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Interventions for tobacco cessation in the dental setting (Review)

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[Intervention Review]

Interventions for tobacco cessation in the dental setting

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ABSTRACT

Background

Tobacco use has significant adverse effects on oral health. Oral health professionals in the dental office or community setting have a unique opportunity to increase tobacco abstinence rates among tobacco users.

Objectives

This review assesses the effectiveness of interventions for tobacco cessation delivered by oral health professionals and offered to cigarette smokers and smokeless tobacco users in the dental office or community setting.

Search methods

We searched the Cochrane Tobacco Addiction Group Specialized Register (CENTRAL), MEDLINE (1966-November 2011), EMBASE (1988-November 2011), CINAHL (1982-November 2011), Healthstar (1975-November 2011), ERIC (1967-November 2011), PsycINFO (1984-November 2011), National Technical Information Service database (NTIS, 1964-November 2011), Dissertation Abstracts Online (1861-November 2011), Database of Abstract of Reviews of Effectiveness (DARE, 1995-November 2011), and Web of Science (1993-November 2011).

Selection criteria

We included randomized and pseudo-randomized clinical trials assessing tobacco cessation interventions conducted by oral health professionals in the dental office or community setting with at least six months of follow-up.

Data collection and analysis

Two authors independently reviewed abstracts for potential inclusion and abstracted data from included trials. Disagreements were resolved by consensus. The primary outcome was abstinence from smoking or all tobacco use (for users of smokeless tobacco) at the longest follow-up, using the strictest definition of abstinence reported. The effect was summarised as an odds ratio, with correction for clustering where appropriate. Heterogeneity was assessed using the I^2 statistic and where appropriate a pooled effect was estimated using an inverse variance fixed-effect model.

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Main results

Fourteen clinical trials met the criteria for inclusion in this review. Included studies assessed the efficacy of interventions in the dental office or in a community school or college setting. Six studies evaluated the effectiveness of interventions among smokeless tobacco (ST) users, and eight studies evaluated interventions among cigarette smokers, six of which involved adult smokers in dental practice settings. All studies employed behavioral interventions and only one required pharmacotherapy as an interventional component. All studies included an oral examination component. Pooling all 14 studies suggested that interventions conducted by oral health professionals can increase tobacco abstinence rates (odds ratio [OR] 1.71, 95% confidence interval [CI] 1.44 to 2.03) at six months or longer, but there was evidence of heterogeneity (I^2 = 61%). Within the subgroup of interventions for smokers, heterogeneity was smaller (I^2 = 51%), but was largely attributable to a large study showing no evidence of benefit. Within this subgroup there were five studies which involved adult smokers in dental practice settings. Pooling these showed clear evidence of benefit and minimal heterogeneity (OR 2.38, 95% CI 1.70 to 3.35, 5 studies, I^2 = 3%) but this was a posthoc subgroup analysis. Amongst the studies in smokeless tobacco users the heterogeneity was also attributable to a large study showing no sign of benefit, possibly due to intervention spillover to control colleges; the other five studies indicated that interventions for ST users were effective (OR 1.70; 95% CI 1.36 to 2.11).

Authors' conclusions

Available evidence suggests that behavioral interventions for tobacco cessation conducted by oral health professionals incorporating an oral examination component in the dental office or community setting may increase tobacco abstinence rates among both cigarette smokers and smokeless tobacco users. Differences between the studies limit the ability to make conclusive recommendations regarding the intervention components that should be incorporated into clinical practice, however, behavioral counselling (typically brief) in conjunction with an oral examination was a consistent intervention component that was also provided in some control groups.

PLAIN LANGUAGE SUMMARY

Can interventions delivered by dental professionals help tobacco users to quit?

In addition to the well-known harmful effects of smoking on respiratory and cardiovascular systems, tobacco use is associated with an increased risk for oral disease, including cancer and gum disease. Dental professionals are in a unique position to help tobacco users who present for dental care by providing assistance to help them stop smoking or using other tobacco products. Combined findings from 14 studies including over 10,500 participants showed that tobacco interventions by dental professionals helped tobacco users to quit. These findings are similar for smokeless tobacco users and smokers, and the body of evidence reveals a significant increase in demonstrated benefit compared to earlier findings of this review.

BACKGROUND

In addition to the well-known harmful effects of smoking on respiratory and cardiovascular systems, tobacco use has significant adverse effects on oral health (Warnakulasuriya 2010). Cigarette smoking is associated with an increased risk for oral disease (Gelskey 1999; Mecklenburg 1998; Salvi 2000). Tobacco exposes the oral cavity to toxic carcinogens that may have a role in initiation and promotion of cancer (Mirbod 2000). Tobacco is the major inducer of oral squamous cell carcinoma (SCC) and is considered to be responsible for 50% to 90% of oral cancer cases worldwide (Epstein 1992; Holleb 1996). The incidence of oral SCC is four to seven times greater in smokers than non-smokers (Piyathilake 1995). Oral cancer and pre-cancer occurs more frequently in smokers, and quitting smoking decreases the risk for oral cancer within 5 to 10 years (EU Working Group 1998). Tobacco exposure is also harmful to periodontal health, and smoking status is an important factor in the prognosis for periodontal therapy, oral wound healing, implant therapy, and cosmetic dentistry (Mecklenburg 1998). Smoking results in discoloration of both teeth and dental restorations, and is associated with halitosis, diminished taste, and an increased prevalence and severity of periodontal disease (EU Working Group 1998). Cigarette smoking is causally associated with an increased prevalence and severity of periodontitis (Gelskey 1999), even when adequate oral hygiene is practiced (Kerdvongbundit 2002). Cessation of smoking may halt disease progression and improve outcomes of periodontal therapy

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(EU Working Group 1998).

Smokeless tobacco use has been reported to cause tooth decay (Tomar 1999) and discoloration of dental restorations (Walsh 2000). Chewing tobacco, in particular, is associated with an increased risk for dental caries due to high sugar content and increased gingival recession. Abrasive particles in chewing tobacco may contribute to significant dental attrition which may require dental restorations in advanced cases (Bowles 1995; Milosevic 1996). Cross-sectional studies have suggested that smokeless tobacco users with co-existing gingivitis have high rates of gingival recession, mucosal pathology, and dental caries (Offenbacher 1985). Smokeless tobacco use has also been associated with irreversible gingival attachment loss resulting in root exposure (Ernster 1990). Effects of smokeless tobacco use are typically observed at anatomical locations where the tobacco contacts the mucosa, such as the labial vestibule and adjacent periodontium. Both the prevalence and severity of tobacco-related oral lesions demonstrate a dose-response relationship with the amount, frequency and duration of smokeless tobacco exposure (Little 1992a). Chronic exposure can lead to leukoplakia (Hirsch 1982), a premalignant condition (Silverman 1984; Silverman 1976). Smokeless tobacco use in the United States has been associated with an increased risk for oral cancer in a dose-response fashion (Stockwell 1986; Williams 1977; Winn 1981). Risk may vary depending upon the type of smokeless tobacco used, as the highest rates of oral cancer are observed in countries where smokeless tobacco is consumed with additives (e.g., areca nut) (Critchley 2003).

The dental practice setting provides a unique opportunity to assist tobacco users in achieving tobacco abstinence (Christen 1990; Needleman 2010; Ramseier 2010). Widespread acceptance of tobacco use interventions in the dental setting have been lacking and limitations in primary care resources have curtailed further efforts (Warnakulasuriya 2002). Compared to other health care providers, dentists more accurately estimate patient tobacco use (Block 1999). However, dental practitioners are less consistent with and supportive of intervention, less likely to report having strong knowledge or skill levels regarding tobacco cessation, and more likely to perceive barriers to tobacco intervention (Block 1999). More than 40% of dentists do not routinely ask about tobacco use and 60% do not routinely advise tobacco users to quit (Tomar 2001).

While 61.5% of dentists believe their patients do not expect tobacco cessation services, 58.5% of their patients felt such services should be provided (Campbell 1999). Barriers to providing tobacco cessation service include concern for patient resistance (Campbell 1994), lack of knowledge, lack of time (Dolan 1997), lack of financial reimbursement (Fried 1992), and a concern for poor co-ordination of care between dentistry and tobacco cessation services (Campbell 1994).

OBJECTIVES

We assess the effectiveness of interventions for tobacco cessation offered by oral health professionals to cigarette smokers and smokeless tobacco users in the dental office or community setting. We were interested in testing the following hypotheses in regards to increasing tobacco abstinence rates among tobacco users:

1. In dental settings, brief counselling cessation interventions are more effective than usual care.

2. Brief counselling cessation interventions conducted by dental professionals combined with nicotine replacement therapy (NRT) are more effective than NRT alone.

3. Tobacco use interventions incorporating personalized feedback from an oral examination are more effective than interventions without personalized feedback from an oral examination.

4. Tobacco use interventions conducted by dental health professionals are more effective than interventions conducted by other healthcare professionals.

METHODS

Criteria for considering studies for this review

Types of studies

All randomized and pseudo-randomized (i.e., by patient number, date of birth, day of attendance) controlled trials with at least six months follow-up were included. The unit of randomization was the dentist or practice for the studies in the dental office setting, and college or high school for the studies in the community setting.

Types of participants

Patients or subjects of any age reporting tobacco use and receiving oral health interventions by dental professionals were included. Subject recruitment and participation included both those actively seeking treatment and those who did not express an interest in quitting. All tobacco users (cigarette, cigar, and pipe smokers, and smokeless tobacco users) were included.

Types of interventions

We included any intervention to promote tobacco use cessation (intervention versus usual care or placebo, and/or intervention versus other intervention) which included a component delivered by a dentist, dental hygienist, dental assistant or office staff in the dental practice setting and any combination of these, as well as the

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same individuals providing intervention as part of a community effort. Interventions could include brief advice to quit, provision of self-help materials, counselling, pharmacotherapy or any combination of these, or referral to other sources of support. Interventions that were directed at both smokers and smokeless tobacco users were included, as were interventions aimed at the training of dental health professionals.

Types of outcome measures

The outcome measure was smoking and tobacco use cessation, assessed at least six months from the delivery of the intervention. Trials which did not report tobacco use outcomes or did not have sufficiently long follow-up were excluded. Biochemical validation of self-reported cessation was not required but was recorded and used where available.

Search methods for identification of studies

The Specialized Registers of the Cochrane Tobacco Addiction Group (most recent search November 2011) and the Cochrane Oral Health Group (Cochrane Central Register of Controlled Trials, Cochrane Library 2011) were searched for references to tobacco use interventions by dental health professionals, in the dental practice setting or otherwise. We also searched the following electronic retrieval systems and databases:

- The Cochrane Central Register of Controlled Trials (CENTRAL)
- MEDLINE (1966- November 2011)
- EMBASE (1988- November 2011)
- CINAHL (1982- November 2011)
- Healthstar (1975- November 2011)
- ERIC (1967- November 2011)
- PsycINFO (1984- November 2011)
- National Technical Information Service database (NTIS, 1964- November 2011)
- Dissertation Abstracts Online (1861- November 2011)
- Database of Abstract of Reviews of Effectiveness (DARE, 1995- November 2011)
- Web of Science (1993- November 2011)

The following terms were used to describe the **participants**: smokers; smoking; cigarettes; smokeless tobacco; chewing tobacco; oral tobacco; spit tobacco; snuff; quid; chew; plug; tobacco use(rs). The following terms described the **interventions**: randomized; dentists; dental; hygienists; dental-patient relations; behavior modification; conditioning therapy; therapy; behavior; conditioning; group therapy; cognitive therapy; counselling; behavioral intervention; pharmacotherapy; drug; patient education; health promotion. The following terms were used to describe the **outcomes**: tobacco use cessation; smoking abstinence; tobacco abstinence. The following terms described the intervention **environment**: dentists; dental; hygienists; dental-patient relations; oral health.

The Medical Subject Headings (MeSH) used in MEDLINE and CINAHL were also used to focus on the dental environment: limit retrieval to the dentistry journals subset; or subject headings Oral Health/ or exp Dentistry/ or exp Dental Staff/ or exp DENTISTS/ or DENTIST'S PRACTICE PATTERNS/ or exp dental auxiliaries/ or dental hygienists. Keywords of the various oral specialties orthodont$, periodont$ and endodont$ were also searched. There were no language restrictions. In general, records were searched by conducting searches the following way: (participants OR outcomes) AND interventions. We contacted experts in the area to locate unpublished studies in an effort to minimise publication bias.

Data collection and analysis

Two authors screened the records retrieved by the searches for potential relevance against stated inclusion criteria: randomized/pseudo-randomized clinical trial, dental setting, tobacco cessation interventions, and cessation measures of six-month minimum follow-up. Two authors checked studies of possible relevance for inclusion or exclusion, and independently extracted and compared data. We resolved disagreements by discussion and consensus (referring to a colleague or Cochrane Review Group staff when necessary).

We extracted the following information about each study:

- Site, including country and type of dental practice
- Method of randomization and allocation concealment, and whether individual or cluster randomized
- Method of participant selection
- Characteristics of the intervention (behavioral/pharmacologic, delivered by whom)
- Characteristics of participants (type of tobacco use, interest in quitting)
- Outcome assessment (length of follow-up, definition of quitting, method for validation of self-report)

For each study we selected the outcome with the most rigorous definition available with regards to maintenance of abstinence (i.e., continuous versus point prevalence) and type of tobacco abstinence (i.e., all tobacco versus smokeless tobacco only) (Hughes 2003). Rates were based on an intention-to-treat analysis with drop-outs and losses to follow-up assumed to be continuing tobacco users. We noted any difference in numbers lost to follow-up between intervention and control groups.

The risk of randomization and allocation concealment were judged to be low if the method was described in sufficient detail to ensure that allocation was blinded until after trial enrolment, unclear if there was insufficient detail with which to judge, and high if allocation was not concealed (as in use of patient record numbers, day of attendance, etc.). We also assessed the risk of attrition bias in included studies. Where there appears to have been a large loss to follow-up we assessed whether the findings were sensitive to

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the use of different denominators. In addition to the judgements above, we assessed bias impact on strength of the evidence by identifying trials with multiple sources of bias, and we comment on the potential impact of the bias on the overall treatment effect. The outcome from each trial was expressed as an odds ratio (OR). Where cessation is the outcome this was defined as (number of quitters in treatment group/number of smokers in treatment group)/(number of quitters in control group/number of smokers in control group). The OR was greater than 1 if people were more likely to quit in the treatment group. For cluster randomized trials we adjusted for clustering using the reported intraclass correlation coefficient (ICC) and the average cluster size. We calculated the logarithm of the adjusted or natural OR and its standard error and pooled studies using the generic inverse variance method (Higgins 2011, Section 16.3.4). We have displayed the raw data in Analysis 1.4.

We hypothesized that the following would explain heterogeneity which was explored through subgroup analyses: 1) **Patients** - smokers (cigarette, cigar, pipe) versus smokeless tobacco users, patients enrolled based on their interest in tobacco cessation versus patients enrolled regardless of interest in quitting (e.g., subjects enrolled in a study requiring informed consent to participate versus subjects enrolled in a study implemented in a dental practice enrolling all patients who are treated clinically), highly dependent versus less dependent tobacco users using the Fagerström Tolerance Questionnaire or modifications of the this dependence measure (to the extent that dependence is similarly categorized across trials), specialty practice versus general practice dental settings; 2) **Interventions** - interventions delivered by dentists versus dental hygienists or other dental staff, behavioral interventions versus pharmacologic interventions; 3) **Outcomes** - all tobacco abstinence versus tobacco-specific (cigarette smoking, smokeless tobacco) outcomes; 4) **Method of randomization** - cluster versus individual. We assessed heterogeneity using the I^2 statistic (Higgins 2003).

Sensitivity analyses included assessment of changes in the estimate of the treatment effect using the random effects model compared with the fixed effect model.

We include in this updated review the Cochrane Tobacco Addiction Group's Glossary of smoking-related terms (Appendix 1).

RESULTS

Description of studies

The review included 14 studies involving over 10,500 participants (Andrews 1999; Binnie 2007; Ebbert 2007; Gordon 2010a; Gordon 2010b; Gansky 2005; Hanioka 2010; Lando 2007; Nohlert 2009; Severson 1998; Severson 2009; Stevens 1995; Walsh 1999; Walsh 2003). Although Andrews 1999 and Severson 1998 reported the same trial they are treated here as separate studies since Andrews 1999 focused on outcomes in smokeless tobacco users and Severson 1998 on smokers. One eligible study had to be excluded due to unavailable subgroup denominator values (Cohen 1989). Other papers identified as potentially relevant but not meeting all inclusion criteria are listed in Characteristics of excluded studies along with the reason for exclusion.

The dental offices involved in the included studies were a heterogeneous group: six studies were conducted in private practice office settings (Andrews 1999; Ebbert 2007; Gordon 2010a; Hanioka 2010; Nohlert 2009; Severson 1998;); one study involved community public health dental clinics (Gordon 2010b); one was set in a hospital-based periodontal clinic (Binnie 2007); two took place in managed care clinics (Lando 2007; Stevens 1995); and one took place in military clinics (Severson 2009). Three involved oral health professionals (dentists and dental hygienists) providing interventions to athletes within high school or college community settings (Gansky 2005; Walsh 1999; Walsh 2003). The school community studies included a dental professional intervention component as a major part of the intervention.

Eight studies targeted smokers (Binnie 2007; Ebbert 2007; Gordon 2010a; Gordon 2010b; Hanioka 2010; Lando 2007; Nohlert 2009; Severson 1998). Five studies involved dental practice settings where adult smokers were provided at least brief behavioral counselling as part of the intervention (Binnie 2007; Ebbert 2007; Hanioka 2010; Gordon 2010b; Gordon 2010a). One study targeted both smokers and smokeless tobacco users; the data for the two types of participant were reported separately and are treated as two studies, Severson 1998 covering smokers and Andrews 1999 covering smokeless tobacco users. Six studies targeted smokeless tobacco users (Andrews 1999; Walsh 2003; Gansky 2005; Severson 2009; Stevens 1995; Walsh 1999). In the dental office studies, studies included tobacco users not actively seeking treatment (Andrews 1999; Gordon 2010a; Severson 1998; Stevens 1995) and those willing to participate (Binnie 2007; Ebbert 2007; Gordon 2010b; Hanioka 2010; Lando 2007; Nohlert 2009; Severson 2009).

Interventions in the dental office setting occurred during hygiene visits in general dental practices (Andrews 1999; Binnie 2007; Ebbert 2007; Gordon 2010a; Gordon 2010b; Hanioka 2010; Lando 2007; Nohlert 2009; Severson 1998; Stevens 1995), and involved either: 1) brief advice plus quitline referral (Ebbert 2007), brief advice plus motivational interviewing (Lando 2007), brief advice plus video-based cessation program with phone follow-up (Andrews 1999; Severson 1998; Severson 2009), or 2) counselling using the 5 A's plus nicotine replacement therapy (NRT) (Binnie 2007), 5 A's plus NRT and population-specific printed material (Gordon 2010b), 3 A's plus pharmacotherapy and referral as needed (Gordon 2010a). One study used target population-specific videos as an adjunct to counselling (Severson 2009). Two studies used a high intensity intervention where intensity was

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gauged as frequency of personal contact, and occurred five times or more (Hanioka 2010; Nohlert 2009).

In the school community studies, tobacco users had to agree to participate and informed consent was obtained (Gansky 2005; Walsh 1999; Walsh 2003). Some dental office studies restricted enrolment to 15 years of age or older (Andrews 1999; Severson 1998; Stevens 1995), one of which placed gender restrictions on inclusion, while the remaining targeted adults. All of the school community studies based their intervention on the Cognitive Social Learning Theory (Bandura 1986), two of which reported that the Diffusion of Innovation Theory (Rogers 1983) was instrumental for incorporating the use of peer leaders. No such theoretical foundation was mentioned for the interventions applied to the dental office studies.

Nicotine replacement therapy in the form of gum (2 mg) was used in one of the school community studies (Walsh 1999). The gum was reinforced with counselling by a dental professional. In the majority of the studies, dental professionals (dentists and dental hygienists) provided counselling interventions which most often included combinations of an oral examination, feedback from the examination as to oral effects of tobacco use, a message to quit, motivational counselling using printed material or media presentations, and self-help aids. In five dental office studies, the usual care group included was either not described (Hanioka 2010) or involved no structured intervention (Andrews 1999; Gordon 2010a; Gordon 2010b; Stevens 1995), and in all the school community studies the control schools received no formal training.

In five of the dental office studies, the dental office was the unit of randomization (Andrews 1999; Ebbert 2007, Gordon 2010a, Gordon 2010b, Severson 1998), and in six studies, the patient was the unit of randomization (Binnie 2007, Hanioka 2010, Lando 2007, Nohlert 2009, Severson 2009, Stevens 1995). In the school community studies, the school was the unit of randomization following stratification based on baseline prevalence of tobacco use.

In the included trials, participants were followed for a maximum of six months (Ebbert 2007; Severson 2009), seven and a half months (Gordon 2010b), 12 months (Andrews 1999; Binnie 2007; Gansky 2005; Gordon 2010a; Hanioka 2007; Lando 2007; Nohlert 2009; Severson 1998; Stevens 1995; Walsh 1999), and 24 months (Walsh 2003, two year outcomes reported in Gansky 2002).

Of the studies targeting smokeless tobacco users, three reported all tobacco abstinence outcomes (Andrews 1999; Severson 1998; Stevens 1995). Point prevalence was reported as the primary outcome in three studies (Gansky 2005; Stevens 1995; Walsh 1999). Two studies reported abstinence as one week (seven day) point prevalence (Ebbert 2007; Stevens 1995), while four reported 30-day point prevalence abstinence (Gansky 2005; Lando 2007, Walsh 1999; Walsh 2003). Seven studies used continuous (sustained or prolonged) abstinence requiring either no tobacco use at both 3 and 12 months (Andrews 1999; Severson 1998), 12 months continuous abstinence (Hanioka 2007), six months continuous abstinence (Nohlert 2009), prolonged abstinence (Gordon 2010a, Gordon 2010b), or no current tobacco use at both 12 and 24 months after quitting before the one-month follow-up (Walsh 2003, reported in Gansky 2002).

Details of included studies can be found in Characteristics of included studies.

Risk of bias in included studies

The risk of selection bias, judged on the basis of random sequence generation, was considered low in 12 studies (Binnie 2007; Ebbert 2007; Gansky 2005; Gordon 2010a; Gordon 2010b; Hanioka 2010; Lando 2007; Nohlert 2009; Severson 1998; Severson 2009; Walsh 1999; Walsh 2003), unclear in Andrews 1999, and high in Stevens 1995. Methods of allocation concealment were judged to be at low risk of bias in 11 studies (Andrews 1999; Binnie 2007; Gansky 2005; Gordon 2010a; Gordon 2010b; Hanioka 2010; Nohlert 2009; Severson 1998; Severson 2009; Walsh 1999; Walsh 2003), at unclear risk of bias in Ebbert 2007 and Lando 2007, and at high risk of bias in Stevens 1995. The risk of attrition bias was judged to be low in nine studies (Andrews 1999; Gansky 2005; Gordon 2010a; Gordon 2010b; Hanioka 2010; Severson 1998; Severson 2009; Walsh 1999; Walsh 2003), unclear in three studies (Binnie 2007; Ebbert 2007; Nohlert 2009), and high in two studies (Lando 2007; Stevens 1995).

Biochemical confirmation was used to validate self report in two studies (Binnie 2007; Hanioka 2010). In three other studies, biochemical confirmation was initially utilized and abandoned due to poor compliance (Stevens 1995), or used as a strategy to enhance self report (Walsh 1999; Walsh 2003) (i.e., the 'bogus pipeline' method). The remaining studies did not use biochemical confirmation.

The control of detection bias through the blinding participants or oral health care personnel was limited due to the nature of the behavioral interventions evaluated.

In one school-based study (Gansky 2005), the authors describe a 'spill-over' effect between the intervention and control group that was felt to bias the results of the trial. In one study which took place in a managed care setting, the authors describe a host of process constraints limiting the effectiveness of achieving study goals, therefore impacting the outcomes (Lando 2007).

Rationale for risk of bias judgements can be found in Characteristics of included studies.

Effects of interventions

When the 14 clinical trials of dental interventions compared to usual care, no contact, or less treatment intensive controls are pooled (including all tobacco users), a statistically significant increase in the odds of tobacco abstinence at 6 to 24 months is observed (odds ratio [OR] 1.71, 95% confidence interval [CI] 1.44

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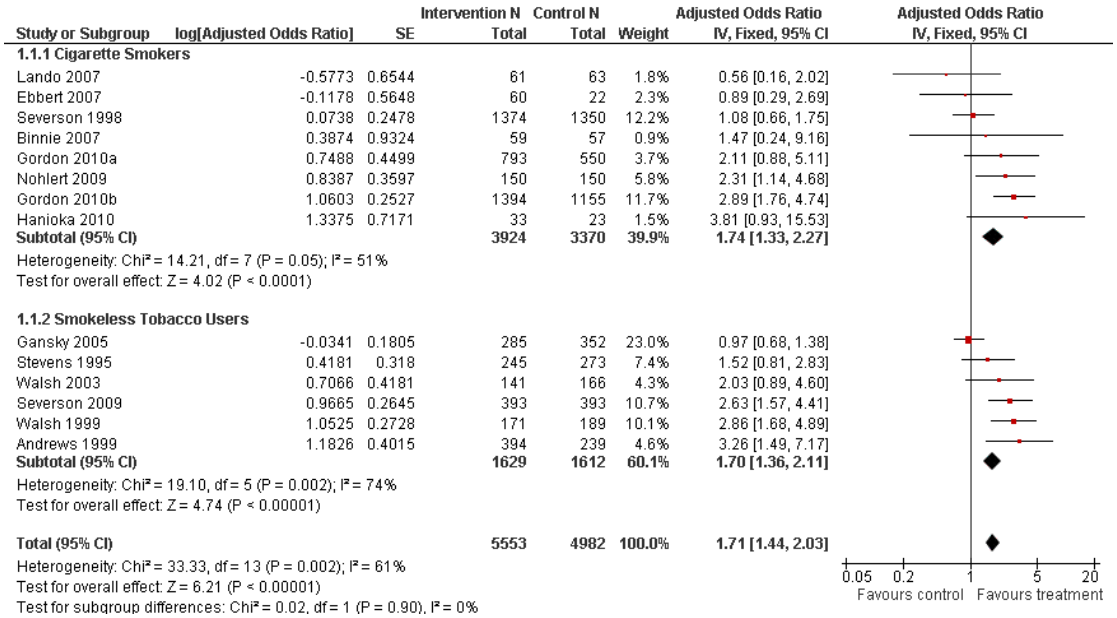
to 2.03, Figure 1, Analysis 1.1,) but with evidence of heterogeneity between the studies (I^2 = 61%).

Figure 1. Forest plot of comparison: 1 Behavioral interventions versus control, outcome: 1.1 Abstinence at longest follow-up.



Heterogeneity was explored by assessing the prespecified potential explanations.

Patients

Heterogeneity is not fully explained by separating studies targeting cigarette smokers (I^2 = 51%) and smokeless tobacco (ST) users (I^2 = 74%). The estimated effect size was similar in both subgroups. In both groups the study contributing the greatest weight had a point estimate close to no effect, with confidence intervals ruling out large benefits or harms. In the subgroup of interventions for smokers, the largest trial, Severson 1998, failed to detect any effect of an extended intervention compared to a brief intervention by dental hygienists. The same intervention showed a benefit in ST users recruited as part of the same study (Andrews 1999). The next three largest studies amongst smokers did detect significant or near significant benefits and the pooled estimate indicated a clinically and statistically significant effect (OR 1.74, 95% CI 1.33 to 2.27, 8 studies, I^2 = 51%). In a sensitivity analysis using a random effects model the pooled estimate was similar and the confidence intervals still excluded one.

Heterogeneity may be due in part to type of practice. The included studies took place in dental settings characterized as either a specialty dental practice, general dental practices, federally funded dental practices, or managed care dental practices. Some targeted adolescents and adults while others focused only on adults. Recognizing these different features, we conducted a post hoc subgroup analysis of studies conducted in the settings most representative of typical dental environments (general dental practitioners seeing adult smokers). Dental practices providing, at a minimum, brief counselling to adult smokers showed a significant benefit of intervention when compared to usual care or less treatment intensive controls (OR 2.38, 95% CI 1.70 to 3.35, Analysis 1.2) with no evidence of heterogeneity (I^2 = 3%).

In the ST use subgroup, Gansky 2005 had narrow CIs ruling out large benefits or harms, but all other studies suggested benefit and three showed significant effects. As noted above, Gansky 2005 is likely have been affected by spill-over of intervention to control groups. The estimate including Gansky 2005 indicated a clinically and statistically significant effect (OR 1.70, 95% CI 1.36 to 2.11, 6 studies, I^2 = 74%). In a sensitivity analysis using a random effects model the pooled estimate was larger and the

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confidence intervals still excluded 1. A sensitivity analysis omitting Gansky 2005 removed all evidence of heterogeneity and increased the effect estimate (OR 2.40, 95% CI 1.82 to 3.18).
Odds ratios were similar in a subgroup analysis comparing three studies in which participants were actively seeking treatment with three studies in which participants were not actively seeking treatment (actively seeking treatment: OR 1.41, 95% CI 1.07 to 1.86; not actively seeking treatment: OR 1.48, 95% CI 1.05 to 2.09, analysis not shown).

Interventions

Interventions in all studies were a team effort involving brief dental encounters plus additional behavioral interventions and/or pharmacotherapy. Interventions differed in intensity as measured by number of planned contacts but there was no clear indication of a dose-response relationship. Gordon 2010a had three arms: a '3 As' intervention using a 'fax-to-quit' referral form; a '5As' arm with Quitline referral at the provider's discretion; and a usual care control arm. Our analysis uses the '3As' intervention, but opting to use the '5As' intervention arm would not alter the findings.

Outcomes

There was no evidence that the length of follow-up or definition of abstinence explained heterogeneity between studies.

Method of randomization

The group of six trials that were individually randomized had lower heterogeneity (I^2 = 27%), although this may be due to chance, because the two studies contributing most to heterogeneity were both cluster randomized (Severson 1998 and Gansky 2005). The effect estimate in the individually randomized study subgroup, although indicating significant benefit, was not clinically large (OR 1.46, 95% CI 1.06 to 2.01, Analysis 1.3).

DISCUSSION

The findings of our review are consistent with the hypothesis that dental interventions conducted in the dental office and school community setting are more effective than usual care for promoting tobacco use cessation. When dental interventions were compared to usual care, no contact, or less treatment intensive controls, the pooled odds ratio for abstinence at a follow-up of between 6 and 24 months was 1.71 (95% CI 1.44 to 2.03), although this estimate must be viewed cautiously because of unexplained heterogeneity (I^2 = 61%).

Current results are based on a much greater body of research on cigarette smokers when compared to the previous version of this review (Carr 2006), with eight studies of interventions for cigarette smoking now included compared to just one (Severson 1998). Findings now suggest a significant benefit of intervention for increasing tobacco abstinence rates. Findings may be of particular interest to dental care providers whose practices focus on adult patients, as adult smokers may be particularly responsive to the effect of an intervention in this setting (OR 2.38, 95% CI 1.70 to 3.35, Analysis 1.2).

Results should also be viewed cautiously due to the inability to blind, unclear methods of treatment allocation, a lack of biochemical validation of self reported tobacco cessation in most studies and inconsistent content and delivery of dental-specific interventions within the pooled studies. Although all of the included studies contained a dental intervention component, they involved varying dental settings, personnel, and interventions, and statistical heterogeneity was evident. The source of heterogeneity was unclear, and seemed largely attributable to null effects in two large trials. In one of these, the control communities may have been exposed to intervention (Gansky 2005). For the other (Severson 1998), there was no clear reason for the lack of effect of the intervention.

All of the studies included in this review included brief advice to quit by an oral health professional. Brief advice from physicians has been shown to be an effective means to promote cessation (Lancaster 2008), and this review suggests the same can be expected from dental professionals interacting with smokeless tobacco users. Clinical practice guidelines advise brief interventions in the clinical setting where patients are asked about their tobacco use and then advised to quit. If the user is ready to quit, the clinician can offer specific assistance and provide follow-up care. An insufficient number of studies are available to determine what specific assistance measures delivered by a dental professional provide additional effectiveness beyond brief advice.

The public health benefits of tobacco cessation interventions within the dental setting are potentially significant. The findings for both the smokeless tobacco users and smokers in this review suggest that there is an advantage of cessation interventions using dental professionals. However, the limited number of studies reviewed does not allow identification of intervention components most critical for cessation.

AUTHORS' CONCLUSIONS

Implications for practice

Interventions for tobacco users delivered by oral health professionals, either in the dental office or in the school community, increase the odds of quitting tobacco. Insufficient evidence exists to make conclusions about the effectiveness of specific intervention components, but behavioral counselling (typically brief) is a consistent component.

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Implications for research

Additional study of interventions for tobacco cessation within the dental office setting is important to identify critical intervention components which are effective for this group of providers in this clinical setting.

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* *Indicates the major publication for the study*

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CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Andrews 1999

Methods	Country: USA Recruitment: Hygiene patients in private dental practices Cluster randomized trial
Participants	633 ST users >= 15 years of age
Interventions	1. Intervention: Determine tobacco use, identify oral disease, strong advice to quit, set quit date within 2w, motivation video, written material, call patient within 2w. 2. Usual care
Outcomes	12m 'sustained' abstinence from ST and all tobacco: subjects must have reported 7-day PP ST and all tobacco abstinence at both 3m and 12m. Abstinence verification: None
Notes	Data for smokers in the same trial reported in Severson 1998 ICC calculated < 0.0009. Intervention group more likely to have previously been advised by a dental care provider to quit use of ST and were less likely to be single Study reports only those using smokeless tobacco.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Cluster randomized: Practices were blocked (by average number of hygiene visits per week and years dentists had been in practice). Method not described
Allocation concealment (selection bias)	Low risk	At hygiene visit all patients completed health survey; those responding 'Yes' to current use of tobacco were enrolled
Incomplete outcome data (attrition bias) All outcomes	Low risk	Loss to follow-up was 26% (102/394) in intervention and 26% (62/239) in the control group

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Binnie 2007

Methods	Country: UK Recruitment: occurred in a single hospital-based periodontal clinic Randomized controlled trial
Participants	118 smoking adults attending consultant clinics in an outpatient dental hospital periodontal clinic
Interventions	1. Intervention group - 5 A's, NRT prn (patches, gum) 2. Usual care - Received information regarding the role of tobacco in periodontal disease, 'very brief' advice to quit smoking
Outcomes	3, 6, 12m PP tobacco abstinence. Repeated PP (3, 6, 12m) used in analyses 12m cotinine measured for self reported quitters.
Notes	CO <8 ppm, COT <20 ng/ml cutoffs for quit status

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomization process was set up by the project statistician and was implemented independently from the recruitment process. After recruitment, the patient's name was transcribed into a log book containing sequential patient log numbers and the allocated hygienist
Allocation concealment (selection bias)	Low risk	After allocating the patient to a hygienist, the patient was allocated to either intervention or control group using the minimization method
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Significant loss to follow-up for both groups; 34/57 for control, 26/59 for intervention

Ebbert 2007

Methods	Country: USA Recruitment: General practice attending smokers Cluster-randomized controlled trial
Participants	Adult smokers attending 8 dental practices in south east Minnesota (60 intervention/22 control)
Interventions	1. Quitline referral - Brief counselling plus quitline referral (Fax-to-quit referral form) 2. Usual care - Brief counselling plus patient education brochure

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Ebbert 2007 (*Continued*)

Outcomes	7-day PP at 6m	
Notes	Quitline dose-response trend noted	
Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Random table used for random assignment of clinics to intervention or usual care
Allocation concealment (selection bias)	Unclear risk	Clinic allocation not concealed at time of participant recruitment, and lower participation rate amongst control clinic patients
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No attrition from 3 to 6m in responders. Only 17 of 60 quitline subjects received any follow-up counselling and 32 of the 60 in the quitline group received no quitline contact

Gansky 2005

Methods	Country: USA Recruitment: Contacted athletic trainers at California colleges Cluster-randomized controlled trial
Participants	College baseball athletes who use ST
Interventions	Based upon the innovation theory and social learning theory. 1. Intervention consisted of the following components: • Video conference and follow-up newsletter: 3-hours with ATCs/dentists/hygienists • Dental component: dentists/hygienists provided oral cancer screening, advised ST users to stop, identified oral lesions, provided self-help guide, offered single 10-15 min individual counselling session focusing on ST addiction, set a quit date, developing a plan, training in action and thinking skills to get ready to quit and to prevent relapse • ATC follow-up and referral: follow-up by ATC on quit date and 3 booster sessions 1w apart • Peer-led component: 50-60 min education meeting with included 3 components: 2 videos and slides of facial disfigurement 2. Nonintervention - (not described)
Outcomes	30-day point-prevalence ST abstinence at 12m Abstinence verification: None
Notes	Spillover of cessation intervention seen in control groups via ATC activity ICC: 0.0197.

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Gansky 2005 (*Continued*)

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Cluster randomized: Schools stratified by tertiles of baseline ST use then within strata colleges were randomized to intervention or control group
Allocation concealment (selection bias)	Low risk	Intervention assignment determined by the allocation of the school (cluster) they attended; no differential recruitment suspected
Incomplete outcome data (attrition bias) All outcomes	Low risk	76% of ST users, 81% nonusers completed 1 yr follow-up [non significant after adjustment]; no differential drop-out seen between groups

Gordon 2010a

Methods	Country: USA Recruitment: Tobacco users in private practice clinics Cluster-randomized controlled trial of 1 year duration
Participants	2160 tobacco users attending 68 dental clinics in Mississippi
Interventions	1. '3 As' intervention; ask, advise, arrange quitline referral using 'fax-to-quit referral form 2. '5 As' intervention; ask, advise, assess, assist, arrange counselling with Quitline referral as an option at provider's discretion 3. Usual care - Practitioners provided usual tobacco-use cessation services
Outcomes	12m prolonged abstinence (9m without tobacco use with 3m grace period)
Notes	1 vs. 3 used in meta-analyses. 5As results were very similar (27/817, 3.3% quit) ICC .012 for 9m prolonged abstinence. Significant impact on study by Hurricane Katrina.

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Stratified approximately 17 clinics in each cohort (4) by location and assigned each of them randomly to one of the three study conditions. Probably done through the investigating institution

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Gordon 2010a (*Continued*)

Allocation concealment (selection bias)	Low risk	Probably done through the investigating institution.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing data fairly well balanced (usual care 26.4%, 5 A's 26.4%, 3 A's 31.3%); reasons not likely study related

Gordon 2010b

Methods	Country: USA Recruitment: Smokers attending federally funded public health dental clinics in Mississippi, New York & Oregon Cluster randomized controlled trial
Participants	2549 adult smokers attending public dental clinics for non-emergency visits
Interventions	1. Intervention - Brief 'tailored' tobacco advice, assistance, & NRT 2. Usual Care - Tobacco cessation methods as standard practice
Outcomes	Prolonged abstinence at 7.5m
Notes	Did not use small participant group of ST only (2.4%) and ST/smoked tobacco (1%) users in analysis ICC for prolonged abstinence at 7.5m: 0.009.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Clinics were stratified by size and patient ethnicity, and randomized to one of two study conditions. Probably done through investigating institution
Allocation concealment (selection bias)	Low risk	Centrally through Oregon Research Institute by clinic assignment
Incomplete outcome data (attrition bias) All outcomes	Low risk	Usual care response 73.9%, Intervention 69.3%; relatively equivalent attrition Women more likely to respond than men; respondents were older, smoked longer, and more educated; impact of responder profile for significant bias likely low

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Hanioka 2010

Methods	Country: Japan Recruitment: Adults willing to stop smoking within 1m Randomized controlled multi-clinic trial
Participants	Adult smokers attending dental clinics in Japan
Interventions	1. Intervention - behavioral and pharmacological (nicotine patch and gum) relapse strategies; counselled at initial 2 visits and at 2, 4, 8, and 12w 2. Nonintervention - (not described)
Outcomes	3, 6, 12m continuous abstinence (intention-to-treat analyses) Validation by saliva cotinine < 20 ng/ml
Notes	Results for willing to quit cohort.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Assignment cards in envelopes provided *a priori* to clinics; allocated as subjects agreed to participate/consented
Allocation concealment (selection bias)	Low risk	Low risk with stated allocation process
Incomplete outcome data (attrition bias) All outcomes	Low risk	Comparable numbers lost to follow-up

Lando 2007

Methods	Country: USA Recruitment: Adolescents attending hygiene visits within multi-clinic managed care organization Randomized controlled trial
Participants	Adolescents (14 to 17 years old) attending dental offices for hygiene care
Interventions	1. Intervention - provider advice plus motivational interviewing/follow-up phone calls 2. Usual care - provider advice
Outcomes	Smoking abstinence within past 30 days at 1 year
Notes	Significant process errors impacting recruitment and limiting amount of useful study data

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**

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Lando 2007 (*Continued*)

Random sequence generation (selection bias)	Low risk	A table of random numbers in sequential order was used with odd numbers assigned to intervention and even number assigned to control
Allocation concealment (selection bias)	Unclear risk	A prominent sticker was placed in the charts of subjects in both groups to prompt staff hygienists and dentists to provide tobacco-related advice. Unclear if this identification could have impacted subsequent intervention
Incomplete outcome data (attrition bias) All outcomes	High risk	Authors report that administrative database problems had significant impact on study data

Nohlert 2009

Methods	Country: Sweden Recruitment: smokers identified via dental and health care personnel screening over 18m Randomized controlled trial
Participants	300 smokers in a mixed urban/rural general dental setting; counselling conducted by dental hygienists at local dental clinics
Interventions	1. High intensity - 8 x 40 minute counselling sessions over 4m; mixed behavioral, coaching, and pharmacological advice 2. Low intensity - 1 x 30 minute counselling session explaining a self-help program [8 week program] Information on NRT given to both groups but no recommendation about whether to use or not
Outcomes	PP & 'Continuous' (previous 6m) smoking abstinence at 1 year; ITT analyses
Notes	Did not exclude ST users from obtaining cessation support; smokers meeting inclusion criteria were randomized

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Randomization was performed by an independent person using an envelope technique in blocks of four
Allocation concealment (selection bias)	Low risk	Assignment done through central location after consent/baseline questionnaire received

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Nohlert 2009 (*Continued*)

Incomplete outcome data (attrition bias) All outcomes	Unclear risk	29% of high intensity treatment; 18% of low intensity treatment

Severson 1998

Methods	Country: USA Recruitment: Hygiene patients in 75 private practices Cluster randomized clinical trial
Participants	4029 cigarette smokers >= 15 years of age
Interventions	1. Minimal intervention: • Determined tobacco use status from the patient's chart and health questionnaire; • Identified and recorded findings from the oral examination and related them to patient's tobacco use; • Gave advice to quit and relating advice to oral health; • Gave the patient a packet of materials that included pamphlets of health problems/ways to quit; a quit kit with sugarless candy and gum, flavoured toothpicks, and rubber bands. 2. Extended intervention: as per minimal intervention, plus asked the patient to set a quit date within 2w of visit, gave the patient a motivational video, and called the patient within 2w after the hygiene visit to ask if he/she read the materials, watched the video, and either quit or is now willing to set a quit date 3. Usual care
Outcomes	12m 'sustained' abstinence from ST and all tobacco: subjects must have reported 7-day PP ST and all tobacco abstinence at both 3m and 12m. Abstinence verification: None
Notes	2 vs 3 (extended intervention compared to usual care) in analyses. Minimal intervention quit rate similar (34/1305, 2.6%) Data for ST users reported in Andrews 1999. ICC for cigarette smoking was 0.00004.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Cluster randomized: Practices were blocked by average number of hygiene visits per week and number of years dentists had been in practice, then randomized to usual care, minimal intervention, or extended intervention
Allocation concealment (selection bias)	Low risk	Patient treatment assignment determined by the allocation of the practice (cluster) they attended; no differential recruitment

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Severson 1998 (*Continued*)

		suspected
Incomplete outcome data (attrition bias) All outcomes	Low risk	24.3% loss to follow-up not broken down by study arm or type of tobacco used. Non responders counted as smokers

Severson 2009

Methods	Country: USA Recruitment: Active duty military ST users attending annual examination at military dental clinics, asked to participate irrespective of motivation to quit
Participants	785 active-duty military personnel using ST
Interventions	1. Minimal contact behavioral treatment consisting of ST cessation manual, videotape cessation guide tailored for military personnel, 3 x15 min telephone counselling sessions using motivational interviewing methods 2. Usual care: recommendations to quit using ST and referral to extant local tobacco cessation programs
Outcomes	PP, repeated PP (3 & 6m, all tobacco), and prolonged abstinence at 3 and 6 mo (ST only). Prolonged ST abstinence at 6m used in analyses
Notes	Though minimal in face-to-face contact, which apparently occurred only at the annual evaluation session and then for recruitment, the intervention was not minimal in time expenditure

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Enrollment material mailed to Oregon Research Institute where participants were randomized
Allocation concealment (selection bias)	Low risk	Names/phone numbers of behavioral intervention participants sent to military phone counselling staff
Incomplete outcome data (attrition bias) All outcomes	Low risk	Incomplete data not different in terms of condition, race/ethnicity, rank, readiness to quit, age, first tobacco use, or time to 1st chew Completed 6m assessment - Intervention 69.9% & usual care 75.6%

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Stevens 1995

Methods	Country: USA Recruitment: Hygiene patients in HMO dental offices
Participants	518 male ST users
Interventions	Intervention: soft-tissue exam, cleaning, patient education, feedback on oral health and advice on self care, report of keratotic lesions asking where tobacco was placed, hygienist-directed advice to quit, dentists' strong advice to quit, 9 min video, setting a quit date, self-help booklet, 24-hour advice phone line, kit providing oral substitutes and tip sheets with advice on how to quit, 1w follow-up call by hygienist, plus monthly mailing of tip sheets and newsletter Control: usual care
Outcomes	12m 7-day PP all tobacco abstinence 12m 7-day PP ST abstinence 12m all tobacco sustained abstinence: subjects must have reported no tobacco use in the last 7 days at the 3m and 12m assessments (used in analyses) 12m ST tobacco abstinence: subjects must have reported no ST use in the last 7 days at the 3m and 12m assessments Abstinence verification: None
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	High risk	Pseudo-randomized by clinic identification number
Allocation concealment (selection bias)	High risk	Allocation not concealed at time of enrolment
Incomplete outcome data (attrition bias) All outcomes	High risk	High numbers lost to follow-up: 51.9% (intervention) and 53.7% (control)

Walsh 1999

Methods	Country: USA Recruitment: Publicly-supported colleges were contacted for permission to recruit athletes
Participants	ST users among college-baseball and football athletes
Interventions	Intervention: 3-5 min dental exam, advice to quit, discussed ST-related tissue changes, photographs of facial disfigurement due to oral cancer, self-help guide, offered a 10-15 minute counselling session by the hygienist which included nicotine gum, review of addiction nature of ST and nicotine withdrawal, setting a quit date, developing a plan to quit, and identifying triggers for tobacco use. Phone calls were conducted by the

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Walsh 1999 (*Continued*)

	hygienist on the quit date and 1m later. Control: No intervention.	
Outcomes	30-day PP ST abstinence at 12m Abstinence verification: None	
Notes	ICC: 0.02	
Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Cluster randomized: Colleges were pair-matched based on baseline prevalence of ST use and 1 randomized to intervention, the other to control
Allocation concealment (selection bias)	Low risk	Patient treatment assignment determined by the allocation of the school (cluster) they attended; no differential recruitment suspected
Incomplete outcome data (attrition bias) All outcomes	Low risk	Low loss to follow-up: 10% (intervention) and 5% (control)

Walsh 2003

Methods	Country: USA Recruitment: Principals from randomly selected high schools were contacted
Participants	High school baseball team members who use ST
Interventions	Intervention: 1. Peer-led component: 50- to 60 min educational meeting with videotape and discussion, slide presentation, small-group discussion on tobacco industry advertising; 2. Dental-component: Oral cancer screening in school environment by dental hygienist, advice to quit, identified oral findings related to tobacco use, self-help guide for quitting, offered 15 min counselling in groups, dental hygienists made 5 to 10 min follow-up call. Control: Usual care.
Outcomes	Repeated PP smokeless tobacco abstinence at 1m, 12m & 24m Abstinence verification: at 12m only
Notes	Walsh 2003 is the main trial report but only reported 12m findings. Abstinence at 24m reported in Gansky 2002 is used in the meta-analysis.
Risk of bias	

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Walsh 2003 (*Continued*)

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Cluster randomized: High schools stratified by baseline number and size of teams and baseline prevalence of ST use, then within strata schools were randomized to intervention or control groups
Allocation concealment (selection bias)	Low risk	Patient treatment assignment determined by the allocation of the school (cluster) they attended; no differential recruitment suspected
Incomplete outcome data (attrition bias) All outcomes	Low risk	Reported < 10% loss to follow-up

ATC: athletic training coach; CO: carbon monoxide; COT: cotinine; HMO: Health Maintenance Organization; ICC: intraclass correlation; m: month(s); PP: point prevalence abstinence; prn: when necessary; ST: smokeless tobacco; w: week(s)

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Albert 2004	No tobacco use outcomes reported. Study assessed the effectiveness of academic detailing
Barker 1995	Not an RCT. School-wide tobacco cessation effort.
Barker 2001	Not an RCT. Survey of cessation practice behavior of hygienists and dentists
Barnfather 2005	Short follow-up (8 weeks). Intervention included exam and counselling for both arms, with point-of-care test for salivary nicotine as the exposure variable
Binnie 2003	3-month outcomes only. RCT assessing the effectiveness of smoking cessation counselling and nicotine replacement delivered by dental hygienists
Boundouki 2004	Not an RCT. Use of a patient-information leaflet to improve knowledge of mouth cancer
Campbell 1997	No tobacco use outcomes reported. This report describes the recruitment strategy and response rate for a 3 year RCT to test the effectiveness of a dissemination strategy aimed at improving the tobacco cessation services offered by rural dental practices
Christen 1984	15-week outcomes only. Assessed the efficacy of nicotine gum vs. advice to quit and videotape
Christen 1985	Not an RCT. Assessed nicotine effects on oral health.

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(*Continued*)

Cohen 1987	No tobacco use outcomes reported. Results of exit survey conducted during a study of the impact of nicotine gum and chart reminders on tobacco cessation
Cohen 1989	Data reported in composite, without subgroup denominator values. There was no non-behavioral control group. Unable to contact corresponding author, and co-authors did not have access to the data
Cooper 1989	Not an RCT. Hospital-based smoking cessation program using behavioral modification and pharmacotherapy
Gelskey 2002	Not an RCT. No tobacco cessation outcomes. Study of tobacco use cessation counselling by oral health professionals
Glasgow 1993	Methods of individual clinical trials are not included. Description of efforts to biochemically validate self-reports of smoking cessation from participants in four large-scale randomized trials. Study of RCT in dental clinics is reviewed elsewhere in this systematic review. See Little 1992 /Stevens 1995).
Gordon 2002	Not an RCT. Assessed the effectiveness of tobacco use counselling through public health dental clinics
Gordon 2005a	Not an RCT. Assessed the effectiveness of a behavioral intervention delivered through public health dental clinics
Gordon 2005b	No tobacco use outcomes. Compared different methods of training on hygienists tobacco use cessation activities
Gorin 2004	Meta-analysis included 5 dental intervention studies of 3m duration and Stevens 1995, which is included in the review.
Gould 1998	Not an RCT. Survey of participants in an NCI training program for delivering tobacco use interventions
Greene 1994	3-month outcomes only. Assessed the effectiveness of two interventions for smokeless tobacco cessation
Gritz 1993	Not in a dental setting. Hospital-based study assessing the impact of tobacco use counselling on head and neck cancer patients. Only 7/110 health care professionals were dental providers
Hanioka 2007	The effectiveness of intervention was evaluated with respect to attempts to quit and progression through the stages of behavioral changes involved in quitting using the standardized questionnaire - not abstinence
Houston 2008	No tobacco use outcomes reported. Assessed an internet-delivered intervention to increase implementation of brief provider advice
Hovell 1995	No tobacco use outcomes reported. Assessed the distribution of anti-tobacco materials in orthodontic offices
Hovell 2001	Not an RCT. Assessed the effectiveness of a behavioral intervention delivered by orthodontists in preventing pre-teens from initiating tobacco use
Johnston 1996	Not an RCT. The questionnaire was being developed as part of a 2-year RCT of the effect of a multifaceted oral health education program on tobacco use among elementary school children in Ontario, CA. This is a report of pretest evaluation for the questionnaire

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(*Continued*)

Jones 1993	Not an RCT. Baseline survey of tobacco use cessation activity and attitudes in community practices
Kentala 1999	Prevention study. Assessed the effectiveness of behavioral counselling on preventing or treating adolescent smoking
Kirkwood 2001	4-week outcomes only. Assessed the efficacy of a smoking deterrent mouthwash. No tobacco use outcomes reported
Kirkwood 2002	4-week outcomes only. Assessed the efficacy of a smoking deterrent breath spray. Outcome is smoking reduction not cessation
Koerber 2003	No tobacco use outcomes reported. Assessed the effects of teaching dental students brief motivational interviewing
Little 2009	No tobacco use outcomes reported. Evaluated assisted referral
Maassen 2008	Not an RCT. Study sought to determine guideline implementation parameters in a trial of 12 dental practices - measured patient receptiveness to cessation advice
Macgregor 1996	Not an RCT. Evaluated the effectiveness of dental health advice for a reduction in cigarette smoking
Masouredis 1997	3-month outcomes only. Assessed the effectiveness of a smokeless tobacco intervention in colleges
Morgan 2000	Not an RCT. Recommendations for oral health professionals for addressing patient tobacco use
Nasry 2006	Not an RCT. Single cohort of smokers in a periodontal clinic provided counselling and pharmacotherapy as needed
NCI 1994	Collection of monographs addressing smoking cessation in medical and dental environments. Data from primary literature are covered elsewhere in this review. See Cohen 1987, Cohen 1989, Gritz 1993.
NCI 1995	Intervention not confined to the dental setting. Community-based interventions with communities as the unit of randomization. Tobacco control activities were promoted through medical and dental office settings
O'Keefe 1995	Not an RCT. Study of dental practitioner compliance with tobacco use intervention training
Olson 1985	15-week outcomes only of salivary parameters before and after among smokers using nicotine-containing chewing gum. No tobacco cessation outcomes
Secker-Walker 1988	Not an RCT. Pilot study of smoking cessation advice among patients in a periodontal practice
Smith 1998	Not an RCT. Case series of smoking cessation programs conducted in dental practices in the UK
Walsh 2010	No tobacco use outcomes.
Williams 2002	Abstract unavailable. No additional information supplied by author

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(*Continued*)

Wood 1997	Not an RCT. 3-month data only. Office-based training in tobacco cessation for dentists

RCT: randomized controlled trial

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DATA AND ANALYSES

Comparison 1. Behavioral Interventions versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Abstinence at longest follow-up	14	10535	Adjusted Odds Ratio (Fixed, 95% CI)	1.71 [1.44, 2.03]
1.1 Cigarette Smokers	8	7294	Adjusted Odds Ratio (Fixed, 95% CI)	1.74 [1.33, 2.27]
1.2 Smokeless Tobacco Users	6	3241	Adjusted Odds Ratio (Fixed, 95% CI)	1.70 [1.36, 2.11]
2 Abstinence at longest follow-up. Subgroup of trials in adult smokers seen by general dental practitioners	5		Adjusted odds ratio (Fixed, 95% CI)	2.38 [1.70, 3.35]
3 Abstinence at longest follow-up. Subgroups by method of randomization	14		Adjusted odds ratio (Fixed, 95% CI)	1.56 [1.32, 1.85]
3.1 Cluster Randomization	8		Adjusted odds ratio (Fixed, 95% CI)	1.61 [1.32, 1.96]
3.2 Individual Randomization	6		Adjusted odds ratio (Fixed, 95% CI)	1.46 [1.06, 2.01]
4 Tobacco abstinence at longest follow-up. Raw data for all studies			Other data	No numeric data
4.1 Cigarette Smokers			Other data	No numeric data
4.2 Smokeless Tobacco Users			Other data	No numeric data

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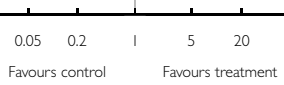
Analysis 1.1. Comparison 1 Behavioral Interventions versus control, Outcome 1 Abstinence at longest follow-up.

Review: Interventions for tobacco cessation in the dental setting

Comparison: 1 Behavioral Interventions versus control

Outcome: 1 Abstinence at longest follow-up

Study or subgroup	Intervention N N	Control N N	log [Adjusted Odds Ratio] (SE)	Adjusted Odds Ratio IV,Fixed,95% CI	Weight	Adjusted Odds Ratio IV,Fixed,95% CI
1 Cigarette Smokers						
Lando 2007	61	63	-0.5773 (0.6544)		1.8 %	0.56 [0.16, 2.02]
Ebbert 2007	60	22	-0.1178 (0.5648)		2.3 %	0.89 [0.29, 2.69]
Severson 1998	1374	1350	0.0738 (0.2478)		12.2 %	1.08 [0.66, 1.75]
Binnie 2007	59	57	0.3874 (0.9324)		0.9 %	1.47 [0.24, 9.16]
Gordon 2010a	793	550	0.7488 (0.4499)		3.7 %	2.11 [0.88, 5.11]
Nohlert 2009	150	150	0.8387 (0.3597)		5.8 %	2.31 [1.14, 4.68]
Gordon 2010b	1394	1155	1.0603 (0.2527)		11.7 %	2.89 [1.76, 4.74]
Hanioka 2010	33	23	1.3375 (0.7171)		1.5 %	3.81 [0.93, 15.53]
Subtotal (95% CI)	**3924**	**3370**			**39.9 %**	**1.74 [1.33, 2.27]**
Heterogeneity: Chi² = 14.21, df = 7 (P = 0.05); I² =51%						
Test for overall effect: Z = 4.02 (P = 0.000058)						
2 Smokeless Tobacco Users						
Gansky 2005	285	352	-0.0341 (0.1805)		23.0 %	0.97 [0.68, 1.38]
Stevens 1995	245	273	0.4181 (0.318)		7.4 %	1.52 [0.81, 2.83]
Walsh 2003	141	166	0.7066 (0.4181)		4.3 %	2.03 [0.89, 4.60]
Severson 2009	393	393	0.9665 (0.2645)		10.7 %	2.63 [1.57, 4.41]
Walsh 1999	171	189	1.0525 (0.2728)		10.1 %	2.86 [1.68, 4.89]
Andrews 1999	394	239	1.1826 (0.4015)		4.6 %	3.26 [1.49, 7.17]
Subtotal (95% CI)	**1629**	**1612**			**60.1 %**	**1.70 [1.36, 2.11]**
Heterogeneity: Chi² = 19.10, df = 5 (P = 0.002); I² =74%						
Test for overall effect: Z = 4.74 (P < 0.00001)						
Total (95% CI)	**5553**	**4982**			**100.0 %**	**1.71 [1.44, 2.03]**
Heterogeneity: Chi² = 33.33, df = 13 (P = 0.002); I² =61%						
Test for overall effect: Z = 6.21 (P < 0.00001)						
Test for subgroup differences: Chi² = 0.02, df = 1 (P = 0.90), I² =0.0%						



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Analysis 1.2. Comparison 1 Behavioral Interventions versus control, Outcome 2 Abstinence at longest follow-up. Subgroup of trials in adult smokers seen by general dental practitioners.

Review: Interventions for tobacco cessation in the dental setting

Comparison: 1 Behavioral Interventions versus control

Outcome: 2 Abstinence at longest follow-up. Subgroup of trials in adult smokers seen by general dental practitioners

Study or subgroup	log [Adjusted odds ratio] (SE)	Adjusted odds ratio IV,Fixed,95% CI	Weight	Adjusted odds ratio IV,Fixed,95% CI
Ebbert 2007	-0.1178 (0.5648)		9.4 %	0.89 [0.29, 2.69]
Gordon 2010a	0.7488 (0.4499)		14.8 %	2.11 [0.88, 5.11]
Gordon 2010b	1.0603 (0.2527)		46.9 %	2.89 [1.76, 4.74]
Hanioka 2010	1.3375 (0.7171)		5.8 %	3.81 [0.93, 15.53]
Nohlert 2009	0.8387 (0.3597)		23.1 %	2.31 [1.14, 4.68]
Total (95% CI)			**100.0 %**	**2.38 [1.70, 3.35]**

Heterogeneity: $Chi^2 = 4.13$, df = 4 (P = 0.39); $I^2 = 3\%$

Test for overall effect: Z = 5.02 (P < 0.00001)

Test for subgroup differences: Not applicable

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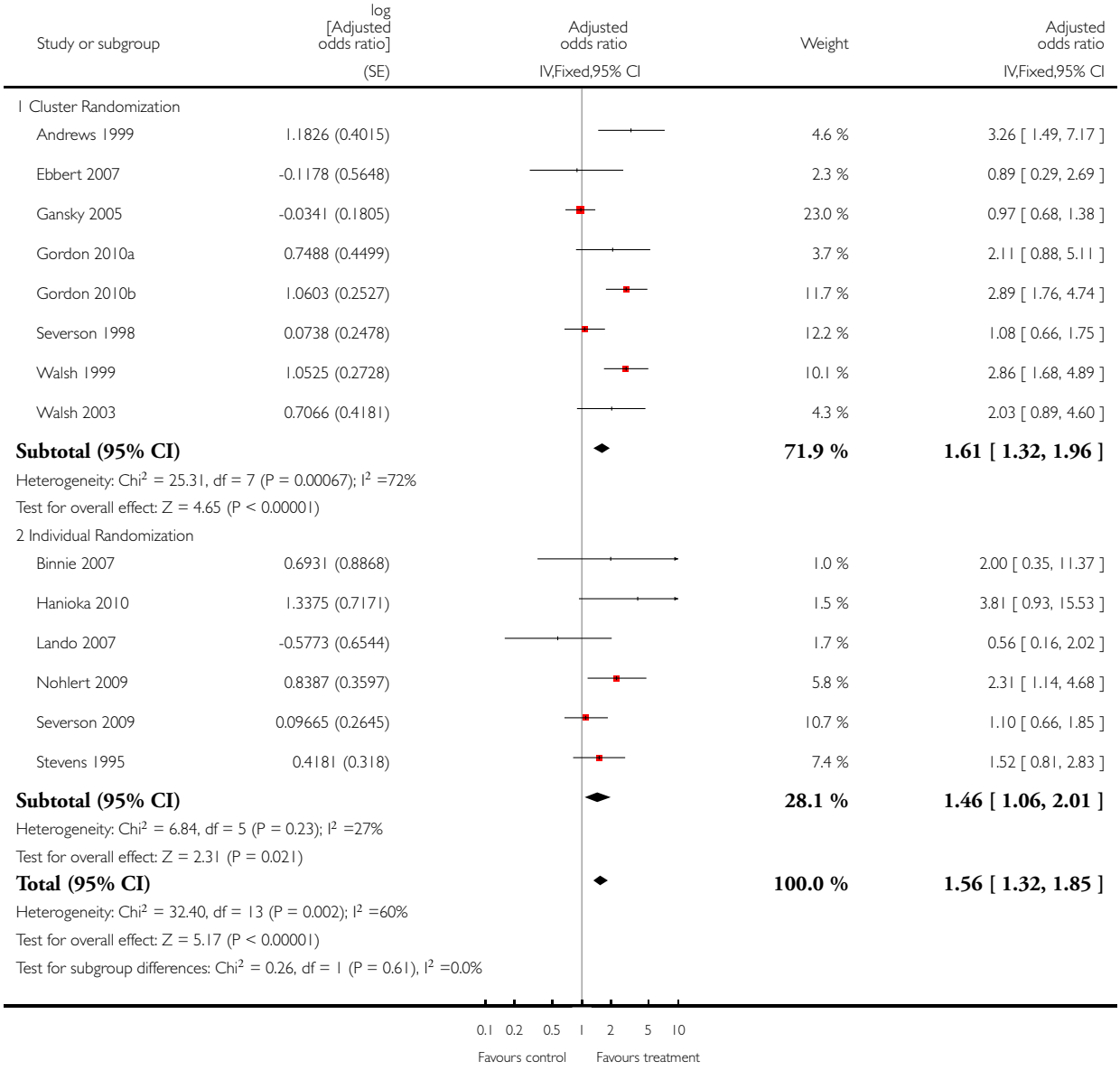
Analysis 1.3. Comparison 1 Behavioral Interventions versus control, Outcome 3 Abstinence at longest follow-up. Subgroups by method of randomization.

Review: Interventions for tobacco cessation in the dental setting

Comparison: 1 Behavioral Interventions versus control

Outcome: 3 Abstinence at longest follow-up. Subgroups by method of randomization



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Analysis 1.4. Comparison 1 Behavioral Interventions versus control, Outcome 4 Tobacco abstinence at longest follow-up. Raw data for all studies.

Tobacco abstinence at longest follow-up. Raw data for all studies

Study	Intervention	Control	Abstinence def	Notes
Cigarette Smokers				
Binnie 2007	3/59	2/57	12m, prolonged (repeated PP), all tobacco	Validated
Ebbert 2007	15/60	6/22	6m, PP, all tobacco	Cluster RCT, ICC 0.001
Gordon 2010a	24/793	8/550	12m, sustained, all tobacco	Cluster RCT, ICC 0.012 27/817 quit in 5As
Gordon 2010b	74/1394	22/1155	7.5m, prolonged, all tobacco	Cluster RCT, ICC 0.009
Hanioka 2010	12/33	3/23	12m, continuous, all tobacco	
Lando 2007	4/61	7/63	12m, PP (30 day), smoking	
Nohlert 2009	27/150	13/150	12m, sustained, smoking	
Severson 1998	35/1374	32/1350	12m, sustained, all tobacco	Cluster RCT, ICC 0.0004
Smokeless Tobacco Users				
Andrews 1999	40/394	8/239	12m, sustained, all tobacco	Cluster RCT, ICC 0.0009
Gansky 2005	103/285	130/352	12m, PP, ST	Cluster RCT, ICC 0.0074
Severson 2009	53/393	22/393	6m, prolonged, ST	
Stevens 1995	25/245	19/273	12m, sustained, all tobacco	
Walsh 1999	60/171	30/189	12m, PP, ST	Cluster RCT, ICC 0.02
Walsh 2003	32/141	21/166	24m, sustained, ST	Cluster RCT, ICC 0.04 12m outcome was 38/141 vs 23/166

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APPENDICES

Appendix 1. Glossary of terms

Term	Definition
Abstinence	A period of being quit, ie stopping the use of cigarettes or other tobacco products, May be defined in various ways; see also: point prevalence abstinence; prolonged abstinence; continuous/sustained abstinence
Biochemical verification	Also called 'biochemical validation' or 'biochemical confirmation': A procedure for checking a tobacco user's report that he or she has not smoked or used tobacco. It can be measured by testing levels of nicotine or cotinine or other chemicals in blood, urine, or saliva, or by measuring levels of carbon monoxide in exhaled breath or in blood
Bupropion	A pharmaceutical drug originally developed as an antidepressant, but now also licensed for smoking cessation; trade names Zyban, Wellbutrin (when prescribed as an antidepressant)
Carbon monoxide (CO)	A colourless, odourless highly poisonous gas found in tobacco smoke and in the lungs of people who have recently smoked, or (in smaller amounts) in people who have been exposed to tobacco smoke. May be used for biochemical verification of abstinence
Cessation	Also called 'quitting' The goal of treatment to help people achieve abstinence from smoking or other tobacco use, also used to describe the process of changing the behaviour
Continuous abstinence	Also called 'sustained abstinence' A measure of cessation often used in clinical trials involving avoidance of all tobacco use since the quit day until the time the assessment is made. The definition occasionally allows for lapses. This is the most rigorous measure of abstinence
'Cold Turkey'	Quitting abruptly, and/or quitting without behavioural or pharmaceutical support
Craving	A very intense urge or desire [to smoke]. See: Shiffman et al 'Recommendations for the assessment of tobacco craving and withdrawal in smoking cessation trials' Nicotine & Tobacco Research 2004: 6(4): 599-614
Dopamine	A neurotransmitter in the brain which regulates mood, attention, pleasure, reward, motivation and movement
Efficacy	Also called 'treatment effect' or 'effect size': The difference in outcome between the experimental and control groups
Harm reduction	Strategies to reduce harm caused by continued tobacco/nicotine use, such as reducing the number of cigarettes smoked, or switching to different brands or products, e.g. potentially reduced exposure products (PREPs), smokeless tobacco

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(*Continued*)

Lapse/slip	Terms sometimes used for a return to tobacco use after a period of abstinence. A lapse or slip might be defined as a puff or two on a cigarette. This may proceed to relapse, or abstinence may be regained. Some definitions of continuous, sustained or prolonged abstinence require complete abstinence, but some allow for a limited number or duration of slips. People who lapse are very likely to relapse, but some treatments may have their effect by helping people recover from a lapse
nAChR	[neural nicotinic acetylcholine receptors]: Areas in the brain which are thought to respond to nicotine, forming the basis of nicotine addiction by stimulating the overflow of dopamine
Nicotine	An alkaloid derived from tobacco, responsible for the psychoactive and addictive effects of smoking
Nicotine Replacement Therapy (NRT)	A smoking cessation treatment in which nicotine from tobacco is replaced for a limited period by pharmaceutical nicotine. This reduces the craving and withdrawal experienced during the initial period of abstinence while users are learning to be tobacco-free The nicotine dose can be taken through the skin, using patches, by inhaling a spray, or by mouth using gum or lozenges
Outcome	Often used to describe the result being measured in trials that is of relevance to the review. For example smoking cessation is the outcome used in reviews of ways to help smokers quit. The exact outcome in terms of the definition of abstinence and the length of time that has elapsed since the quit attempt was made may vary from trial to trial
Pharmacotherapy	A treatment using pharmaceutical drugs, e.g. NRT, bupropion
Point prevalence abstinence (PPA)	A measure of cessation based on behaviour at a particular point in time, or during a relatively brief specified period, e.g. 24 hours, 7 days. It may include a mixture of recent and long-term quitters. cf. prolonged abstinence, continuous abstinence
Prolonged abstinence	A measure of cessation which typically allows a 'grace period' following the quit date (usually of about two weeks), to allow for slips/lapses during the first few days when the effect of treatment may still be emerging. See: Hughes et al 'Measures of abstinence in clinical trials: issues and recommendations'; Nicotine & Tobacco Research, 2003: 5 (1); 13-25
Relapse	A return to regular smoking after a period of abstinence
Secondhand smoke	Also called passive smoking or environmental tobacco smoke [ETS] A mixture of smoke exhaled by smokers and smoke released from smouldering cigarettes, cigars, pipes, bidis, etc. The smoke mixture contains gases and particulates, including nicotine, carcinogens and toxins
Self-efficacy	The belief that one will be able to change one's behaviour, e.g. to quit smoking
SPC [Summary of Product Characteristics]	Advice from the manufacturers of a drug, agreed with the relevant licensing authority, to enable health professionals to prescribe and use the treatment safely and effectively

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(*Continued*)

Tapering	A gradual decrease in dose at the end of treatment, as an alternative to abruptly stopping treatment
Tar	The toxic chemicals found in cigarettes. In solid form, it is the brown, tacky residue visible in a cigarette filter and deposited in the lungs of smokers
Titration	A technique of dosing at low levels at the beginning of treatment, and gradually increasing to full dose over a few days, to allow the body to get used to the drug. It is designed to limit side effects
Withdrawal	A variety of behavioural, affective, cognitive and physiological symptoms, usually transient, which occur after use of an addictive drug is reduced or stopped. See: Shiffman et al 'Recommendations for the assessment of tobacco craving and withdrawal in smoking cessation trials' Nicotine & Tobacco Research 2004: 6(4): 599-614

WHAT'S NEW

Date	Event	Description
10 April 2012	New citation required and conclusions have changed	Conclusions updated to include interventions among cigarette smokers as well as among smokeless tobacco users. New included studies increase strength of effect
10 April 2012	New search has been performed	8 new included studies added, evaluating interventions among cigarette smokers

HISTORY

Protocol first published: Issue 1, 2005

Review first published: Issue 1, 2006

Date	Event	Description
22 February 2012	New search has been performed	Updated search to November 2011
29 July 2008	Amended	Converted to new review format.

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(*Continued*)

5 September 2006	New search has been performed	Updated for issue 1 2007. No new studies identified. Two studies reviewed and added to excluded studies list

CONTRIBUTIONS OF AUTHORS

JOE and ABC both conceived and planned the review, sought trials and extracted data; both were equally involved in writing the review.

DECLARATIONS OF INTEREST

None.

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Internal sources

- No sources of support supplied

External sources

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INDEX TERMS

Medical Subject Headings (MeSH)

*Dental Offices; Counseling; Oral Health; Randomized Controlled Trials as Topic; Schools; Smoking Cessation [methods; psychology]; Tobacco Use Cessation [*methods; psychology]; Tobacco, Smokeless [adverse effects]; Universities

MeSH check words

Humans

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