

WHO Monograph on
**Tobacco cessation
and oral health
integration**



**World Health
Organization**

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Executive Summary

Background

Oral diseases pose a major health burden for many countries. These diseases share common risk factors of noncommunicable diseases (NCDs): tobacco use, unhealthy diets, physical inactivity and harmful use of alcohol, and can benefit from common responses to NCDs, such as quitting tobacco use.

The guidelines for implementation of Article 14 of the WHO Framework Convention on Tobacco Control (WHO FCTC) recommend integrating brief tobacco interventions into existing health care systems as one of the first steps Parties should take to develop a comprehensive tobacco cessation and treatment system. Although brief tobacco interventions should be integrated into all health care services, oral health programmes could be a priority for integration of brief tobacco interventions in primary care because oral health professionals have the highest access to young and “healthy” smokers, and often have more time with patients than other clinicians to advise smokers to quit. Currently however, it is rare for oral health professionals to routinely discuss tobacco habits with their patients. The main barriers to providing tobacco cessation interventions are lack of knowledge and skills about tobacco and tobacco cessation, lack of professional leadership and lack of integration of tobacco cessation interventions with oral health programmes.

Since 2015, the WHO Tobacco Free Initiative (WHO TFI) and WHO Oral Health Programme have been collaborating to update evidence on tobacco use and oral diseases, as well as the impact of tobacco cessation on oral health, in order to lay a scientific foundation for integrating tobacco cessation interventions into oral health programmes in primary care.

Updated evidence on tobacco use and oral diseases

A systematic review was conducted to quantify: 1) whether there are any causal relationships between tobacco use and oral diseases; 2) what forms of tobacco use are causally associated with oral diseases; and 3) what types of oral diseases are caused by tobacco use. All relevant studies published between 2005 and 2015 that met

inclusion criteria were selected. Following the review stages, 32 studies were included for meta-analysis of association between tobacco use and oral cancer, leukoplakia and periodontal disease, 12 studies were included for meta-analysis of association between exposure to second-hand smoke and dental caries, nine studies were included for meta-analysis of association between tobacco smoking and tooth loss.

The review concluded that:

1. Tobacco use, including tobacco smoking and smokeless tobacco use, increases the risk for oral cancer and leukoplakia by five to six times.
2. Tobacco smoking increases the risk for periodontal disease by two times.
3. Exposure to second-hand smoke has a one-and-a-half to twofold higher risk of causing dental caries for both deciduous and permanent teeth.
4. Tobacco smoking increases the risk of tooth loss by one-and-a-half times.

Updated evidence on the benefits of tobacco cessation on oral health outcomes

A systematic review was conducted to evaluate whether tobacco cessation improves oral health outcomes. All relevant studies published between 1996 and 2015 that met inclusion criteria were selected. Following the review stages, nine studies were included for meta-analysis of the effects of tobacco cessation on oral health outcomes.

The review concluded that:

1. Tobacco cessation is significantly associated with better oral health outcomes: as measured by the number of lost teeth, periodontal health and the risk of new lesions or malignancies.
2. Tobacco cessation leads to a significant gain in clinical attachment level of 0.28 mm.

Integrating brief tobacco interventions into oral health programme in primary care

The recognition of associations between tobacco use and oral health, as well as the benefits of tobacco cessation on oral health outcomes makes it imperative for national oral health programmes to actively support tobacco control efforts at both the clinical and community levels. In order to support national oral health programmes to routinely identify and take care of patients who use tobacco, practical policy recommendations have been made for integrating brief tobacco interventions into oral health programmes in accordance with the WHO Oral Health Programme tobacco control policy and WHO policy on tobacco cessation.

Key elements of the policy are that:

1. Oral health professionals should routinely offer three-to-five minute brief tobacco interventions to all tobacco users in primary care through the 5As and 5Rs models.
2. Oral health care systems should be strengthened across all six essential building blocks (service delivery, health workforce, information support, medical products and technologies, financing, leadership and governance) to improve integrated delivery of brief tobacco interventions by oral health professionals.

Technical resources and tools are necessary to support countries in their efforts to promote integration of brief tobacco interventions and oral health programmes. WHO has developed a training package entitled “Strengthening health systems for treating tobacco dependence in primary care”, a tobacco cessation guide containing a fact sheet on tobacco use and oral diseases for oral patients, a practical toolkit for oral health professionals to deliver 5As and 5Rs brief tobacco interventions. If every tobacco user attending oral health care facilities is provided with brief tobacco interventions, it will have a major impact on tobacco use prevalence.

Acknowledgements

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Part I

Association between tobacco use and oral diseases: a systematic review

1. Introduction

Tobacco use and exposure to tobacco smoke harms oral and overall health. With respect to oral health, evidence confirms or suggests that tobacco use has a causal relationship with many oral diseases and conditions including oral cancers and other mucosal lesions, oral clefts, periodontal diseases, dental caries, and premature tooth loss (1). Exposure to second-hand smoke is also associated with oral diseases that include periodontal disease, tooth loss, early childhood dental caries and gingival pigmentation in children (2). In addition, tobacco is consumed in many forms and in several different ways: being smoked as cigarettes, cigars, or in pipes, or being used in smokeless forms, such as chewing tobacco or absorption through the nose. Until now, comprehensive, quantitative evaluations of the association between different forms of tobacco use and oral diseases are scarce. Therefore, a systematic review was conducted to quantify:

- Are there causal relationships between tobacco use and oral diseases?
- What forms of tobacco use are causally associated with oral diseases?
- What types of oral diseases are caused by tobacco use?

2. Methodology for the systematic review

2.1. SELECTION OF ARTICLES

Our research strategy was to review all English language research articles on tobacco use and oral health that met the inclusion criteria. To identify relevant articles, PubMed (MEDLINE) were systematically searched for English language publications from 2005–2015, using the following Medical Subject Headings (MeSH) key words: “smoking”, “tobacco, smokeless”, “tobacco smoke pollution”, “mouth diseases” and “tooth diseases”. These terms were also searched as title words in Google Scholar. Reference lists from published studies, review articles including one on exposure to second-hand smoke and dental caries(2) and one on tobacco use and tooth loss(3), and the 2014 report of the US Surgeon General(1), were examined to identify additional studies. Identified references were then more fully examined if the title or abstract indicated possible relevance, and full texts were collected for screening to be included

according to inclusion criteria (given below). Oral microorganisms are also included in primary outcomes which were evaluated based on literature published since 2008. Each article initially chosen as acceptable for inclusion was reviewed for data extraction by two different reviewers.

2.2. INCLUSION CRITERIA

Published journal articles of prospective cohort study, cross-sectional study and case-control study that were available in the full text, either online or paper-based, and included effect estimates of tobacco use in relation to oral health outcomes (gingival neoplasms, oral leukoplakia, lip neoplasms, palatal neoplasms, salivary gland neoplasms, tongue neoplasms, periodontal diseases, tooth loss and dental caries) were examined for inclusion. All selected articles were required to provide information on study design (cross-sectional or cohort study), sample size, participants (sex, age, country residence and representativeness), type of exposure (forms of tobacco use), statistical significance of dose-response relationship, special mention: sensitivity analysis, subgroup and other types of analyses and the source of funding, definition and prevalence of the oral health outcomes.

2.3. DEFINITIONS

Tobacco use and tobacco smoke exposure are as follows:

1) Tobacco use was defined as self or family reported tobacco smoking, chewing or taking tobacco through the nose. The best measures for determining reported tobacco use were defined as biochemically validated self-report for active smoking: expired CO > 8ppm or saliva cotinine > 15 ng/ml or urinary cotinine > 50 ng/ml unless nicotine replacement therapy is used. 2) Exposure to second-hand smoke was defined as self or family reported or validated with cotinine testing. A failure to provide an explanation of how tobacco use and second-hand smoke exposure were determined was considered unacceptable.

Outcome measures included clinical, radiological or histological diagnosis. For mortality studies, death certificate notification, medical records or family report were considered acceptable sources of information.

2.4. DATA COLLECTION AND ANALYSIS

The literature search was based on electronic and manual (hand) searches. The screening was conducted by title, abstract and key words. Two reviewers independently screened every article to assess full eligibility by full-text reading. The search results for meta-analysis were stored using literature management software on the basis of the title and abstract (EndNote x7.5, Thomson Reuters, New York).

Two reviewers independently assessed the methodological quality of all studies using the Newcastle Ottawa Scale (NOS, see **Appendix 1**), which assessed each criterion for eight items regarding the methodology of observational studies.

Evidence synthesis was completed according to both study quality and study design. The odds ratio meta-analysis of relevant outcome indicators was conducted using the Review Manager, the software used for preparing and maintaining Cochrane Reviews (RevMan 5.3, Cochrane, Informatics and Knowledge Management Department). Subgroup and/or sensitivity analysis was performed if appropriate.

3. Results

3.1. NUMBER OF STUDIES

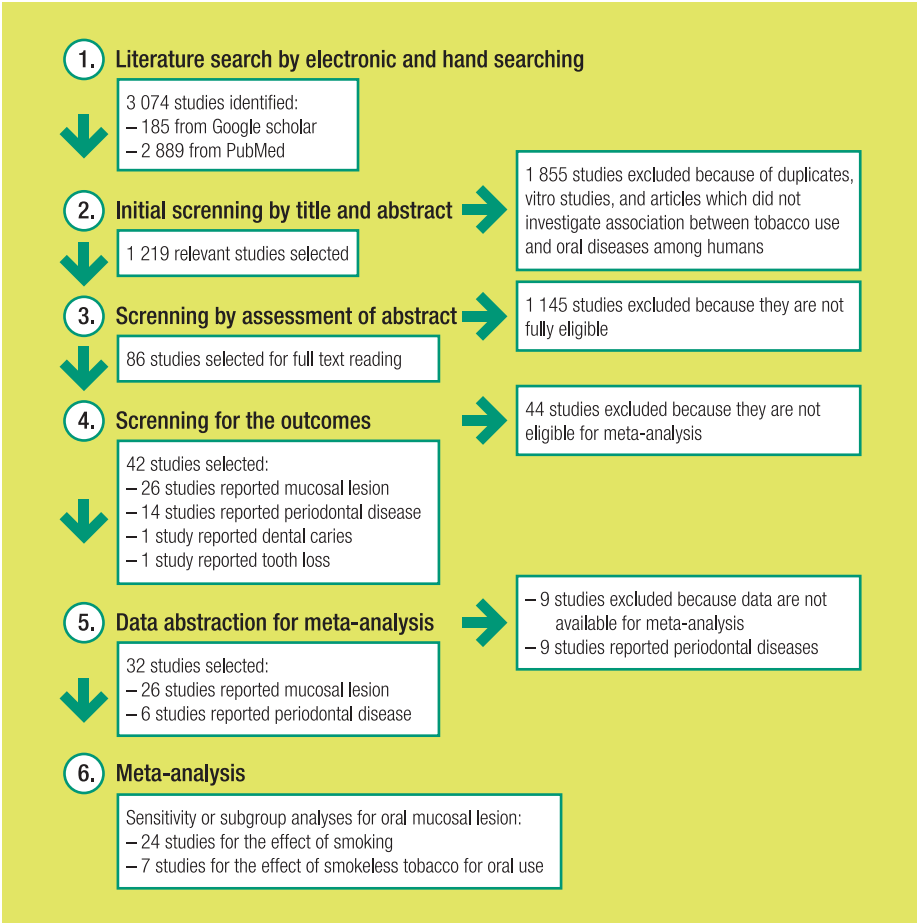
3.1.1. *Oral mucosal lesion, periodontal disease, and dental caries*

The electronic and manual searches yielded 3 074 citations (**Figure 1**). The initial screening by title and abstract identified 1 219 relevant studies for further assessment of abstracts. Among the reviewed studies, 86 relevant studies were identified for a full-text review. Outcomes were reported in 42 studies. The remaining 44 were excluded.

Among the studies which were selected for meta-analysis, oral mucosal lesion and periodontal disease was reported in 26 and 14 studies respectively. Dental caries were reported in one study. Finally, data were available for meta-analysis of the oral mucosal lesion and periodontal disease from 26 (4-29) and six (30-35) studies respectively. An overview of the selected studies for analysis of oral mucosal lesion and periodontal disease are described in **Appendix 2 and 3**, respectively.

Sensitivity and subgroup analyses were performed to evaluate the effect of smoking in 24 studies (4-10, 12-28), the effect of smokeless tobacco for oral use in seven studies (6, 7, 9, 10, 16, 17, 29).

Figure 1. Flow of studies through the review processes for examining the association between tobacco use and oral diseases.

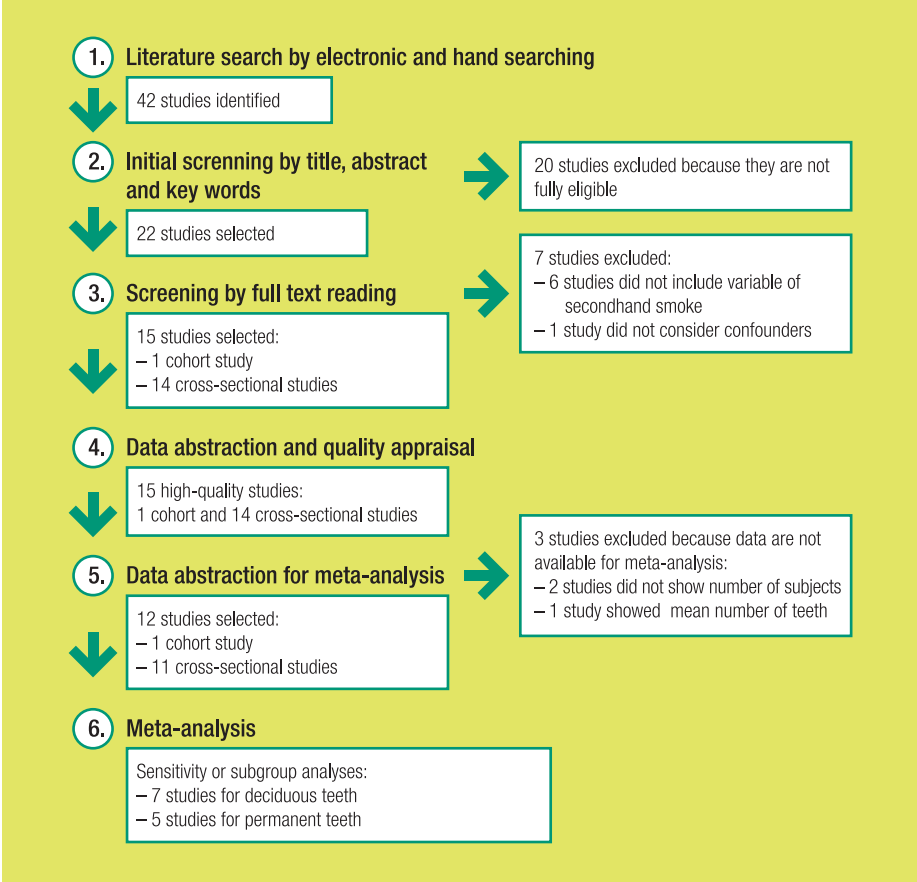


3.1.2. Dental caries associated with exposure to second-hand smoke

Detailed results of searched studies for quality assessment and evidence synthesis were described in the previous study (2). The electronic and manual searches yielded 42 citations (Figure 2). The initial screening by title, abstract, and key word identified 22 relevant studies for full-text reading. Among the reviewed studies, 15 studies were identified for quality appraisal. According to the analysis of abstracted data, all studies were categorized for high quality in methodology.

Finally, data from 12 studies, one cohort (36) and 11 cross-sectional studies (37-47), were available for meta-analysis. Sensitivity and subgroup analyses were performed to evaluate the effect on dental caries of deciduous and permanent teeth in seven (37-39, 42-45) and six (36, 38, 40, 41, 45, 46) studies, respectively.

Figure 2. Flow of studies through the review processes for examining the association between exposure to second-hand smoke and dental caries.

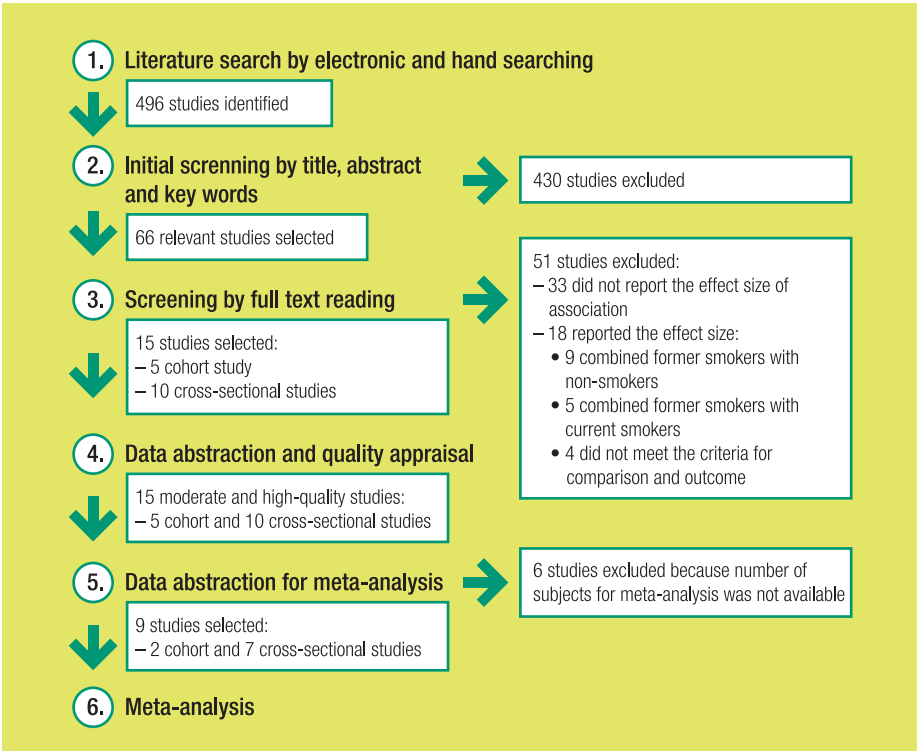


3.1.3. Tooth loss

Detailed results of searched studies for quality assessment and evidence synthesis were described in the previous study (3). Electronic and manual searches yielded 496 citations (**Figure 3**). The initial screening by title, abstract, and key word identified 66 relevant studies for full-text reading. Among the reviewed studies, 15 were identified for quality appraisal. According to the analysis of abstracted data, eight and seven studies respectively were categorized for high and moderate quality.

Finally, data from nine studies, two cohort (48, 49) and seven cross-sectional studies (50-56), were available for meta-analysis.

Figure 3. Flow of studies through the review processes for examining the association between tobacco use and tooth loss.



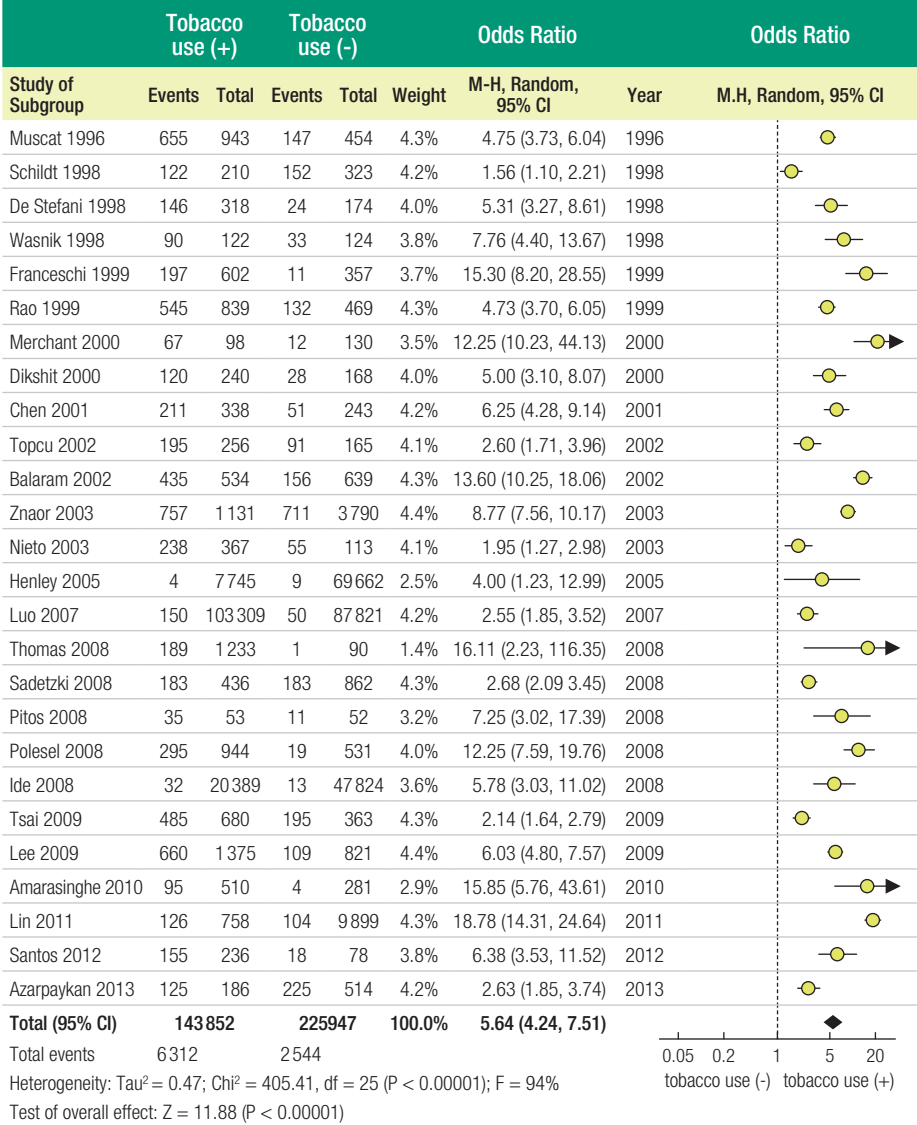
3.2. STRENGTH OF ASSOCIATION WITH CHARACTERISTICS OF STUDIES

3.2.1. Oral cancer and leukoplakia

Tobacco users in 24 countries were examined in 26 studies selected for meta-analysis. Among them, six studies were reported from India (7, 9, 10, 13, 16, 28), three studies examined subjects in the USA (4, 12, 29), and two studies were reported from Sweden (6, 17), Italy (8, 20) and Sri Lanka (14, 25) respectively. One study examined reported the effect in 10 European countries (23). The effect of smoking was reported in 24 studies, while the effect of chewing tobacco was reported from India in four studies (7, 9, 10, 16), Sweden in two studies (6, 17), and the USA in one (29).

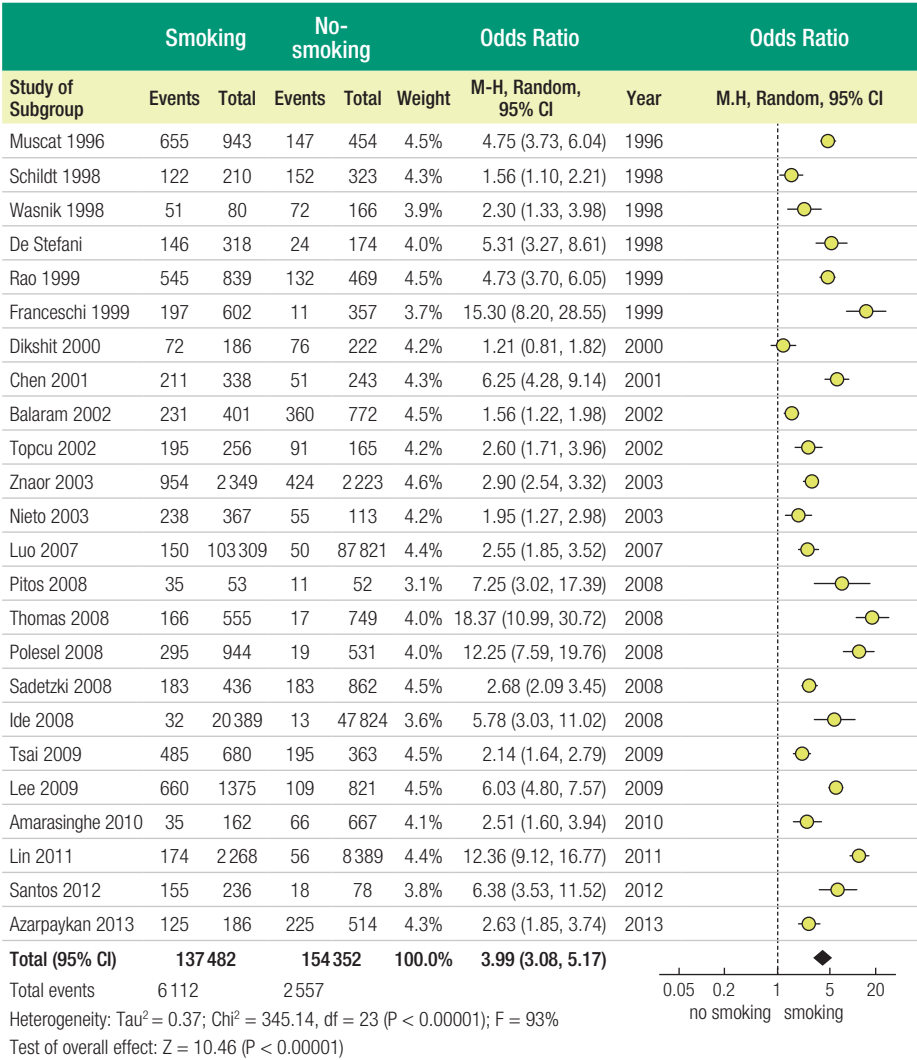
Results of the meta-analysis of odds ratios of oral cancer and leukoplakia in current- vs never-tobacco users are shown in **Figure 4**. A forest plot of random-effects model analysis showed a wide range of odds ratios. The pooled odds ratio of 143 852 tobacco users and 225 947 non-users as estimated by the random-effects model was 5.64 (95%CI: 4.24-7.51). Significant heterogeneity was seen between studies, with a *P*-value of < 0.001 and *I*² of 94%.

Figure 4. Forest plots of the odds ratio of tobacco use for oral cancer and leukoplakia with combined odds ratio calculated using the random-effects model.



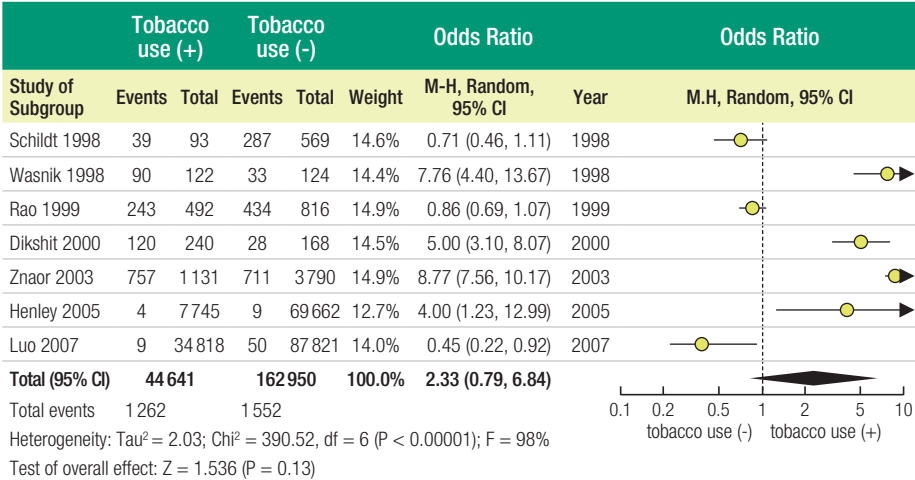
Results of the meta-analysis of the odds ratios of oral cancer and leukoplakia in current-vs-never-smokers are shown in **Figure 5**. A forest plot of random-effects model analysis showed a wide range of odds ratios, 1.5-21.3. The pooled odds ratio of 137 482 tobacco users and 154 352 non-users as estimated by the random-effects model was 3.99 (95%CI: 3.08-5.17). Significant heterogeneity was also seen between studies, with a *P*-value of < 0.001 and *I*² of 93%.

Figure 5. Forest plots of the odds ratio of smoking for oral cancer and leukoplakia with combined odds ratio calculated using the random-effects model.



Results of the meta-analysis of the odds ratios of oral cancer and leukoplakia in current-vs-never-users of chewing tobacco are shown in **Figure 6**. A forest plot of random-effects model analysis also showed a wide range of odds ratios from 0.5-8.8. The pooled odds ratio of 44 641 users and 162 950 non-users as estimated by the random-effects model was 2.33 (95%CI: 0.79-6.84). Significant heterogeneity was also seen between studies, with a *P*-value of < 0.001 and *I*² of 98%.

Figure 6. Forest plots of the odds ratio of use of chewing tobacco for oral cancer and leukoplakia with combined odds ratio calculated using the random-effects model.

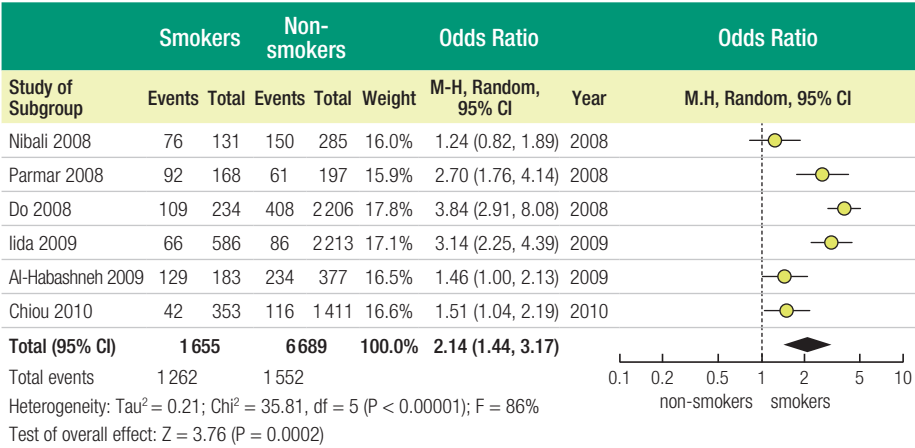


3.2.2. Periodontal disease

Only six studies were selected for meta-analysis of the odds ratio (30-35). Indeed, the 2004 Surgeon General Report concluded that the evidence is sufficient to infer a causal association between smoking and periodontal disease.

Results of the meta-analysis of the odds ratio of periodontal disease in current-vs-never-smokers are shown in **Figure 7**. A forest plot of random-effects model analysis showed a relatively wide range of odds ratios of 1.2-3.8. The pooled odds ratio of 1 655 current smokers and 6 689 never smokers as estimated by the random-effects model was 2.14 (95%CI: 1.44-3.17). Significant heterogeneity was seen between studies, with a *P*-value of < 0.001 and *I*² of 86%.

Figure 7. Forest plots of the odds ratio of smoking for periodontal disease with combined odds ratio calculated using the random-effects model.



3.2.3. Dental caries

Active smoking

In the present search of studies, only one study was available to estimate the association of tobacco use and dental caries. Therefore, the conclusion of the 2014 Surgeon General Report stating that the evidence is suggestive but not sufficient to infer a causal relationship between active cigarette smoking and dental caries would be a reliable statement in the present review.

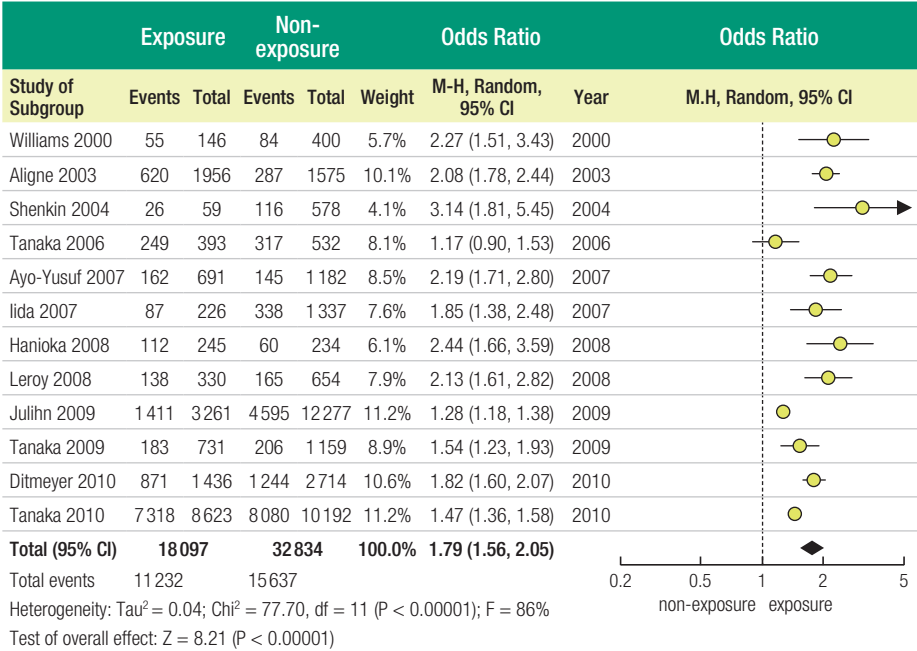
Exposure to second-hand smoke

The Surgeon General report also addressed the effect of exposure to second-hand smoke on dental caries in children. The report also stated that the evidence is suggestive but not sufficient to infer a causal relationship.

The previous study described characteristics of selected studies (Hanioka, 2011a). Among 15 studies, five were reported from the United States and another five from Japan.

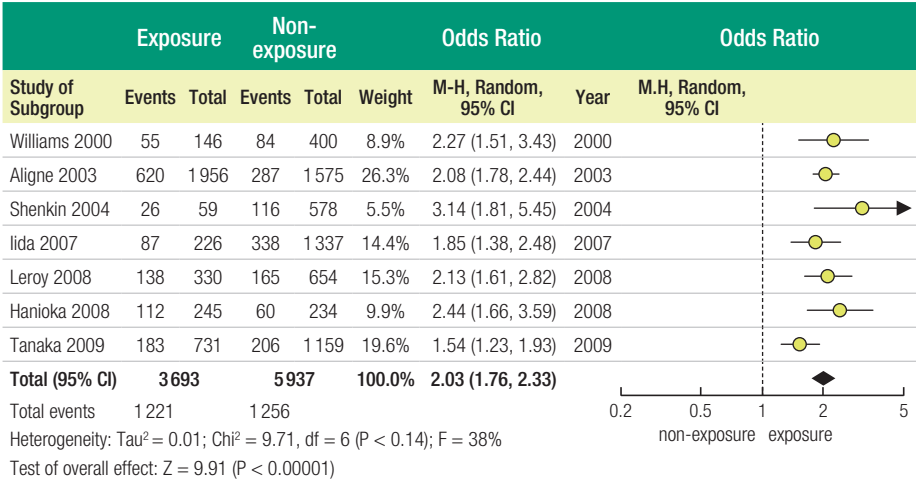
Results of the meta-analysis of odds ratios of dental caries in exposed-vs-never-exposed children under the age of 19 years are shown in **Figure 8**. A forest plot of random-effects model analysis showed a relatively wide range of odds ratios of 1.2-3.1. The pooled odds ratio of 18 097 children with exposure to second-hand smoke and 32 834 children without exposure as estimated by the random-effects model was 1.79 (95%CI: 1.56-2.05). Significant heterogeneity was seen between studies, with a P value of < 0.001 and I² of 86%.

Figure 8. Forest plots of the odds ratio of exposure to second-hand smoke for dental caries with combined odds ratio calculated using the random-effects model.



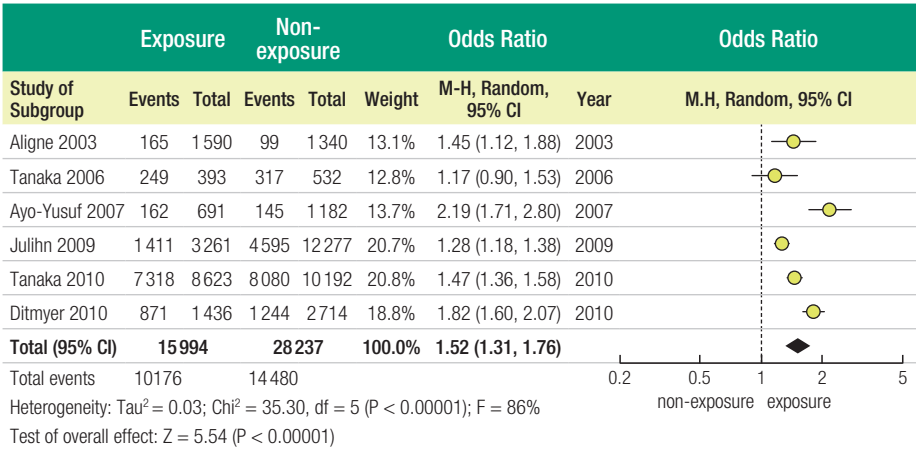
Results of the meta-analysis of odds ratios of dental caries of deciduous teeth in exposed-vs-never-exposed children under the age of seven years are shown in **Figure 9**. A forest plot of random-effects model analysis showed a relatively narrow range of odds ratios from 1.5-3.2. The pooled odds ratio of 3 693 children with exposure to second-hand smoke and 5 937 children without exposure as estimated by the random-effects model was 2.03 (95%CI: 1.76-2.33). Heterogeneity between studies was not significant, with a *P*-value of 0.14 and *I*² of 38%.

Figure 9. Forest plots of the odds ratio of exposure to second-hand smoke for dental caries of deciduous teeth with combined odds ratio calculated using the random-effects model.



Results of the meta-analysis of odds ratios of dental caries of permanent teeth in exposed-vs-never-exposed children under the age of 19 years are shown in **Figure 10**. A forest plot of random-effects model analysis showed a relatively narrow range of odds ratios, from 1.2-2.2. The odds ratios for permanent teeth were somewhat lower than those for deciduous teeth. The pooled odds ratio of 15994 children with exposure to second-hand smoke and 28237 children without exposure as estimated by the random-effects model was 1.52 (95%CI: 1.31-1.76). Significant heterogeneity was seen between studies, with a *P*-value of < 0.001 and *I*² of 86%.

Figure 10. Forest plots of the odds ratio of exposure to second-hand smoke for dental caries of permanent teeth with combined odds ratio calculated using the random-effects model.

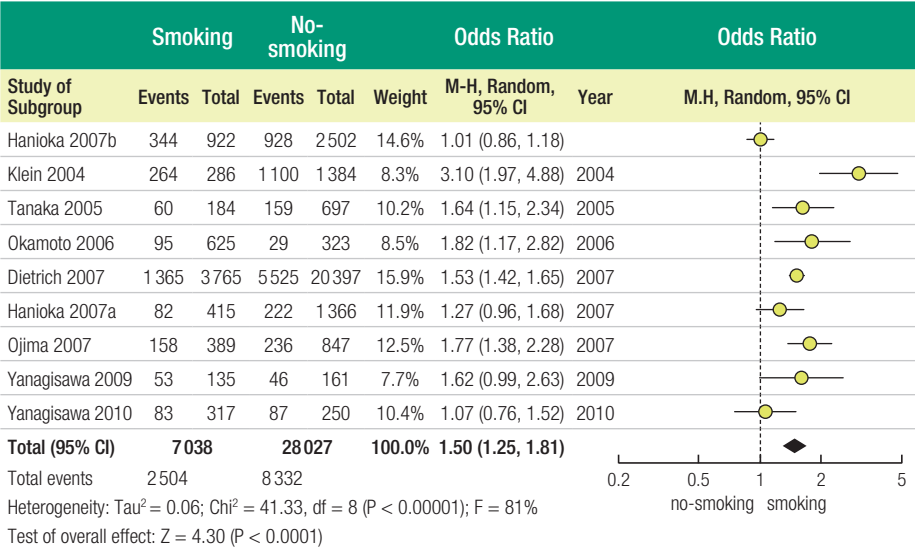


3.2.4. Tooth loss

The previous study described characteristics of selected studies (Hanioka, 2011b). Among 15 studies, seven were reported from Japan and another five from the United States. Definition of tooth loss varied according to age group examined because of the cumulative nature of lost teeth with age.

Results of the meta-analysis of odds ratios of tooth loss in current-vs-never smokers are shown in **Figure 11**. A forest plot of random-effects model analysis showed a relatively wide range of odds ratios, from 1.0-3.1. The pooled odds ratio of 7 038 current smokers and 28 027 never smokers as estimated by the random-effects model was 1.50 (95%CI: 1.25-1.81). Significant heterogeneity was seen between studies, with a *P*-value of < 0.001 and *I*² of 81%.

Figure 11. Forest plots of the odds ratio of smoking for tooth loss with combined odds ratio calculated using the random-effects model.



3.2.5. Effects on oral microorganism

The number of articles reported since 2008 regarding the effects of tobacco exposure on periodontal pathogens, cariogenic bacteria, and human papillomavirus were 27, four and three, respectively.

Molecular and genetic factors were investigated to explain the effect of tobacco use on periodontal disease (56), although this effect is under investigation (57). The use of tobacco extract and nicotine revealed the effect of tobacco on the reinforcement of pathogenicity of periodontal microbe and reduction of the immune response (58-64).

Application of the 16S rRNA gene-based pyrosequencing has revealed that smoking decreases structural and functional resilience in the subgingival ecosystem (65-77). Smoking during periodontal treatment impairs recovery of the periodontal ecosystem (65, 66, 69, 78).

The effects of nicotine on cariogenic bacteria were demonstrated with respect to the enhancement of matrix production which may inhibit dilution of acid in the plaque, and then increase destruction of the structure of hard enamel on tooth surfaces (79-82). Human papilloma virus which is a significant risk of oral mucosal lesions was more frequently detected in smokers than never smokers (83-85).

4. Discussion

4.1. PRINCIPAL FINDINGS

The present study on the comprehensive analyses of the effect of tobacco use on oral health clearly confirmed quantitatively the causal relationship between tobacco use and oral diseases, and destruction of oral tissue that were qualitatively demonstrated. The risk estimate varied by oral disease. The association was strongest for oral cancer and leukoplakia.

Although combined strengths of association for periodontal disease and dental caries were less than for oral mucosal lesions, the significance of association are particularly important because of the high prevalence rate of these diseases. Furthermore, tooth loss negatively affects daily life because the accumulation of such damage impairs important functions such as mastication and conversation.

In the present analysis, the effect of exposure to second-hand smoke was quantitatively confirmed. Exposure to tobacco smoke in the oral cavity has a profound influence in terms of the effects on various age groups, as studies showed that it was significantly associated with dental caries for both deciduous and permanent teeth.

In a dental setting, the unique role would be accelerated by the novel findings regarding the effects of tobacco smoke exposure on the virulence of oral microorganisms including periodontal pathogens, cariogenic bacteria and human papillomavirus, although the effects on microorganisms by exposure to tobacco smoke should be further elucidated.

Since causal relationships have been established qualitatively for oral mucosal lesions such as oral cancer and leucoplakia, this review added quantitative evidence of the risk of tobacco use on these diseases of the oral cavity. Various forms of tobacco, including burning and smokeless tobacco, are harmful to oral health. Dental caries are associated with exposure to second-hand smoke for primary and permanent teeth because tobacco affects the virulence of oral microorganisms.

4.2. LIMITATIONS OF EXISTING ANALYSES

The huge limitation is the heterogeneity of combined results of odds ratios, which would be attributable to a lack of common indicators between studies. Furthermore, the potential difference in gender should be considered for interpretation of the results.

4.3. LIMITATIONS OF THE REVIEW PROCESS

This systematic review has some limitations that warrant discussion. First, the quality of methodology has not been assessed for all searched studies. Therefore, a wide range of odds ratios may be attributable in part to the variation of the quality of methodology by selected study. Second, due to time and funding restrictions, the review did not include papers in languages other than English, which may underestimate the magnitude of the association between tobacco use and oral diseases.

4.4. RECOMMENDATIONS FOR RESEARCH

Use of standardized methodology should be strongly recommended for this kind of comprehensive, quantitative evaluation for the strength of association.

5. References

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Part II

The potential benefits of tobacco cessation on oral health outcomes: a systematic review

1. Introduction

Supporting patients wishing to quit tobacco use should be an integral component of routine oral and dental practice. After cessation of tobacco use, patients will see immediate and long-term benefits, both for oral and overall health. For oral health, comprehensive and quantitative evaluation of the benefits of quitting on oral health outcomes is currently not available, although many studies have found tobacco cessation may be associated with a relatively rapid improvement in oral disease treatment outcomes (1). Therefore, we conducted a systematic review to evaluate whether tobacco cessation improves oral health outcomes. If the findings are encouraging, more oral and dental professionals may be willing to help tobacco users quit as part of their routine practice.

2. Methodology for the systematic review

2.1. SELECTION OF ARTICLES

Our research strategy was to review all English language research articles on tobacco use cessation and oral health that met the inclusion criteria. To identify relevant articles, PubMed (MEDLINE) was systematically searched for English language publications from 1996–2015, using the following Medical Subject Headings (MeSH) key words: “tobacco use cessation”, “smoking cessation”, “oral hygiene”, “oral health”, “mouth diseases”, “tooth loss” and “tooth diseases”. These terms were also searched as title words in Google Scholar. Reference lists from published studies and review articles were examined to identify additional studies. Identified references were then more fully examined if the title or abstract indicated possible relevance, and full texts were collected for screening to be included according to inclusion criteria (given below). Each article initially chosen as acceptable for inclusion was reviewed for data extraction by two different reviewers.

2.2. INCLUSION CRITERIA

Published journal articles of longitudinal studies (randomized controlled trials and cohort studies) of adolescents and adults that met the following criteria were examined for inclusion:

- reported data on those who had continued using tobacco and those who had quit tobacco use during the study period.
- assessed oral health before tobacco cessation and at least three months after cessation, or baseline in clinical or community settings
- were available in the full text either online or paper-based.

All selected articles were required to provide information on study design, sample size, participants (sex, age, country of residence and representativeness), type of exposure/interventions, outcome assessment (length of follow-up, definition of cessation and oral health outcomes).

2.3. DEFINITIONS

Tobacco use was defined as self or family reported tobacco smoking, chewing or taking tobacco through the nose. The best measures for determining reported tobacco use were defined as biochemically validated self-reporting for active smoking: expired CO > 8ppm or saliva cotinine > 15 ng/ml or urinary cotinine > 50 ng/ml unless nicotine replacement therapy is used.

Quitting/cessation was defined as self-reported continuous or point prevalence and type of tobacco abstinence (all tobacco versus smokeless tobacco only). Biochemical validation of self-reported cessation was not required but was recorded and used where available.

Oral health outcome measures included clinical, radiological or histological diagnosis. For mortality studies, death certificate notification, medical records or family report were considered acceptable sources of information.

2.4. DATA COLLECTION AND ANALYSIS

The literature search was based on electronic and manual searches. The screening was conducted by title, abstract and key words. Two reviewers independently screened every article by full-text reading to assess full eligibility. The screening process, evidence synthesis and statistical analysis was completed following the system developed by the Cochrane Collaboration Handbook with the Review Manager which is the software used for preparing and maintaining Cochrane Reviews (RevMan 5.3, Cochrane, Informatics and Knowledge Management Department). Subgroup and/or sensitivity analysis was performed if appropriate.

3. Results

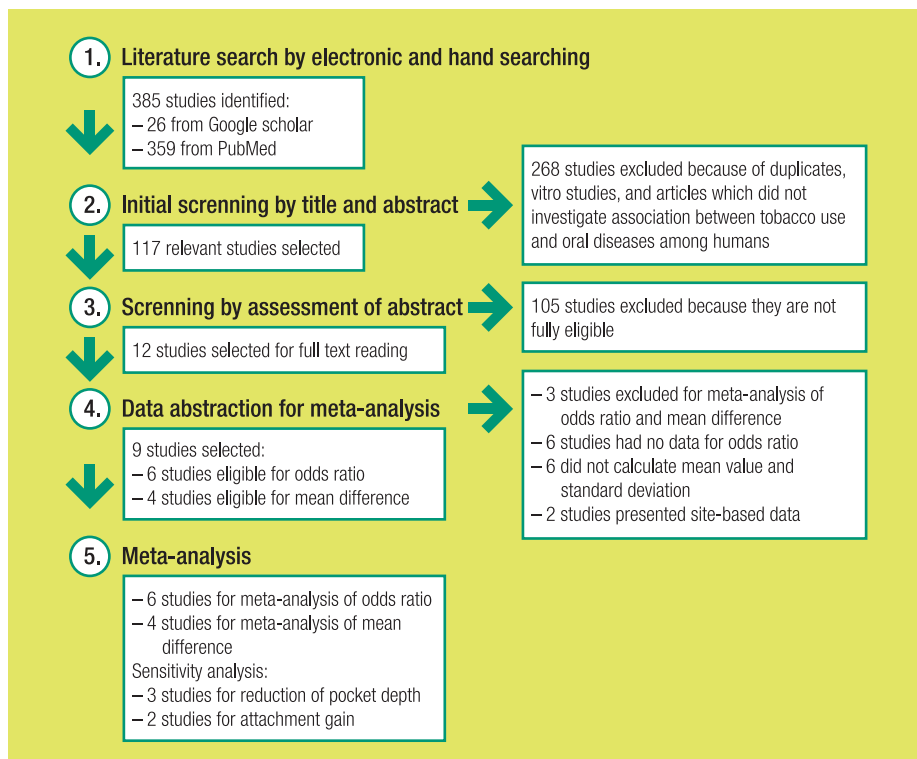
3.1. NUMBER OF STUDIES

The electronic and manual searches yielded 385 citations (Figure 12). The initial screening by title and abstract identified 117 relevant studies for deeper assessment of abstract. Among the reviewed studies, outcomes of the potential benefit of tobacco cessation on oral health were reported in 12 studies (2-13). Overview of the selected studies was described in **Appendix 4**. The remaining 105 were excluded.

Among the studies which were selected for meta-analysis, nine were available for meta-analysis (2-4, 6-10, 12). Data from six studies were available for meta-analysis of odds ratio (2-4, 6, 9, 12). Among six studies which calculated mean value and standard deviation, two presented site-based data (6, 13) and four were eligible for meta-analysis of mean difference (4, 7, 8, 10).

However, a common measure for these four studies was not available. Therefore, sensitivity analysis for mean difference was performed for reduction of pocket depth by using data from three studies (4, 7, 10) and for attachment gain using data from two studies (4, 7).

Figure 12. Flow of studies through the review processes for the benefit of quitting tobacco use.

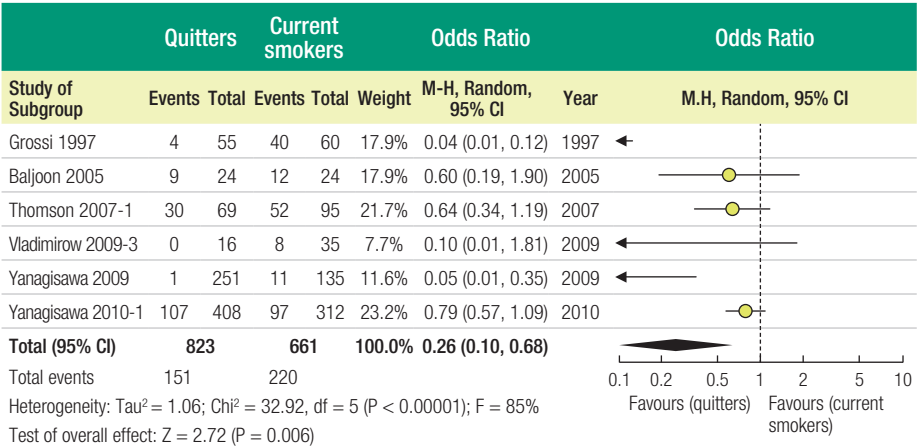


3.2. EFFECTS OF TOBACCO USE CESSATION

Among six studies analysed for odds ratios, two were reported from Japan and assessed the number of lost teeth. Changes in periodontal health were assessed in three studies which were reported from the United States, Sweden and New Zealand. One study from Denmark evaluated the risk of new lesions or malignancies after surgical excision of the oral malignant lesion.

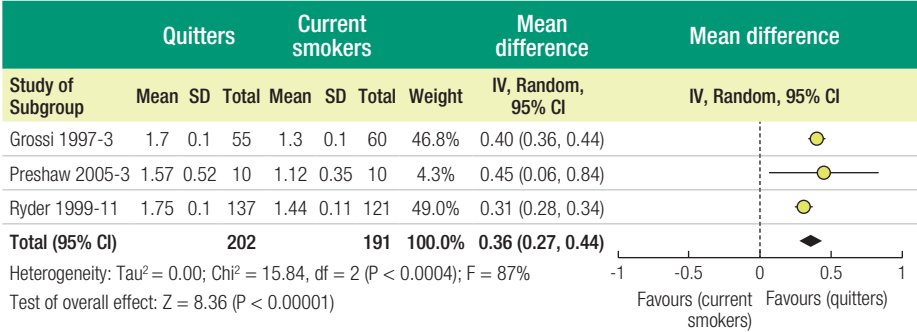
Results of the meta-analysis of odds ratios of quitting tobacco use in former-vs-current-users are shown in **Figure 13**. A forest plot of random-effects model analysis for the effects of tobacco cessation on oral health showed a relatively wide range of odds ratios, from 0.1 to 0.8. The pooled odds ratio of 823 quitters and 661 current smokers as estimated by the random-effects model was 0.26 (95%CI: 0.10-0.68). Significant heterogeneity was seen between studies, with a *P*-value of < 0.001 and *I*² of 85%.

Figure 13. Forest plots of the odds ratio of quitting tobacco use for oral health with combined odds ratio calculated using the random-effects model.



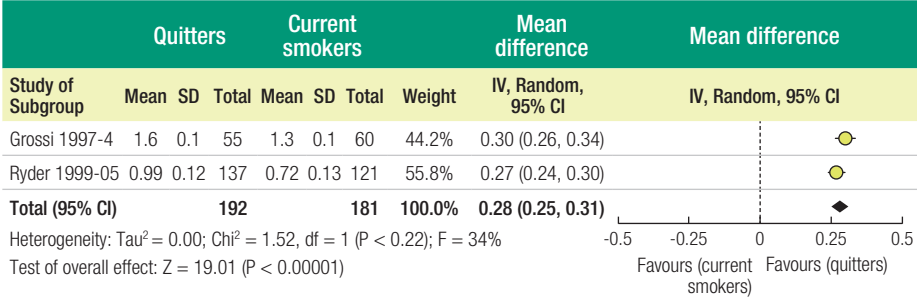
Results of the meta-analysis of mean difference of pocket depth between quitters and current smokers are shown in **Figure 14**. A forest plot of random-effects model analysis showed significant reduction of pocket depth. The pooled mean difference of 202 quitters and 191 current smokers as estimated by the random-effects model was 0.36 mm (95%CI: 0.27-0.44). Significant heterogeneity was seen between studies, with a *P*-value of < 0.001 and *I*² of 87%.

Figure 14. Forest plots of combined mean difference in pocket depth between former and current users calculated using the random-effects model.



Results of the meta-analysis of mean difference of quitting tobacco use in former-vs-current users for clinical attachment level are shown in **Figure 15**. A forest plot of random-effects model analysis showed a significant gain of attachment level. The pooled mean difference of 192 quitters and 181 current smokers as estimated by the random-effects model was 0.28 mm (95%CI: 0.25-0.31). Heterogeneity between studies was not significant, with a *P*-value of 0.22 and *I*² of 34%.

Figure 15. Forest plots of combined mean difference in clinical attachment level between former and current users calculated using the random-effects model.



4. Discussion

The effect of quitting smoking on oral health was confirmed qualitatively. Tobacco cessation could improve oral health outcomes as demonstrated in this quantitative analysis of the benefits of quitting. The benefits of tobacco cessation were reflected by the combined odds ratios of the effects on various kinds of oral health, periodontal disease, tooth loss and mucosal lesions. The diversity in the effects of quitting tobacco use would encourage oral health professionals to engage with tobacco users in a dental setting, as well as with non-smokers on the dangers of exposure to second-hand smoke.

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Part III

Integrating brief tobacco interventions into oral health programmes in primary care: policy recommendations

1. Introduction

The systematic review presented in the previous chapter demonstrated that there are adverse associations between tobacco use and oral disease, in that direct tobacco use and exposure to second-hand smoke are associated with oral cancer, periodontal diseases, dental caries and tooth loss.

The recognition of associations between tobacco use and oral health makes it imperative for national oral health programmes to actively support tobacco control efforts at both the clinical and community levels.

This chapter explores the possibilities and advantages of integrating brief tobacco interventions (brief advice) into oral health programmes in primary care. Its objectives are:

- to describe what oral health professionals can do to identify and support tobacco users to quit in primary care, and
- to propose the effective system changes needed for integrating tobacco cessation services into oral health programmes as part of oral health professionals' routine practice in primary care

1.1. WHO ORAL HEALTH PROGRAMME TOBACCO CONTROL POLICY

The objectives of the WHO Global Oral Health Programme, one of the technical programmes within the Department of Prevention of Noncommunicable diseases (PND), have been reoriented according to the new strategy of disease prevention and health promotion. There is greater emphasis on developing global policies in oral health promotion and oral disease prevention, coordinated more effectively with other priority programmes of PND and other clusters, and with external partners (1).

WHO recommends that oral health programmes should embrace what is termed “the common risk factor approach” to integrate oral health promotion into broader health promotion (2). Tobacco use, as a common risk factor between oral diseases and major chronic non-communicable diseases (NCDs), provides the rationale for national oral health programmes to support tobacco control.

The tobacco-related goal of the WHO Oral Health Programme is to ensure that oral health professionals and oral health organizations are directly, appropriately and routinely involved in influencing patients and the public to increase their awareness of the risks of tobacco use, and to avoid and discontinue the use of all forms of tobacco (3). The WHO Oral Health Programme aims to control tobacco-related oral diseases and adverse conditions through several strategies. Within WHO, the Programme enjoys a strong collaboration with the WHO Tobacco Free Initiative (TFI), and has always participated fully in oral health-related programmes. Externally, the Programme works in partnership with international and national oral health organizations to encourage the ratification and implementation of WHO Framework Convention on Tobacco Control (WHO FCTC).

Promoting the effective involvement of oral health professionals in tobacco cessation is one of the priority areas in relation to tobacco control recommended by the WHO Global Oral Health Programme (4). Therefore, national oral health programmes should routinely identify and treat patients who use tobacco, and all oral health professionals should be urged to integrate tobacco cessation services into their routine practice, particularly in primary care.

1.2. WHO POLICY ON TOBACCO CESSATION

Supporting current tobacco users to quit, consistent with Article 14 of the WHO FCTC, has been recommended by WHO as part of a comprehensive tobacco control package to achieve voluntary global targets related to tobacco use, as well as the premature mortality target in the WHO Global Action Plan for the Prevention and Control of Noncommunicable Diseases (2013–2020) (5). There is strong evidence that supporting current tobacco users to quit synergistically with other population-level tobacco control measures can bring about significant changes in the prevalence of tobacco use and tobacco-related death and disease in the short- to medium-term. It was estimated that if adult tobacco consumption were to decrease by 50% by 2020, about one third of global tobacco-related deaths could be avoided within 30 years (6).

Currently, only 15% of the world population has access to comprehensive tobacco cessation services, and 97 countries are providing tobacco cessation support in some or most primary care facilities with some cost coverage, according to the WHO Report on the Global Tobacco Epidemic 2015 (7). Therefore, technical assistance to WHO Member States in establishing and improving their national tobacco cessation and treatment systems is urgently needed.

Guidelines for the implementation of Article 14 of the WHO FCTC recommend integrating brief tobacco interventions into existing health care systems as a first step for Parties to develop comprehensive treatment systems. Although brief tobacco interventions should be made available throughout a country's health system at all levels of service delivery, the primary care setting should be the main focus. It has the potential to reach the majority of tobacco users in many countries, where the cost of service delivery in primary care settings is relatively low. National oral health programmes could provide a priority health care platform for integration of brief tobacco interventions in primary care because oral health professionals are in a unique position to identify and help tobacco users, especially those who are young and "healthy" (8).

1.3. THE UNIQUE ROLE OF ORAL HEALTH PROFESSIONALS IN HELPING TOBACCO USERS

Oral health professionals are able to reach large numbers of tobacco users and have considerable potential in persuading them to quit. In developed countries, more than 60% of tobacco users see their dentist or dental hygienist annually (9). As emphasized in the World Oral Health Report 2003 (8), there are also ethical, moral and practical reasons why oral health professionals can play an important role in helping tobacco users to quit:

- They are particularly concerned about the adverse effects caused by tobacco use in the oropharyngeal area of the body.
- They typically have access to children, young people and their caregivers, thus providing opportunities to influence individuals to quit or never begin using tobacco.
- They often have more time with patients than many other health professionals, providing opportunities to integrate tobacco cessation interventions into practice.
- They often treat women of childbearing age, and are thus able to explain the potential harm to babies from tobacco use.
- They are as effective as other health professionals in helping tobacco users quit.
- They can build their patient's interest in discontinuing tobacco use by showing actual tobacco effects in the mouth.

2. What should a national oral health programme do to promote tobacco cessation?

National oral health programmes can promote tobacco cessation both in the clinical setting where dental/oral patients are diagnosed and treated, and outside the clinical setting. In a clinical setting, such programmes should strengthen the oral health care service to ensure that every oral disease patient who uses tobacco is identified and provided with at least brief tobacco intervention. Outside the clinical setting, oral health professionals – both individually and through their professional associations – can actively support the implementation of tobacco control measures contained in other articles of the WHO FCTC to promote tobacco cessation and increase demand for tobacco cessation services.

2.1. ORAL HEALTH PROFESSIONALS SHOULD ROUTINELY OFFER BRIEF TOBACCO INTERVENTIONS TO ALL TOBACCO USERS IN PRIMARY CARE

There are a range of effective treatments for tobacco dependence, including brief advice to stop tobacco use (brief tobacco interventions) by health care professionals, more intensive behavioural support to quit (given individually, in a group or by phone), and pharmacological treatments. In line with the WHO FCTC Article 14 guidelines, WHO recommends that oral health professionals should at least deliver brief tobacco interventions as part of routine services in primary care.

Available evidence suggests that behavioural counselling (typically brief) conducted by oral health professionals in conjunction with an oral examination in the dental office or community setting can increase tobacco abstinence rates by 70% (odds ratio [OR] 1.71, 95% confidence interval [CI] 1.44 to 2.03) at six months or longer (10).

Helping oral patients to quit smoking as part of oral health care providers' routine practice takes only three-to-five minutes and is feasible, effective and efficient. The algorithm below can guide them to deliver three-to-five minute, brief tobacco interventions to oral patients in primary care by using the 5As and 5Rs models (Figure 16).

Figure 16. Algorithm for delivering brief tobacco interventions



Every oral health care provider should also educate about the dangers of second-hand smoke, and encourage their patients to avoid exposure to second-hand smoke and to create a smoke-free home for their children.

2.1.1. The 5As model to help patients ready to quit

There are several structured models available to help deliver brief tobacco interventions. The 5As and 5Rs are the most widely used delivery models for brief tobacco intervention in primary care.

The 5As (Ask, Advise, Assess, Assist, Arrange) summarize all the activities that an oral health care provider can do to help a tobacco user make a quit attempt within three-to-five minutes in a primary care setting (11).

Ask – Systematically identify all tobacco users at every visit.

Advise – Advise all tobacco users that they need to quit.

Assess – Determine readiness to make a quit attempt.

Assist – Assist the patient with a quit plan or provide information on specialist support.

Arrange – Schedule follow-up contacts or a referral to specialist support.

Ask: We need to ask **ALL** our patients if they use tobacco and make it part of our routine. Only then can we start to make a real difference to the tobacco use rates around us. Tobacco use should be asked about in a friendly way – it is not an accusation!

Advise: Your advice should be clear and positive. It should also be tailored to the particular patient’s characteristics and circumstances.

Assess: This will be determined by whether the patient wants to be a non-tobacco user, and whether they think they have any chance of quitting successfully.

Assist: If the patient is ready to quit then he or she will need some help from us. We need to assist tobacco users in developing a quit plan or to tell them about specialist support if it is available. The support needs to be described positively but realistically.

Arrange: If the patient is willing to make a quit attempt we should arrange follow-up around one week after the quit date, or arrange referrals to the specialist support.

The 5As model can guide oral health care providers to talk about tobacco use and deliver advice to patients who are ready to quit. Below are recommended actions and strategies for implementing each of the 5As (Table 1) (12).

Table 1. The 5As brief tobacco interventions for patients ready to quit

5A's	Action	Strategies for implementation
Ask - Systematically identify all tobacco users at every visit.	<ul style="list-style-type: none"> Ask ALL of your patients at every encounter if they use tobacco and register the information in the patient’s dental treatment card. Make it part of your routine. 	<ul style="list-style-type: none"> Tobacco use should be asked about in a friendly way – it is not an accusation. Keep it simple, some sample questions may include: <ul style="list-style-type: none"> “Do you smoke cigarettes?” “Do you use any tobacco products?” Tobacco use status should be included in all medical notes. Countries should consider expanding the vital signs to include tobacco use, or using tobacco use status stickers on all patient charts, or indicating tobacco use status via electronic medical records.
Advise - Persuade all tobacco users that they need to quit.	<ul style="list-style-type: none"> Urge every tobacco user to quit in a clear, strong and personalized manner. 	<p>Advice should be:</p> <ul style="list-style-type: none"> Clear – “It is important that you quit smoking (or using chewing tobacco) now, and I can help you.” “Cutting down while you are ill is not enough.” “Occasional or light smoking is still dangerous.” Strong – “As your dentist, I need you to know that quitting tobacco use is the most important thing you can do to protect your health now and in the future. We are here to help you.” Personalized – Tie tobacco use to: <ul style="list-style-type: none"> <i>Demographics:</i> For example, women may be more interested in the effects of smoking on fertility, bad breath, stained teeth and dark lips.

5A's	Action	Strategies for implementation								
		<ul style="list-style-type: none">– <i>Health concerns</i>: Asthma sufferers may need to hear about the effect of smoking on respiratory function, while those with periodontal disease may be interested in the effects of smoking on oral health. “Continuing to smoke makes your periodontal disease worse, and quitting may dramatically improve your oral health.”– <i>Social factors</i>: People with young children may be motivated by information on the effects of second-hand smoke, while a person struggling with money may want to consider the financial costs of tobacco use. “Quitting smoking may reduce the number of ear infections your child has.” <p>In some cases, how to tailor advice for a particular patient may not always be obvious. A useful strategy may be to ask the patient:</p> <ul style="list-style-type: none">– “What do you <i>not</i> like about being a smoker?” <p>The patient’s answer to this question can be built upon by you with more detailed information on the issue raised.</p> <ul style="list-style-type: none">– Example: <p>Dentist: “What do you not like about being a tobacco user?”</p> <p>Patient: “Well, I don’t like how much I spend on tobacco.”</p> <p>Dentist: “Yes, it does build up. Let’s work out how much you spend each month. Then we can think about what you could buy instead!”</p>								
Assess - Determine readiness to make a quit attempt	<ul style="list-style-type: none">• Ask two questions in relation to “importance” and “self-efficacy”: <ol style="list-style-type: none">1. “Would you like to be a non-tobacco user?”2. “Do you think you have a chance of quitting successfully?”	<ul style="list-style-type: none">• Any answer in the shaded area indicates that the tobacco user is NOT ready to quit. In these cases you should deliver the 5 R’s intervention (see Session 4.1.2). <table><tr><td>Question 1</td><td>Yes</td><td>Unsure</td><td>No</td></tr><tr><td>Question 2</td><td>Yes</td><td>Unsure</td><td>No</td></tr></table> <ul style="list-style-type: none">• If the patient is ready to go ahead with a quit attempt you can move on to Assist and Arrange steps.	Question 1	Yes	Unsure	No	Question 2	Yes	Unsure	No
Question 1	Yes	Unsure	No							
Question 2	Yes	Unsure	No							

5A's	Action	Strategies for implementation
Assist - Help the patient with a quit plan	<ul style="list-style-type: none"> • Help the patient develop a quit plan • Provide practical counseling • Provide intra-treatment social support • Provide supplementary materials, including information on quit lines and other referral resources • Recommend the use of approved medication if needed 	<ul style="list-style-type: none"> • Use the STAR method to facilitate and help your patient to develop a quit plan: <ul style="list-style-type: none"> – Set a quit date ideally within two weeks. – Tell family, friends, and coworkers about quitting, and ask for support. – Anticipate challenges to the upcoming quit attempt. – Remove tobacco products from the patient's environment and make their home tobacco free. • Practical counseling should focus on three elements: <ul style="list-style-type: none"> – Help the patient identify the danger situations (events, internal states, or activities that increase the risk of smoking or relapse). – Help the patient identify and practice cognitive and behavioral coping skills to address the danger situations. – Provide basic information about smoking and quitting • Intra-treatment social support includes: <ul style="list-style-type: none"> – Encourage the patient in the quit attempt – Communicate caring and concern – Encourage the patient to talk about the quitting process • Make sure you have a list of existing local tobacco cessation services (quit lines, tobacco cessation clinics and others) on hand whenever a patient enquires. • The support given to the patient needs to be described positively but realistically.
Arrange - Schedule follow-up contacts or a referral to specialist support	<ul style="list-style-type: none"> • Arrange a follow-up contact with your dental patient either in person or by telephone. • Refer the patient to specialist support if needed 	<ul style="list-style-type: none"> • When: The first follow up contact should be arranged during the first week after the quit date. A second follow up contact is recommended one month thereafter. • How: Use practical methods such as telephone, personal visit and mail/email to follow up. Following up with patients is recommended through a team approach if possible. • What: <p>For all patients:</p> <ul style="list-style-type: none"> – Identify problems already encountered and anticipate challenges. – Remind patients of available extra-treatment social support. – Assess medication use and problems. – Schedule next follow up contact. <p>For patients who are abstinent:</p> <ul style="list-style-type: none"> – Congratulate them on their success <p>For patients who have used tobacco again:</p> <ul style="list-style-type: none"> – Remind them to view relapse as a learning experience. – Review circumstances and elicit recommitment. – Link to more intensive treatment if available.

2.1.2. The 5Rs model to increase motivation to quit.

The 5Rs – relevance, risks, rewards, roadblocks and repetition – should be addressed during a motivational counselling intervention to help those who are not ready to quit. Tobacco users may be unwilling to quit because they don’t think it is important to them, or they don’t feel confident in their ability. Therefore, after asking about tobacco use, advising the tobacco user to quit, and assessing the willingness to make a quit attempt, it is important to provide the 5Rs motivational intervention (11).

Relevance – How is quitting personally relevant to you?

Risks – What do you know about the risks of tobacco use?

Rewards – What would be the benefits of quitting in that regard?

Roadblocks – What would be difficult about quitting?

Repetition – Repeat assessment of readiness to quit; if still not ready to quit, repeat intervention at a later date.

If the patient doesn’t want to be a non-tobacco user (doesn’t think that quitting is important), the oral health care providers should focus more time on “Risks” and “Rewards”. If the patient wants to discontinue tobacco use but doesn’t think he or she can quit successfully (doesn’t feel confident in their ability to quit), more time should be spent on the “Roadblocks”. If patients are still not ready to quit, we need to end positively with an invitation to return if they change their minds.

Table 2 summarizes useful strategies to deliver a brief motivational intervention in primary care (12).

Table 2. The 5Rs brief motivational intervention for patients not ready to quit

5Rs	Strategies for implementation	Example
Relevance	Encourage the patient to indicate how quitting is personally relevant to him or her. Motivational information has the greatest impact if it is relevant to a patient’s disease status or risk, family or social situation (e.g. having children in the home), health concerns, age, sex, and other important patient characteristics (e.g. prior quitting experience, personal barriers to cessation).	Oral Health Care Provider (OHCP): “How is quitting most personally relevant to you?” P: <i>“I suppose smoking is bad for my health.”</i>

5Rs	Strategies for implementation	Example
Risks	<p>Encourage the patient to identify potential negative consequences of tobacco use that are relevant to him or her.</p> <p>Examples of risks are:</p> <ul style="list-style-type: none"> • Acute risks: shortness of breath, exacerbation of asthma, increased risk of respiratory infections, harm in pregnancy, impotence and infertility. • Long-term risks: heart attacks and strokes, lung and other cancers (e.g. larynx, oral cavity, pharynx, esophagus), chronic obstructive pulmonary diseases, osteoporosis, long-term disability and need for extended care. • Environmental risks: increased risk of lung cancer and heart disease in spouses; increased risk for low birth-weight, sudden infant death syndrome, asthma, middle ear disease and respiratory infections in children of smokers. 	<p>OHCP: “What do you know about the risks of smoking to your health? What particularly worries you?”</p> <p>P: “<i>I know it causes oral cancer. That must be awful.</i>”</p> <p>OHCP: “That’s right – the risk of having oral cancer is many times higher among tobacco users.”</p>
Rewards	<p>Ask the patient to identify potential relevant benefits of stopping tobacco use.</p> <p>Examples of rewards could include:</p> <ul style="list-style-type: none"> – improved health; – improved sense of taste; – improved sense of smell; – saving money; – better self-esteem; – home, car, clothing and breath will smell better; – setting a good example for children and decreasing the likelihood that they will smoke; – healthier babies and children; – feeling better physically; – performing better in physical activities; – improved appearance, including reduced wrinkling/ageing of skin and whiter teeth. 	<p>OHCP: “Do you know how stopping tobacco use would affect your risk of oral cancer?”</p> <p>P: “<i>I guess it would be lower if I quit.</i>”</p> <p>OHCP: “Yes, and it doesn’t take long for the risk to decrease. But it’s important to quit as soon as possible.”</p>
Roadblocks	<p>Ask the patient to identify barriers or impediments to quitting and provide treatment (problem-solving counselling, medication) that could address barriers.</p> <p>Typical barriers might include:</p> <ul style="list-style-type: none"> – withdrawal symptoms; – fear of failure; – weight gain; – lack of support; – depression; – enjoyment of tobacco; – being around other tobacco users; – limited knowledge of effective treatment options. 	<p>OHCP: “So what would be difficult about quitting for you?”</p> <p>P: “<i>Cravings – they would be awful!</i>”</p> <p>OHCP: “We can help with that. We can give you nicotine replacement therapy (NRT) that can reduce the cravings.”</p> <p>P: “<i>Does that really work?</i>”</p> <p>OHCP: “You still need will-power, but study shows that NRT can double your chances of quitting successfully.”</p>

5Rs	Strategies for implementation	Example
Repetition	<p>Repeat assessment of readiness to quit. If still not ready to quit repeat intervention at a later date.</p> <p>The motivational intervention should be repeated every time an unmotivated dental patient visits the clinic setting.</p>	<p>OHCP: “So, now we’ve had a chat, let’s see if you feel differently. Can you answer these questions again...?”</p> <p>(Go back to the Assess stage of the 5As. If ready to quit then proceed with the 5As. If not, end intervention positively by saying “This is a difficult process but I know you can get through it and I am here to help you”.)</p>

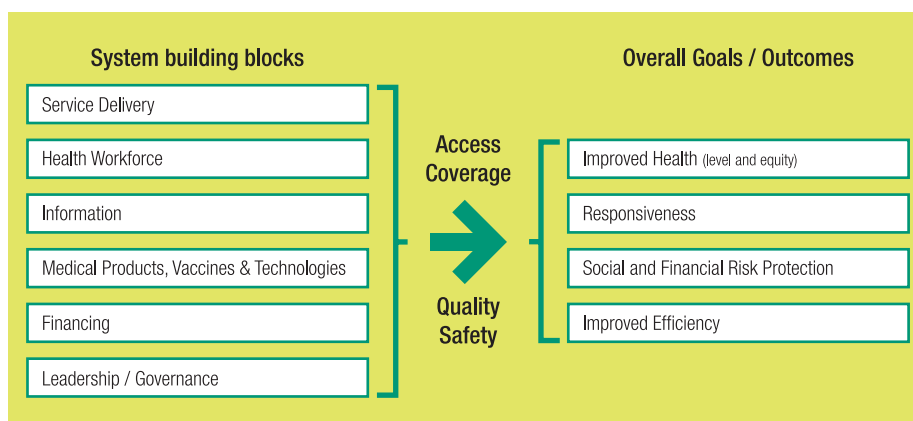
2.2. STRENGTHENING ORAL HEALTH CARE SYSTEMS TO IMPROVE INTEGRATED DELIVERY OF BRIEF TOBACCO INTERVENTIONS BY ORAL HEALTH PROFESSIONALS

While oral health professionals are in a favourable position to help tobacco users, more than 40% do not routinely query tobacco use and 60% do not routinely advise tobacco users to quit (13). Health systems performance assessments suggests that the whole health-care system should function well in order to ensure that oral health professionals routinely identify and provide brief tobacco interventions to all tobacco users at every visit. It is the responsibility of oral health service managers and the appropriate authorities to ensure a well-functioning system to support oral health professionals.

The WHO Health System Framework (six building blocks) (Figure 17) can be a good tool for oral health service managers to build a well-functioning oral health-care system to support providers to routinely deliver brief tobacco interventions. This framework illustrates the basic functions required by health systems have to carry out and defines a set of six essential building blocks to develop an understanding of how to strengthen health systems. The building blocks are:

- service delivery;
- health workforce;
- information support;
- medical products and technologies;
- financing;
- leadership and governance.

Figure 17. The WHO Health System Framework



The WHO Health System Framework shows practical ways to strengthen health systems by using six operational “building blocks” to:

- locate, describe and classify health system constraints;
- identify where and why interventions are needed;
- predict the effects of health system strengthening interventions on results.

Emerging evidence shows that systems-level interventions can enhance the delivery of effective tobacco cessation treatment to patients by health-care professionals and can increase patient quit rates, quit attempts and the use of treatment.

- Introduction of electronic health records (EHR) can, at least in the short term, increase documentation of tobacco status and referral to cessation counselling (14);
- Training health-care professionals to provide smoking cessation interventions had a measurable effect on professional performance. The effects of training on the performance of tobacco cessation interventions increased if prompts and reminders were used (15).
- Financial benefits extended to health-care providers can significantly increase the use of behavioural interventions for tobacco cessation (16).
- Full financial interventions directed at tobacco users (covering all the costs of treatment), when compared to no financial interventions, could increase the proportion quitting, quit attempts and the utilization of pharmacotherapy by tobacco users (16).

Table 3 summarizes the effective system-level changes (organizational policies and practices) oral health service managers can make to improve the function of all six building blocks in order to improve the integrated delivery of brief tobacco interventions by oral health care providers in primary care.

Table 3. A checklist of systems-level changes to promote brief tobacco interventions by oral health care providers in primary care

Service delivery	<ul style="list-style-type: none"> • Team working to improve integrated delivery of brief tobacco interventions: <ul style="list-style-type: none"> – delegation of roles and responsibilities and development of a team approach within dental/oral practices. • Models to implement brief tobacco interventions (e.g. 5As, 5Rs). • Referral to existing effective tobacco dependence treatments in primary care settings: <ul style="list-style-type: none"> – cessation clinics (face-to-face individual, or group-intensive counselling as well as pharmacotherapy where possible); – telephone quit lines and or mobile cessation programme; – community self-help cessation programme.
Health workforce	<ul style="list-style-type: none"> • Help every oral health care provider recognize that it is his/her responsibility to identify and provide brief tobacco interventions to every tobacco user who presents to a dental/oral health care facility. • Training on brief tobacco intervention as a fundamental part of the dental/oral curriculum: <ul style="list-style-type: none"> – in-service training; – pre-service training. • Help oral health professionals quit tobacco use and serve as non-tobacco use role models. • Ensure the availability and distribution of an appropriate number of tobacco dependence treatment specialists.
Information system	<ul style="list-style-type: none"> • A tobacco-use identification system: <ul style="list-style-type: none"> – tobacco-use status stickers on all patient charts; – a vital sign stamp (expanding the vital signs to include tobacco use); – a field in the computer information system to register tobacco use status, if appropriate. • A provider reminder system: <ul style="list-style-type: none"> – chart sticker or stamp; – indicate tobacco use status using computer reminder systems, if appropriate.
Governance and leadership	<ul style="list-style-type: none"> • Recognize the key role and responsibility of dental/oral health care service managers in promoting brief tobacco interventions. • Provision of appropriate regulations and incentives to support integrated delivery of brief tobacco interventions: <ul style="list-style-type: none"> – develop and disseminate clinical guidelines and service standards; – reimburse providers for service delivery; – include delivery of brief tobacco interventions in staff performance evaluations; – monitor and evaluate oral health care provider practices in brief tobacco interventions and provide feedback. • Ensure that all sections of the dental/oral health-care facility are entirely smoke-free. • Attention to system-design: <ul style="list-style-type: none"> – develop a policy and mechanism for integrated service delivery in primary care where possible; – ensure a fit between strategy and structure, and reduce duplication and fragmentation. • Collaboration and coalition-building: <ul style="list-style-type: none"> – engage with communities, NGOs and the private sector; – advocate and link to population-level tobacco control interventions in the community.

Medical products and technologies	<ul style="list-style-type: none"> • Promote the availability of NRT and other effective smoking cessation medicines. • Protocol/toolkit/guide to aid oral health professionals in providing brief tobacco interventions. • Develop information materials (self-help materials, poster and brochure). • Promote appropriate use of motivational tools: <ul style="list-style-type: none"> – risk charts (facilitate physician-patient discussion about disease risk); – visual motivational tools (e.g. carbon monoxide monitor).
Financing	<ul style="list-style-type: none"> • Health insurance to cover tobacco dependence treatment. • Resource mobilization to raise additional funds for tobacco dependence treatment (e.g. tobacco taxes). • Improve resource efficiency. • Financial incentives for efficient, integrated service provision.

3. Engaging in tobacco control beyond the clinical setting

Oral health professionals and their organizations can significantly contribute to improving the health status of their patients beyond the oral health care services. All oral health professionals - individually and through their professional associations - have a prominent role to play in tobacco control because they have the trust of the population, the media and opinion leaders, and their voices are heard across a wide range of social, economic and political arenas.

At the individual level, oral health professionals should be tobacco-free role models and peers can encourage each other to this end. They should help educate the population on the harm of tobacco use and exposure to second-hand smoke. Although most people are fully aware of the health dangers of smoking in relation to lung cancer and heart disease, fewer know about the links between tobacco use and oral diseases (17). Oral health professionals are a potentially valuable source of community education about the health effects surrounding tobacco use. Many of the effects of tobacco use are visible; dentists and other oral health care providers have broad exposure to the general population; and patients are interested in obtaining help from them regarding tobacco use (18).

At the community/local level, oral health professionals can initiate or support the implementation of tobacco control measures contained in other articles of the WHO FCTC, such as tax increases, health warning labels and smoke-free laws. For example, oral health professionals could help with the design and implementation of the graphic health warning labels on tobacco product packaging, which usually includes pictures of oral diseases. Oral health professionals should also actively participate in or support community awareness-raising and education campaigns like World No Tobacco Day, which can help stimulate interest in quitting and demand for tobacco cessation services.

At the national and international levels, oral health professionals and their organizations can add their voices to national and global tobacco control efforts like tobacco tax increase campaigns, become involved at the national level in promoting the WHO FCTC and the development of a national plan of action for tobacco control.

In addition, oral health professional organizations can show leadership and become role models for other professional organizations and for society as a whole by embracing the Health Professional Code of Practice on Tobacco Control (Table 4).

Table 4. Code of practice on tobacco control for health professional organizations

<p>Preamble: In order to contribute actively to the reduction of tobacco consumption and include tobacco control in the public health agenda at national, regional and global levels, it is hereby agreed that health professional organizations will:</p> <ul style="list-style-type: none">• Encourage and support their members to be role models by not using tobacco and by promoting a tobacco-free culture.• Assess and address the tobacco consumption patterns and tobacco-control attitudes of their members through surveys and the introduction of appropriate policies.• Make their own organizations' premises and events tobacco-free and encourage their members to do the same.• Include tobacco control in the agenda of all relevant health-related congresses and conferences.• Advise their members to routinely ask patients and clients about tobacco consumption and exposure to tobacco smoke, using evidence-based approaches and best practices, give advice on how to quit smoking and ensure appropriate follow-up of their cessation goals.• Influence health institutions and educational centres to include tobacco control in their health professionals' curricula, through continued education and other training programmes.• Actively participate in World No Tobacco Day every 31 May.• Refrain from accepting any kind of tobacco industry support – financial or otherwise – and from investing in the tobacco industry, and encourage their members to do the same.• Ensure that their organization has a stated policy on any commercial or other kind of relationship with partners who interact with or have interests in the tobacco industry through a declaration of interest.• Prohibit the sale or promotion of tobacco products on their premises, and encourage their members to do the same.• Actively support governments in the process leading to signature, ratification and implementation of the WHO Framework Convention on Tobacco Control.• Dedicate financial and/or other resources to tobacco control – including dedicating resources to the implementation of this code of practice.• Participate in the tobacco-control activities of health professional networks.• Support campaigns for tobacco-free public places. <p>Adopted and signed by the participants of the WHO Informal Meeting on Health Professionals and Tobacco Control; 28-30 January 2004; Geneva, Switzerland.</p>
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4. Conclusions

Since there is a well-known relationship between tobacco use and oral diseases, national oral health programmes and national tobacco control programmes have mutual concerns. Oral health professionals have the opportunity for regular interaction with a large number of tobacco users in primary care through routine dental check-ups and oral health examinations. Oral health care systems must be strengthened to ensure that oral health professionals routinely identify and provide brief tobacco interventions to every dental/oral patient who uses tobacco at every visit. Oral health service managers may need to bring about effective system-level changes of the whole health care system (service delivery, health workforce, information support, medical products and technologies, financing, and leadership and governance) in order to improve the integrated delivery of brief tobacco interventions by oral health care providers.

Both programmes have a duty to support the oral health service delivery to fulfil the responsibility in providing such assistance in the period during which the dental/oral patient is treated. Through the identification and treatment of tobacco dependence, higher levels of lasting dental/oral treatment success will be achieved. A national oral health programme should also support tobacco control beyond the clinical settings.

In turn, any progress achieved by a national tobacco control programme in implementing effective population-based tobacco control policies will reduce the prevalence of tobacco users and have a beneficial impact on oral diseases, morbidity and mortality rates.

A national tobacco control programme should also contribute to improving the national oral health programme's performance by stressing oral disease-related issues in information and advocacy campaigns about the dangers of tobacco use and tobacco smoke, especially in countries where oral diseases are highly prevalent and people have a clear perception of this disease threat.

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Appendix 1

The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomized studies in meta-analyses

http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp

Coding manual for case-control studies

SELECTION

1) Is the Case Definition Adequate?

- a) Requires some independent validation (e.g. >1 person/record/time/process to extract information, or reference to primary record source such as x-rays or medical/ hospital records)
- b) Record linkage (e.g. ICD codes in database) or self-report with no reference to primary record
- c) No description

2) Representativeness of the Cases

- a) All eligible cases with outcome of interest over a defined period of time, all cases in a defined catchment area, all cases in a defined hospital or clinic, group of hospitals, health maintenance organisation, or an appropriate sample of those cases (e.g. random sample)
- b) Not satisfying requirements in part (a), or not stated

3) Selection of Controls

This item assesses whether the control series used in the study is derived from the same population as the cases and essentially would have been cases had the outcome been present.

- a) Community controls (i.e. same community as cases and would-be cases if had outcome)
- b) Hospital controls, within same community as cases (i.e. not another city) but derived from a hospitalized population
- c) No description

4) Definition of Controls

- a) If cases are first occurrence of outcome, then it must explicitly state that controls have no history of this outcome. If cases have new (not necessarily first) occurrence of outcome, then controls with previous occurrences of outcome of interest should not be excluded
- b) No mention of history of outcome

COMPARABILITY

1) Comparability of Cases and Controls on the Basis of the Design or Analysis

A maximum of two stars can be allotted in this category.

Either cases and controls must be matched in the design and/or confounders must be adjusted for in the analysis. Statements of no differences between groups, or that differences were not statistically significant, are not sufficient to establish comparability. Note: If the odds ratio for the exposure of interest is adjusted for the confounders listed, then the groups will be considered to be comparable on each variable used in the adjustment.

There may be multiple ratings for this item for different categories of exposure (e.g. ever-vs-never, current-vs-previous or never).

Age (one star), Other controlled factors (one star)

EXPOSURE

1) Ascertainment of Exposure

Allocation of stars as per rating sheet

2) Non-Response Rate

Allocation of stars as per rating sheet

Coding manual for cohort studies

SELECTION

1) Representativeness of the Exposed Cohort

Item assesses the representativeness of exposed individuals in the community, not the representativeness of the sample of women from some general population. For example, subjects derived from groups likely to contain middle class, better educated, health oriented women are likely to be representative of postmenopausal estrogen users, while they are not representative of all women (e.g. members of a health maintenance organisation (HMO)) will be a representative sample of estrogen users. While the HMO may have an under-representation of ethnic groups, the poor, and poorly educated, these excluded groups are not the predominant users of estrogen).

Allocation of stars as per rating sheet

2) Selection of the Non-Exposed Cohort

Allocation of stars as per rating sheet

3) Ascertainment of Exposure

Allocation of stars as per rating sheet

4) Demonstration That Outcome of Interest Was Not Present at Start of Study

In the case of mortality studies, outcome of interest is still the presence of a disease/ incident, rather than death. That is to say that a statement of no history of disease or incident earns a star.

COMPARABILITY

1) Comparability of Cohorts on the Basis of the Design or Analysis

A maximum of two stars can be allotted in this category.

Either exposed and non-exposed individuals must be matched in the design and/or confounders must be adjusted for in the analysis. Statements of no differences between groups, or that differences were not statistically significant, are not sufficient for establishing comparability. Note: If the relative risk for the exposure of interest is adjusted for the confounders listed, then the groups will be considered to be comparable on each variable used in the adjustment.

There may be multiple ratings for this item for different categories of exposure (e.g. ever vs. never, current vs. previous or never).

Age (one star), Other controlled factors (one star)

OUTCOME

1) Assessment of Outcome

For some outcomes (e.g. fractured hip), reference to the medical record is sufficient to satisfy the requirement for confirmation of the fracture. This would not be adequate for vertebral fracture outcomes where reference to x-rays would be required.

- a) Independent or blind assessment stated in the paper, or confirmation of the outcome by reference to secure records (x-rays, medical records, etc.)
- b) Record linkage (e.g. identified through ICD codes on database records)
- c) Self-report (i.e. no reference to original medical records or x-rays to confirm outcome)
- d) No description

2) Was Follow-Up Long Enough for Outcomes to Occur

An acceptable length of time should be decided before quality assessment begins (e.g. five years for exposure to breast implants)

3) Adequacy of Follow Up of Cohorts

This item assesses the follow-up of the exposed and non-exposed cohorts to ensure that losses are not related to either the exposure or the outcome.

Allocation of stars as per rating sheet

Coding manual for crosssectional studies (modified)

A study can be awarded a maximum of one star for each numbered item within the Selection and Outcome categories.

SELECTION

1) Representativeness of the Study Group

- a) Truly representative of the average individuals in the community * (1)
- b) Somewhat representative of the average individuals in the community * (1)
- c) Selected group of users e.g. nurses, volunteers
- d) No description of the derivation of the cohort

2) Selection of the Comparison Group

- a) Drawn from the same community as the study group * (1)
- b) Drawn from a different source
- c) No description of the derivation of the comparison group

3) Ascertainment of Exposure

- a) Secure record (e.g., surgical records) * (1)
- b) Structured interview
- c) Written self-report
- d) No description

COMPARABILITY

A maximum of two stars can be given for comparability

1) Comparability of Cohorts on the Basis of the Design or Analysis

- a) Study controls for age for the outcome of tooth loss, and oral health behaviour for the outcome of dental caries (association with exposure to second-hand smoke) * (1)
- b) Study controls for any additional factor, at least one variable each for socioeconomic status and oral health behaviour for the outcome of tooth loss and at least one variable each for socioeconomic status or dental visit for the outcome of dental caries (association with exposure to second-hand smoke) * (1)

OUTCOME

1) Assessment of Outcome

- a) Independent blind assessment * (1)
- b) Record linkage * (1)
- c) Self-report
- d) No description

Appendix 2

Overview of selected studies to assess association of tobacco use (smoking and use of chewing tobacco) with oral cancer and leucoplakia

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
Muscat, 1996, USA, case-control study	Gender differences in smoking and risk for oral cancer.	1 009 patients with cancer with oral cavity and pharynx and 923 matched hospital controls	68% for cases 67% for controls	21-80 years	Cancer of the oral cavity and pharynx	<p>Males</p> <p>Cases (n=687)</p> <p>Never smoking 10.2%</p> <p>Current smoking 66.8%</p> <p>Former smoking 23.0%</p> <p>Controls (n=619)</p> <p>Never smoking 22.3%</p> <p>Current smoking 35.4%</p> <p>Former smoking 42.3%</p> <p>Females</p> <p>Cases (n=322)</p> <p>Never smoking 23.9%</p> <p>Current smoking 60.9%</p> <p>Former smoking 15.2%</p> <p>Controls (n=304)</p> <p>Never smoking 54.9%</p> <p>Current smoking 21.4%</p> <p>Former smoking 23.7%</p>
Wasnik, 1998, India, case-control study	Tobacco use and risk of oropharyngeal cancer	123 oro-pharyngeal cancer patients and 123 hospital controls of non-cancer patients	59%	> 21 years	Oro-pharyngeal cancer	<p>Tobacco consumption practices</p> <p>Cases (n=123)</p> <p>Tobacco chewers n=90</p> <p>Non-chewers n=33</p> <p>Control 1</p> <p>Tobacco chewers n=32</p> <p>Non-chewers n=91</p> <p>Tobacco smoking</p> <p>Cases</p> <p>Smokers n=51</p> <p>Non-smokers n=72</p> <p>Control 1</p> <p>Smokers n=29</p> <p>Non-smokers n=94</p>
Schildt, 1998, Sweden, case-control study	Oral snuff, smoking habits and alcohol consumption in relation to oral cancer	354 patients with oral cancer and 354 controls drawn from the National Population Registry	67%	Mean ages of 72.3 years for women and 69.6 years for men	Oral cancer	<p>Oral snuff (Case/Control)</p> <p>Never snuff user n=287/282</p> <p>Active n=39/54</p> <p>Ex-user n=28/18</p> <p>Ever user n=67/72</p> <p>Smoking</p> <p>Never smoker n=152/171</p> <p>Active n=122/88</p> <p>Ex-smoker n=80/95</p> <p>Ever smoker n=202/183</p>

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
De Stefani, 1998, Uruguay, case-control study	Smoking patterns and cancer of the oral cavity and pharynx	425 patients with squamous cell carcinoma of oral cavity and pharynx and 427 hospitalized controls	100%	25-84 years	Cancer of oral cavity	Cases/Controls Non-smokers n=24/150 Former smokers n=36/105 Current smokers n=146/172
Franceschi, 1999, Italy and Switzerland, case-control study	Comparison of the effect of smoking and alcohol drinking between oral and pharyngeal cancer	274 cases and 1 254 hospital controls	100%	26-74 years Median = 57 years	Oral cancer	Cases/Controls Never smoker n=11/346 Current smoker n=197/405 Ex-smoker n=66/503
Rao, 1999, India, case-control study	Alcohol as an additional risk factor in laryngo-pharyngeal cancer	1 698 male patients with cancer in pharyngeal and laryngeal regions and 635 unmatched hospital controls	100%	45.4±12.9 for controls 54.3±9.7 for cases	Cancer of oropharynx	Controls/Cases Chewers Non-chewers n=382/434 Chewers n=249/243 Smoking Non-smokers n=337/132 Smokers n=294/545
Dikshit, 2000, India, case-control study	Tobacco habits and risk of lung, oro-pharyngeal and oral cavity cancer	148 oral cavity cancer cases from the population-based cancer registry records and 260 randomly selected controls from population survey	100%	Not available	Oral cancer	Cases/Controls Smoking Smokers n=72/114 Bidi smokers only n=50/81 Cigarette smokers only n=6/20 Bidi and cigarette smokers n=16/13 Non-smokers n=76/146 Chewing Chewers n=120/120 Without tobacco n=4/12 With tobacco n=115/108 Non-chewers n=28/140 Smoking + tobacco chewing n=49/43 No tobacco habits n=9/81
Merchant, 2000, Pakistan, case-control study	Paan without tobacco and risk factor for oral cancer	79 cases and 149 hospital controls	68% men in the cases	22-80 years for cases 18-78 years for controls	Oral squamous cell carcinoma	Cases/Controls (n=79/149) Ever used paan with tobacco 41/15 Ever used paan without tobacco 26/16

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
Chen, 2001, USA, case-control study	Poly-morphism, cigarette smoking and alcohol consumption, and oral squamous cell cancer risk	341 cases and 552 controls in population-based study sample	70% for cases 72% for controls	18-65 years for cases	Squamous cell cancers of the oral cavity,	Cases/Control n=341/552 Smokeless tobacco use 5.9%/3.8% Cigarette smoking Never 15.0%/34.8% Former 23.2%/42.2% Current 61.9%/23.0%
Balaram, 2002, India, case-control study	Influence of smoking, drinking, paan-chewing and oral hygiene on oral cancer	591 cases of cancer of the oral cavity and 582 hospital controls	52% for cases 50% for controls	18-87 years	Cancer of the oral cavity	Cases/Controls Smoking habit Men Never n=86/127 Ever n=223/165 Women Never n=274/285 Ever n=8/5 Chewing habit Men Never chewers n=127/232 Ever chewers n=182/60 Women Never chewers n=29/251 Ever chewers n=253/39
Topcu, 2002, Sri Lanka, case-control study	Gene deletion and oral cancer risk in betel quid chewers	286 cases with oral malignant or premalignant lesions and 135 controls in hospital and clinics	86% for cases 67% for controls	26-82 years for cases 40-85 for controls	Oral cancer	All subjects were habitual betel quid chewers Cases/Controls n=286/135 Cigarette smoking n=195/61
Znaor, 2003, India, case-control study	Independent and combined effects of tobacco smoking, chewing and alcohol drinking on the risk of oral, pharyngeal and esophageal cancer	1 563 cases of oral cancer and 3 638 disease and healthy control in the same centres	100%	> 25 years	Oral cancer	Controls/Cases Smoking n=1 799/424 n=444/185 n=1 395/954 Chewing n=3,079/711 n=181/88 n=374/757

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
Nieto, 2003, Spain, case-control study	Lifetime body mass index and risk of oral cavity and oropharyngeal cancer by smoking and drinking habits	375 incident cases and 375 hospital-based controls	81% for cases and controls	More than 20 years	Invasive cancers of the oral cavity and oropharynx	Cases/Controls Males Never smokers n=5/52 Ex-smokers n=76/130 Current smokers n=223/122 Females Never smokers n=50/61 Ex-smokers n=6/3 Current smokers n=15/7
Henley, 2005, USA, CPS-I, Cohort study	Mortality among men who use snuff or chewing tobacco (United States)	11 871 deaths in CPS-I in 1959 for exclusive use of snuff or chewing tobacco (7 745) or no previous use of any tobacco product (69 662)	100%	12-year follow-up	Death from oropharynx cancer	No. of deaths for spit tobacco use CPS-I Never n=9/69 662 Current n=4/7 745 CPS-II Never n=45/111 482 Current n=1/2,488 Former n=0/839
Luo, 2007, Sweden, cohort study	Oral use of Swedish moist snuff (snus) and risk for cancer of the mouth, lung, and pancreas	125 576 male Swedish construction workers in 1978–92 among never smokers	100%	35±13 years at entry, followed-up for 20±6 years	Incidence of oral cancer	Cases or oral cancer Never users of any tobacco n=50/87 821 Ex-smokers n=48/51 012 Current smokers n=150/103 309 Ex-users of snus 1/2 937 Current users of snus 9/34 818
Polesel, 2008, Italy and Switzerland, case-control study	Tobacco smoking and the risk of upper aero-digestive tract cancers	1 241 cases of upper aero-digestive tract cancers and 2 835 hospital controls	100%	Not available	Cancer of oral cavity	Cases/Controls Never smokers n=19/512 Current smokers n=295/649
Pitos, 2008, Canada, case-control study	Human papillomavirus infection and oral cancer	72 cases and 129 hospital controls	Over 70%	55–74 years	Squamous cell carcinoma of oral cavity and oropharynx	Controls/Cases Never n=41/11 Former n=70/26 Current n=18/35

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
Thomas, 2008, Papua New Guinea, case-control study	Betel quid not containing tobacco and oral leukoplakia	197 cases and 1 282 controls selected in two census districts	48%	≥18 years	Oral leukoplakia	Cases/Controls Chewing Never 1/89 Ex-chewer 7/149 Occasional 26/256 Daily 163/788 Current Chewer 189/1 044 Smoking Never 17/732 Ex-smoker 14/161 Occasional 24/105 Daily 142/284 Current smoker 166/389
Ide, 2008, Japan, cohort study	Cigarette smoking, alcohol drinking, and oral and pharyngeal cancer mortality	34 136 men and 43 711 women of 45 geographical area	44%	40-79 years Follow-up period of 12.5 years	Oral and pharyngeal cancer mortality	Number of deaths Men (n=34,136) Non-smoker (20.5%) n=5 Past smoker (26.3%) n=7 Current smoker 53.2% n=29 Women (n=43,711) Non-smoker (93.4%) n=8 Past smoker (1.5%) n=0 Current smoker (5.1%) n=3
Sadetzki, 2008, Israel, case-control study	Smoking and risk of parotid gland tumours	459 cases and 1 265 population-based controls	55% for cases and controls	≥18 years	Parotid gland tumours	Cases/Controls Cigarette smoking Never 183/679 Current 183/253 Past 93/331
Lee, 2009, 10 European countries, case-control study	Active and involuntary tobacco smoking and upper aerodigestive tract cancer risks	2 103 UADT squamous cell carcinoma cases and 2 221 population and hospital controls	81% for cases 75% for control	Not available	Cancer of oral cavity and oropharynx	Cases/Controls Never n=109/712 Former n=205/741 Current n=660/715
Tsai, 2009, Taiwan, case-control study	Interaction of genotypes and smoking habit in oral cancer	680 cases with oral cancer and 680 hospital healthy controls	72% for controls 74% for cases	62±9 years for controls and 65±9 for cases	Oral cancer	Controls/Cases n=680/680 Cigarette smokers n=485/512 Areca chewers n=418/451
Amarasinghe, 2010, Sri Lanka, case-control study	Betel-quid chewing with or without tobacco and a major risk factor for oral potentially malignant disorders	101 cases in population based survey and 728 controls	67% for case 32% for control	>30 years	Oral potentially malignant disorders	Cases/Controls n=101/728 Betel-quid chewing Never n=4/277 Past n=2/36 Occasionally n=3/83 Daily n=92/332 Smoking Never 66/601 Ever 35/127

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
Lin, 2011, Taiwan, cohort study	Smoking, alcohol, and betel quid and oral cancer	10 657 clinic patients	100%	≥18 years	Oral cancer	Cases/Participants Habitual smoker Yes n=174/2 268 No n=56/8 389 Habitual betel quid chewer Yes n=126/758 No n=104/9 899
Santos, 2012, Brazil, case-control study	Genetic polymorphisms and the association between smoking and oral cancer	202 cases and 196 hospitalized patient controls	83% for case 77% for control	15-79 years	Oral cavity squamous cell carcinoma	Controls/Cases Never n=60/18 Current n=81/155 Former n=55/29
Azarpaykan, 2013, India, case-control study	Interaction between active smoking and alcohol consumption on oral cancer	350 oral cancer patients and 350 healthy people referred to hospital	72% for case 73% for control	18-80 years	Oral cancer	Cases/Controls n=350/350 Active smoking (Bidi included) 125/61
Henley, 2005, USA, CPS-I, Cohort study	Mortality among men who use snuff or chewing tobacco (United States)	11 871 deaths in CPS-I in 1959 for exclusive use of snuff or chewing tobacco (7 745) or no previous use of any tobacco product (69 662)	100%	≥30 years 12-year follow-up	Death from oropharynx cancer	No. of deaths for spit tobacco use CPS-I Never n=9/69 662 Current n=4/7 745 CPS-II Never n=45/111 482 Current n=1/2 488 Former n=0/839

Appendix 3

Overview of selected studies to assess association of tobacco use with periodontal disease

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
Nibali 2008, UK, case-control study	Relationship between a vitamin D receptor polymorphism and the diagnosis and progression of periodontitis	231 subjects with healthy periodontium, 224 aggressive periodontitis and 79 chronic periodontitis patients	32% for cases 49% for controls	Not available	Localized or generalized aggressive periodontitis Chronic periodontitis	Periodontitis/Healthy n=301/231 Smoking Never 150/135 Former 77/41 Current 76/55
Parmar 2008, India, cross-sectional study	Effect of chewing a mixture of areca nut and tobacco on periodontal tissues and oral hygiene status	365 subjects attending a dental college and hospital	81%	33±1 years for quid chewers and 30±1 years for non-chewers	Periodontal pocket	Non-chewers n=61 (31%) Chewers n=92 (55%)
					Gingival lesions	Non-chewers n=2 (1%) Chewers n=10 (6%)
					Gingival recession	Non-chewers n=52 (26%) Chewers n=85 (51%)
Do 2008, Australia,	Smoking-attributable periodontal disease	The 2004–2006 Australian National Survey of Adult Oral Health	38%	≥15 years	Moderate-severe periodontitis: 2 inter-proximal sites with ≥4mmCAL or ≥5mmPPD	Never smokers, n=2 206 (18.5%) Former smokers, n=842 (31.0%) Light smokers, n=125 (15.6%) Moderate smokers, n=141 (29.1%) Heavy smokers, n=234 (46.6%)
Iida 2009, USA, cross-sectional study	Effect of tobacco smoke on the oral health of US women of childbearing age	The 1999-2004 National Health and Nutrition Examination Survey	0%	15-44 years	Presence of one or more mesial and buccal/ mid-facial sites with ≥4 mm loss of tooth attachment	Tobacco-smoking history Current 11.3% (n=586) Previous 3.4% (n=960) Never 3.9% (n=2213)

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
Al-Habashneh 2009, Jordan, cross-sectional study	Smoking and caries experience in subjects with various form of periodontal diseases	560 patients referred to dental teaching clinic	48%	16-35 years	Chronic periodontitis and aggressive periodontitis	Smokers/Non-smokers n=183/377 Chronic gingivitis n=54/143 Chronic periodontitis n=69/87 Aggressive periodontitis n=60/147
Chiou 2010, Taiwan, cross-sectional study	Association of psychosocial factors and smoking with periodontal health	1 764 civilian non-institutional individuals in Taipei City	44%	>18 years	Community periodontal index (CPI) ≥ 3	CPI ≥ 3 Smoking habit Non-smoker n=116/1 411 Smoker 42/353

Appendix 4

Overview of selected studies to assess the benefit of quitting tobacco use for oral health

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
Grossi et al, 1997; USA	Effects of smoking on clinical outcomes following mechanical periodontal therapy	143 patients with periodontitis – Former smokers: 55 (38.5%) – Current smokers: 60 (42.0%)	54% men	Range 35-65 Mean: 46.2	Plaque scores (SD)	Reduction at 3 months from baseline – Former smokers: -0.69 (\pm 0.08) – Current smokers: -0.54 (\pm 0.07)
					Whole-mouth mean (SD) pocket depth	Reduction at 3 months from baseline – Former smokers: -0.49 (\pm 0.06) – Current smokers: -0.33 (\pm 0.04)
					Mean (SD) pocket depth	Reduction at 3 months from baseline – Former smokers: -1.7 (\pm 0.1) – Current smokers: -1.3 (\pm 0.1)
					Mean (SD) clinical attachment level	Gain at 3 months from baseline – Former smokers: 1.6 (\pm 0.1) – Current smokers: 1.3 (\pm 0.1)
					Percentage (SD) of deep pockets 5mm or greater	Reduction at 3 months from baseline – Former smokers: -7.1 (\pm 1.2) – Current smokers: -4.8 (\pm 0.7)
					Percentage of patients who became negative for P. gingivalis after treatment	– Former smokers: 92% – Current smokers: 33%

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
Krall et al, 1997; USA	Effects of smoking on tooth loss	248 women over a period of 2 to 7 years [mean(SD): 6±2 years] – Continuous smokers: 9 (3.6%) – Quitters: 14 (5.6%)	80% men	Range W:40-70 M:21-75	Women: Rate of tooth loss/10 years	– Quit cigarettes during follow-up: 0.55 – Smoked cigarettes continuously: 2.73
		977 men over a period of 3 to 26 years [mean(SD): 18±7 years] – Continuous smokers: 117 (12%) – Quitters: 167 (17.1%)			Men: Rate of tooth loss/10 years	– Quit cigarettes during follow-up: 2.23 – Smoked cigarettes continuously: 3.16

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
Ryder et al, 1999; USA	Effects of smoking on scaling and root planning alone (SRP) or local delivery of controlled-release doxycycline	358 subjects from 2 9-month multicentre studies – Former smokers (F): 137 (38.3%) – Current smokers (C): 121 (33.8%)			Attachment level gain from baseline (mean±s.e.)	– Baseline probing depth ≥5mm [month 4] F: 0.65 (±0.07), C: 0.57 (±0.07) month 6] F: 0.74 (±0.07), C: 0.63 (±0.08) [month 9] F: 0.74 (±0.07), C: 0.79 (±0.08) – Baseline probing depth ≥7mm [month 4] F: 0.79 (±0.10), C: 0.79 (±0.12) [month 6] F: 0.99 (±0.12), C: 0.72 (±0.13) [month 9] F: 1.03 (±0.11), C: 0.92 (±0.12)
					Probing depth reduction from baseline (mean±s.e.)	– Baseline probing depth ≥5mm [month 4] F: -0.99 (±0.06), C: -0.89 (±0.07) [month 6] F: -1.23 (±0.06), C: -1.10 (±0.07) [month 9] F: -1.19 (±0.06), C: -1.12 (±0.07) – Baseline probing depth ≥7mm [month 4] F: -1.41 (±0.09), C: -1.30 (±0.11) [month 6] F: -1.75 (±0.10), C: -1.44 (±0.11) [month 9] F: -1.79 (±0.10), C: -1.48 (±0.12)

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
Jansson et al, 2002; Sweden (prospective study)	Effects of smoking on longitudinal marginal bone loss and tooth loss	507 individuals from an epidemiological study – Continuous smokers: 163 (32.1%) – Quitters: 124 (24.5%)	48% men	Range 38-85 Mean: 54.5 years	Marginal bone loss mean (SD) 1970-1990 Number of teeth lost mean (SD) between 1970 and 1990	– Continuous smokers: 0.130 (± 0.099) – Quitters: 0.095 (± 0.069) – Continuous smokers: 3.7 (± 4.8) – Quitters: 3.2 (± 4.0)
Baljoon et al, 2005; Sweden (cohort study)	Effects of smoking on vertical periodontal bone loss	91 individuals from a comprehensive periodontal health study – Current smokers: 24 (26.4%) – Former smokers: 24 (26.4%)		Mean: 51 years	10-year cumulative vertical defects incidence (%) Proportion (%) of vertical bone defects mean at 10-year follow-up	– Current smokers: 50% – Former smokers: 39% – Current smokers: 4.5 (95% CI: 1.8-7.1) – Former smokers: 2.9 (95% CI: 1.3-4.5)
Preshaw et al, 2005; UK	Effects of smoking cessation on clinical outcomes following non-surgical treatment of chronic periodontitis	49 smokers with chronic periodontitis who wished to quit smoking – Quitters (Q): 10 (20.4%) – Non-quitters (NQ): 10 (20.4%)	37% men	Range 23-61 Mean: 42 years	Means (SD) for the reduction in probing depths (PD) Periodontal sites demonstrating PD reduction at 12 month Quantitative bone density change mean (SD) (mm ³ AI) at 12 month	– Baseline probing depth >3mm [month 3] Q: 1.07 (± 0.36), NQ: 0.74 (± 0.23) [month 6] Q: 1.21 (± 0.40), NQ: 0.88 (± 0.28) [month 12] Q: 1.57 (± 0.52), NQ: 1.12 (± 0.35) – ≥ 2 mm improvement N (%) of sites Quitters: 351 (28.5), Non-quitters: 276 (18.0) – ≥ 3 mm improvement N (%) of sites Quitters: 141 (11.5), Non-quitters: 79 (5.2) – Quitters: 0.00 (± 0.64) – Non-quitters: -0.08 (± 0.86)

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
Rosa et al, 2011; Brazil (prospective study)	Effects of smoking cessation on periodontal clinical parameters	52 subjects who enrolled from a smoking cessation clinic – Quitters(Q): 17 (32.6%) – Non-quitters(NQ): 35 (67.3%)	39% men	Mean: 49.3 years	Extent (SD) of clinical attachment level (CAL) change and thresholds of changes in CAL during the 1-year study period	– CAL loss < 2mm Q: 9.3 (±5.7), NQ: 12.7 (±8.1) – CAL loss < 1mm Q: 27.9 (±10.5), NQ: 32.7 (±13.1) – No change CAL Q: 72.1 (±10.5), NQ: 67.3(±13.1) – CAL gain ≥ 1mm Q: 39.3 (±12.3), NQ: 34.4 (±14.8) – CAL gain ≥ 2mm Q: 15.8 (±7.8), NQ: 14.7 (±11.2)
					Extent (SD) of probing depth (PD) change and thresholds of changes in PD during the 1-year study period	– PD loss ≥ 2mm Q: 3.9 (±4.0), NQ: 5.6 (±4.8) – PD loss ≥ 1mm Q: 19.5 (±8.6), NQ: 22.7 (±12.8) – No change PD Q: 60.7 (±15.2), NQ: 63.5 (±16.9) – PD reduction ≥ 1mm Q: 39.3 (±15.2), NQ: 36.5 (±16.9) – PD reduction ≥ 2mm: Q: 10.4 (±9.4), NQ: 14.0 (±12.8)
Thomson et al, 2007; NZ (cohort study)	Association between smoking patterns and periodontal attachment loss	810 individuals – Smoked at all ages: 95 (11.7%) – Gave up smoking after 26: 69 (8.5%)	51% men	Range 26-32	Number showing probing depth (PD) gains between ages 26 and 32	– PD gain of 2+ mm (%) Smoked at all ages: 52 (54.7) Gave up smoking after 26: 30 (43.5) – PD gain of 3+ mm (%) Smoked at all ages: 9 (9.5) Gave up smoking after 26: 2 (2.9)
					Mean % of sites showing PD gains between ages 26 and 32	– PD gain of 2+mm (SD) Smoked at all ages: 3.2 (±4.8) Gave up smoking after 26: 1.7 (±2.3) – PD gain of 3+mm (SD) Smoked at all ages: 0.4 (±2.0) Gave up smoking after 26: 0.1 (±0.4)

Author, year, place (study type)	Research question	Study numbers and population source	% Men	Age	Outcome	Results
Yanagisawa et al, 2009; Japan (cohort study)	Relationship of number of teeth with smoking habits	547 males from Japanese Public Health Center-based Prospective Study – Current smokers: 135 (24.7%) – Former smokers: 251 (45.9%)	100% men	Range 55-75	Percentage and number of subjects with more than eight teeth lost	– Current smokers: 39.3% (53/135) – Former smokers: 39.0% (98/251)
Yanagisawa et al, 2010; Japan (cohort study)	Relationship of teeth and periodontal diseases with smoking habits	1 088 men from Yokote city, Akita prefecture – Current smokers: 317 (29.1%) – Former smokers: 421 (38.7%)	100% men	Range 40-75	Percentage and number of subjects with more than eight teeth lost Percentage and number of subjects with periodontitis	– Current smokers: 26.2% (83/317) – Former smokers: 26.8% (113/421) – Current smokers: 31.1% (97/312) – Former smokers: 26.2% (107/408)
Krall et al, 2006; USA (cohort study)	Effects of smoking cessation on risk of tooth loss	789 participants in the Veterans Administration Dental Longitudinal Study from 1968 to 2004. – Continuous smokers: 113 (14.3%) – Quitters: 129 (16.3%)	100% men	Mean: 48 years	No. of teeth lost per person No. of teeth lost per year per 1 000 teeth at risk	Median (with 25 th and 75 th percentiles shown in parentheses) – Quitters: 3 (1,8) – Continuous smokers: 2 (0,4) Median (with 25 th and 75 th percentiles shown in parentheses) – Quitters: 7 (2,20) – Continuous smokers: 8 (0,17)
Vladimirow et al, 2009; Denmark (prospective study)	Effects of smoking cessation on the risk of new lesions or malignancies after surgical excision of oral malignant lesion	51 patients with oral leukoplakia or erythroplakia treated at the Glostrup Hospital, Copenhagen University from 1997 to 2006 – Continuing smokers: 35 (69%) – Quitters: 16 (31%)	53% men	Range 35-85 Mean: 56.9 years	Recurrence of leukoplakia or erythroplakia New lesions Cancer	– Continuing smokers: 11 – Quitters: 1 – Continuing smokers: 8 – Quitters: 0 – Continuing smokers: 5 – Quitters: 0



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