokers at the initial visit. Therefore, a larger cohort and a longer follow-up period are needed to allow for a more refined analysis of the group of current smokers.

Another important limitation of the present study is the fact that all smokers underwent the same TUPAC combined with the monitoring of exhaled CO values without a control group. Therefore, it is not possible to estimate the added effect of the monitoring of exhaled CO values in comparison to patients receiving brief intervention for smoking cessation alone. Nevertheless, the primary outcome of this study was to monitor the evolution and changes of smoking habits in a dental setting using questionnaire data and TUPAC combined with measurement of exhaled CO values. For future studies, further evaluation of the effectiveness of exhaled CO level measurements as an easy, robust and non-invasive method for motivation of patients undergoing TUPAC in a dental setting should be undertaken. Additionally, studies are needed to establish the best time of day to measure exhaled CO values for assessing TUPAC outcomes with regard to the last cigarette smoked.

Conclusions

Measurement of exhaled carbon monoxide is a non-invasive, simple and objective measurement technique for documenting and monitoring smoking cessation and reduction. In oral health care units, where smoking cessation is an important aspect of the treatment strategy, the measurement of exhaled carbon monoxide shows a very good correlation with self-reported smoking habits. Documenting how the measurement of exhaled CO levels could influence or motivate smoking cessation efforts in a dental setting is an important goal for future research.

Acknowledgments The study was supported by University of Bern departmental funds as well as funds from the National Stop Smoking Program of Switzerland, which is funded by the Tobacco Control Fund and the Swiss Cancer League.

Conflict of interest statement The authors declare that there are no financial or other relations that could lead to a conflict of interest.

References

1. Alwan A (2011) WHO report on the global tobacco epidemic, 2011: warning about the dangers of tobacco. MPOWER brochures,World Health Organization, Geneva
2. Keller R, Radtke T, Krebs H, Hormung R (2011) Der Tabakkonsum der Schweizer Wohnbevölkerung in den Jahren 2001 bis 2010. Zusammenfassung des Forschungsberichtes 2011. Psychologisches Institut, Sozial- und Gesundheitspsychologie, University of Zurich, Switzerland
3. Nagelhout GE, Levy DT, Blackman K, Currie L, Clancy L, Willemsen MC (2012) The effect of tobacco control policies on smoking prevalence and smoking-attributable deaths. Findings from the Netherlands SimSmoke Tobacco Control Policy Simulation Model. Addiction 107:407–416
4. Carr AB, Ebbert J (2012) Interventions for tobacco cessation in the dental setting. Cochrane Database Syst Rev. doi:10.1002/14651858.CD005084.pub3
5. Ramseier CA, Mattheos N, Needleman I, Watt R, Wickholm S (2006) Consensus report: First European Workshop on Tobacco Use Prevention and Cessation for Oral Health Professionals. Oral Health Prev Dent 4:7–18
6. Ramseier CA, Warnakulasuriya S, Needleman IG, Gallagher JE, Lahtinen A, Ainamo A, Alajbeg I, Albert D, Al-Hazmi N, Antohe ME, Beck-Mannagetta J, Benzian H, Bergstrom J, Binnie V, Bornstein MM, Buchler S, Carr A, Carrassi A, Casals Peidro E, Chapple I, Compton S, Crail J, Crews K, Davis JM, Dietrich T, Enmark B, Fine J, Gallagher J, Jenner T, Forna D, Fundak A,

Gyenes M, Hovius M, Jacobs A, Kinnunen T, Knevel R, Koerber A, Labella R, Lulic M, Mattheos N, McEwen A, Ohrn K, Polychronopoulou A, Preshaw P, Radley N, Rosseel J, Schoonheim-Klein M, Suvan J, Ulbricht S, Verstappen P, Walter C, Warnakulasuriya S, Wennstrom J, Wickholm S, Zoitopoulos L (2010) Consensus report: 2nd European Workshop on Tobacco Use Prevention and Cessation for Oral Health Professionals. Int Dent J 60:3–6

7. Fu M, Martinez-Sanchez JM, Agudo A, Pascual JA, Ariza C, Moncada A, Fernandez E (2012) Nicotine dependence and salivary cotinine concentration in daily smokers. Eur J Cancer Prev 21:96–102
8. Dhavan P, Bassi S, Stigler MH, Arora M, Gupta VK, Perry CL, Ramakrishnan L, Reddy KS (2011) Using salivary cotinine to validate self-reports of tobacco use by Indian youth living in low-income neighborhoods. Asian Pac J Cancer Prev 12:2551–2554
9. Kotz D, Wesseling G, Aveyard P, van Schayck OC (2011) Smoking cessation and development of respiratory health in smokers screened with normal spirometry. Respir Med 105:243–249
10. Gorber SC, Schofield-Hurwitz S, Hardt J, Levasseur G, Tremblay M (2009) The accuracy of self-reported smoking: a systematic review of the relationship between self-reported and cotinine-assessed smoking status. Nicotine Tob Res 11:12–24
11. Hilberink SR, Jacobs JE, van Opstal S, van der Weijden T, Keegstra J, Kempers P, Muris JW, Grol RP, de Vries H (2011) Validation of smoking cessation self-reported by patients with chronic obstructive pulmonary disease. Int J Gen Med 4:85–90
12. Frei M, Engel Brügger O, Sendi P, Reichart PA, Ramseier CA, Bornstein MM (2012) Assessment of smoking behaviour in the dental setting. A study comparing self-reported questionnaire data and exhaled carbon monoxide levels. Clin Oral Invest 16:755–760
13. Andersson MF, Moller AM (2010) Assessment of carbon monoxide values in smokers: a comparison of carbon monoxide in expired air and carboxyhaemoglobin in arterial blood. Eur J Anaesthesiol 27:812–818
14. Middleton ET, Morice AH (2000) Breath carbon monoxide as an indication of smoking habit. Chest 117:758–763
15. Low EC, Ong MC, Tan M (2004) Breath carbon monoxide as an indication of smoking habit in the military setting. Singapore Med J 45:578–582
16. Lambert R, Sauvaget C, de Camargo CM, Sankaranarayanan R (2011) Epidemiology of cancer from the oral cavity and oropharynx. Eur J Gastroenterol Hepatol 23:633–641
17. Needleman I, Warnakulasuriya S, Sutherland G, Bornstein MM, Casals E, Dietrich T, Suvan J (2006) Evaluation of tobacco use cessation (TUC) counselling in the dental office. Oral Health Prev Dent 4:27–47
18. Warnakulasuriya KA, Johnson NW (1999) Dentists and oral cancer prevention in the UK: opinions, attitudes and practices to screening for mucosal lesions and to counselling patients on tobacco and alcohol use: baseline data from 1991. Oral Dis 5:10–14
19. Stead LF, Bergson G, Lancaster T (2008) Physician advice for smoking cessation. Cochrane Database Syst Rev 16, CD000165
20. Shipton D, Tappin DM, Vadiveloo T, Crossley JA, Aitken DA, Chalmers J (2009) Reliability of self reported smoking status by pregnant women for estimating smoking prevalence: a retrospective, cross sectional study. BMJ 339:b4347
21. Jarvis MJ, Tunstall-Pedoe H, Feyerabend C, Vesey C, Saloojee Y (1987) Comparison of tests used to distinguish smokers from non-smokers. Am J Pub Health 77:1435–1438
22. Sandberg A, Skold CM, Grunewald J, Eklund A, Wheelock AM (2011) Assessing recent smoking status by measuring exhaled carbon monoxide levels. PloS One 6:e28864
23. Underner M, Peiffer G (2010) Interpretation of exhaled CO levels in studies on smoking (article in French). Rev Mal Respir 27:293–300
24. Nohlert E, Tegelberg A, Tillgren P, Johansson P, Rosenblad A, Helgason AR (2009) Comparison of a high and a low intensity smoking cessation intervention in a dentistry setting in Sweden: a randomized trial. BMC Public Health 9:121
25. Binnie VI, McHugh S, Jenkins W, Borland W, Macpherson LM (2007) A randomised controlled trial of a smoking cessation intervention delivered by dental hygienists: a feasibility study. BMC Oral Health 7:5
26. Gordon JS, Andrews JA, Albert DA, Crews KM, Payne TJ, Severson HH (2010) Tobacco cessation via public dental clinics: results of a randomized trial. Am J Pub Health 100:1307–1312
27. Smith SE, Warnakulasuriya KA, Feyerabend C, Belcher M, Cooper DJ, Johnson NW (1998) A smoking cessation programme conducted through dental practices in the UK. Br Dent J 185:299–303
28. Hanioka T, Ojima M, Tanaka H, Naito M, Hamajima N, Matsuse R (2010) Intensive smoking-cessation intervention in the dental setting. J Dent Res 89:66–70
29. Bornstein MM, Frei M, Sendi P, Ramseier CA, Reichart PA (2012) Patients' awareness of the potential benefit of smoking cessation. A study evaluating self-reported and clinical data from patients referred to an oral medicine unit. Clin Oral Invest 16:55–62
30. Poate TW, Warnakulasuriya S (2006) Effective management of smoking in an oral dysplasia clinic in London. Oral Dis 12:22–26
31. Bize R, Burnand B, Mueller Y, Rège-Walther M, Camain JY, Cornuz J (2012) Biomedical risk assessment as an aid for smoking cessation. Cochrane Database Syst Rev. doi:10.1002/14651858.CD004705.pub2
32. Barnfather KD, Cope GF, Chapple IL (2005) Effect of incorporating a 10 minute point of care test for salivary nicotine metabolites into a general practice based smoking cessation programme: randomised controlled trial. BMJ. doi:10.1136/bmj.38621.463900.7C