

Alternative Smoking Cessation Aids: A Meta-analysis of Randomized Controlled Trials

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ABSTRACT

BACKGROUND: Acupuncture, hypnotherapy, and aversive smoking are the most frequently studied alternative smoking cessation aids. These aids are often used as alternatives to pharmacotherapies for smoking cessation; however, their efficacy is unclear.

METHODS: We carried out a random effect meta-analysis of randomized controlled trials to determine the efficacy of alternative smoking cessation aids. We systematically searched the Cochrane Library, EMBASE, Medline, and PsycINFO databases through December 2010. We only included trials that reported cessation outcomes as point prevalence or continuous abstinence at 6 or 12 months.

RESULTS: Fourteen trials were identified; 6 investigated acupuncture (823 patients); 4 investigated hypnotherapy (273 patients); and 4 investigated aversive smoking (99 patients). The estimated mean treatment effects were acupuncture (odds ratio [OR], 3.53; 95% confidence interval [CI], 1.03-12.07), hypnotherapy (OR, 4.55; 95% CI, 0.98-21.01), and aversive smoking (OR, 4.26; 95% CI, 1.26-14.38).

CONCLUSION: Our results suggest that acupuncture and hypnotherapy may help smokers quit. Aversive smoking also may help smokers quit; however, there are no recent trials investigating this intervention. More evidence is needed to determine whether alternative interventions are as efficacious as pharmacotherapies.

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Smoking is the most preventable cause of morbidity and mortality in North America and costs the economy \$210 billion each year in the United States alone.¹⁻³ Annually, approximately half of the 51 million smokers in North America try to quit for at least 1 day.⁴⁻⁶ Of these smokers attempting cessation, less than half use pharmacologic cessation aids (nicotine replacement therapy, bupropion, or varenicline) because of concerns about potential side effects and limited efficacy.⁷

Many smokers have turned to alternative smoking cessation aids as a substitute for pharmacotherapies, of which the most studied include acupuncture, hypnotherapy, and aversive smoking. Acupuncture for smoking cessation consists of stimulating specific acupoints on the ear.⁸ Hypnotherapy consists of inducing an altered state of conscious-

ness enabling an adherence to smoking cessation.⁹ Finally, aversive smoking consists of rapidly taking a large number of puffs in a short period of time.¹⁰

In 2005, 6% of smokers trying to quit underwent acupuncture and 13% underwent hypnotherapy. Furthermore, 30% and 40% of smokers have reported an interest in trying acupuncture and hypnotherapy, respectively.¹¹ These alternative aids are costly, with the total price of each therapy ranging from \$400 to \$1000.

Despite the popularity and high cost, the efficacy of alternative smoking cessation aids remains unclear. Several randomized controlled trials have examined their efficacy; however, widely varying estimates of their treatment effect have been reported. Our objective was to carry out a systematic review and meta-analysis to determine the efficacy of alternative smoking cessation aids.

MATERIALS AND METHODS

Data Sources and Searches

We systematically searched the Cochrane Library, EMBASE, Medline, and PsycINFO databases through December 2010 for randomized controlled trials investigating alternative smoking cessation aids. Our search strategy combined the terms *cigarette*, *nicotine*, *smoking*, and *tobacco* with the following key words: *acupuncture*, *electrotherapy*, *electroacupuncture*, *laser therapy*, *hypnosis*, *hypnotherapy*, *aversive smoking*, and *rapid smoking*. We limited our search to the English and French languages and to randomized controlled trials carried out in adults. The references of randomized controlled trials, systematic reviews, and meta-analyses were hand-searched for studies not identified in the database search.

Study Selection

Eligible studies were randomized controlled trials; investigated one of the following alternative smoking cessation aids: acupuncture, hypnotherapy, and aversive smoking; reported long-term smoking cessation at 6 or 12 months; and investigated adults. Randomized controlled trials investigating more than 1 smoking cessation aid also were eligible for inclusion. Specifically, we included 2 types of randomized controlled trials that investigated more than 1 smoking cessation aid: factorial-designed randomized controlled trials and randomized controlled trials with multiple arms per intervention. For factorial-designed randomized controlled trials, we treated these as 2 separate randomized controlled trials and compared intervention arms such that

the only difference between arms was the alternative smoking cessation aid itself. For randomized controlled trials with multiple arms per intervention, we reused the control group in each comparison. We accounted for this reuse in our analysis, avoiding double-counting of groups from randomized controlled trials with multiple arms, while using all available data.

Acupuncture for smoking cessation was defined as the stimulation of specific acupoints on the ear using needles or laser therapy.^{8,12} We included only acupuncture studies that controlled for the intervention using sham acupuncture (ie, insertion of needles or lasers at a location other than the ear, where there should be no effect).

Hypnotherapy was defined as the induction of a state of receptive and attentive concentration. This state enables the individual to adhere to suggestions and strategies to quit smoking.⁹ Randomized controlled trials investigating hypnotherapy used control treatments that varied from being

placed on a wait list to receiving a booklet.

Aversive smoking is a procedure defined as inhaling a puff of cigarette every 6 seconds for 3 minutes, or until the patient consumes 3 cigarettes, or until the patient is unable to smoke. After a short resting period, this procedure is repeated 2 to 3 times per session to deter the patient from smoking.¹⁰ The control groups for randomized controlled trials investigating aversive smoking included smoking at a regular pace during a session or being placed on a wait list.

Data Extraction

Data from each randomized controlled trial were independently extracted by 2 reviewers. Disagreements were resolved by consensus or, when necessary, a third reviewer. Reviewers extracted information on study design, including the type of intervention, the type of randomization, the type of blinding, the therapists delivering the intervention, and the biochemical validation of data. Extracted baseline participant characteristics included mean number of cigarettes per day, mean Fagerström Test for Nicotine Dependence scores, mean age, sex, and race. Treatment characteristics that were extracted included mean number of sessions, mean time of treatment, and type of control intervention.

Smoking abstinence was defined as continuous abstinence or point prevalence of abstinence. Continuous abstinence consists of no smoking from the end of treatment to follow-up. Point prevalence of abstinence consists of no smoking for the 7 days preceding follow-up. We interpreted

CLINICAL SIGNIFICANCE

- The use of unconventional smoking cessation aids, including acupuncture and hypnotherapy, results in substantial increases in smoking cessation compared with control.
- We recommend that practitioners administer acupuncture and hypnotherapy as an alternative to pharmacologic interventions to patients who prefer not to use conventional smoking cessation aids to quit smoking.
- More studies are needed to evaluate with a more precise estimate the efficacy of those alternative aids.

the results of included randomized controlled trials using an intention-to-treat analysis.

The variety of outcomes reported in the randomized controlled trials meant that, for any single outcome, we would have to exclude many studies from the meta-analysis. Therefore, reviewers extracted only the most rigorous criterion of smoking cessation reported for each randomized controlled trial.¹³ The most rigorous criterion uses the most conservative outcome reported in any given randomized controlled trial. Starting from the most rigorous outcome, the criteria are: continuous abstinence at 12 months; continuous abstinence at 6 months; point prevalence abstinence at 12 months; and point prevalence abstinence at 6 months. We calculated abstinence outcomes according to an intention-to-treat analysis. Patients who were randomized but lost to follow-up were considered smokers. Thus, the study can be applicable to real-life smokers who are trying to quit.

Quality Assessment

We used the Cochrane assessment tool to assess the quality of included randomized controlled trials.¹⁴ This assessment tool uses the following criteria to evaluate bias in a randomized controlled trial: sequence generation; allocation concealment; blinding of participants, personnel, and outcome assessors; incomplete outcome data; selective outcome reporting; and other potential threats to validity. Each randomized controlled trial was classified according to the following criteria: high quality, low quality, or unclear. Randomized controlled trials in which smoking cessation was not biochemically validated were automatically considered as unclear for the category of other potential threats to validity.

Statistical Analysis

We synthesized the results of included studies using the DerSimonian and Laird random effect model, taking into account both within randomized controlled trial and between trial variability. A forest plot was created for each outcome, for which we estimated pooled odds ratios (ORs) with their 95% confidence interval (CI). Heterogeneity was assessed using I^2 statistics. In addition, funnel plots were constructed and visually assessed for the possible presence of publication bias. We conducted our analyses using MIX software version 1.3.¹⁵

RESULTS

Search Results and Study Inclusion

A total of 933 potentially relevant abstracts in our initial literature search were identified (Figure 1). Of these abstracts, 111 studies were retrieved and evaluated for eligibility. Thirteen randomized controlled trials met our inclusion criteria and were included in our meta-analysis (Tables 1-3). The 98 remaining studies were excluded because they did not use a randomized controlled trial design ($n = 66$), patients

were followed less than 6 months ($n = 24$), smoking cessation outcomes were not reported ($n = 6$), or studies did not use a proper control ($n = 2$). We identified an additional randomized controlled trial that met our inclusion criteria from our hand-search of previous studies. Thus, we included a total of 14 randomized controlled trials in our meta-analysis. Among these randomized controlled trials, 6 evaluated acupuncture (823 patients), 4 evaluated hypnotherapy (273 patients), and 4 evaluated aversive smoking (99 patients).

Quality Assessment of Included Studies

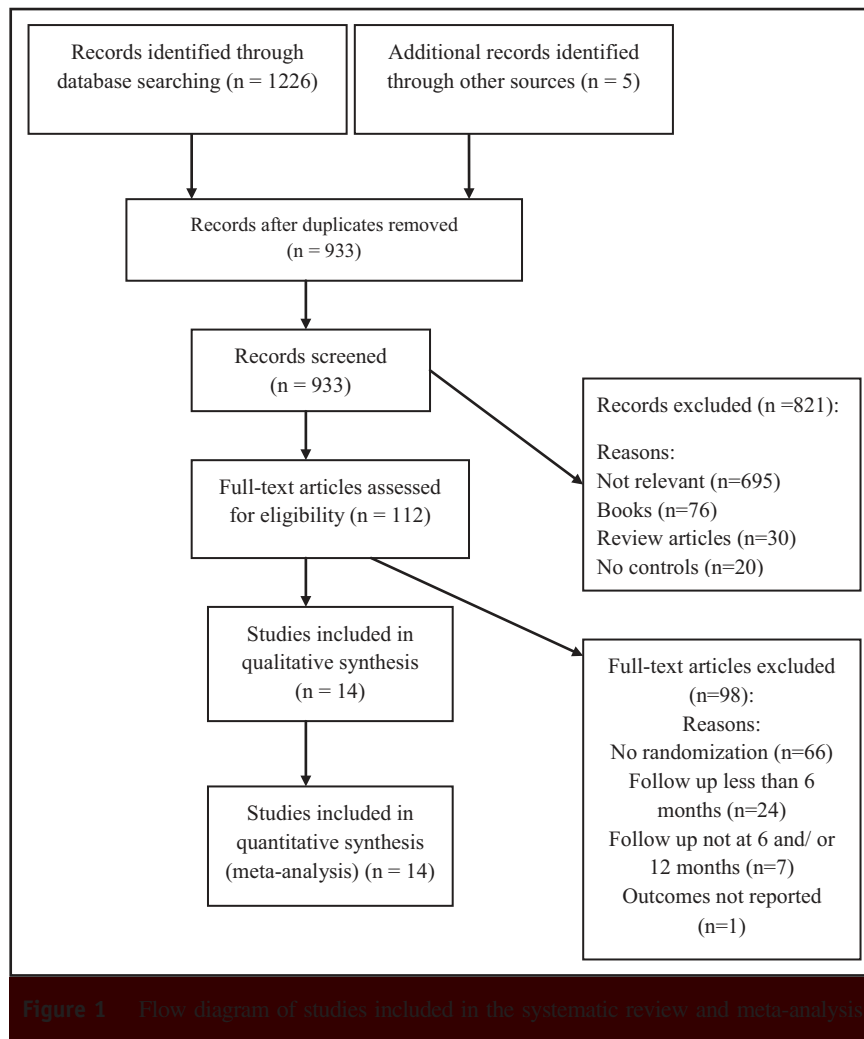
The qualitative risk of bias was relatively low for the 6 randomized controlled trials investigating acupuncture when compared with hypnotherapy and aversive smoking studies (Table 4). In acupuncture randomized controlled trials, the sequence generation, blinding of patients, and outcome data and reporting were generally of high quality. However, only 2 of the 6 acupuncture randomized controlled trials provided biochemical validation of self-reports of smoking cessation. The outcome data in the randomized controlled trial by Kerr et al¹⁶ was difficult to interpret. We contacted the authors, who provided the raw data for their study and confirmed the accuracy of their results. In contrast with acupuncture randomized controlled trials, the 4 randomized controlled trials each investigating hypnotherapy and aversive smoking generally provided few or no details of the sequence generation and allocation concealment of patients. Only 1 of the 4 hypnotherapy randomized controlled trials and 1 of the 4 aversive smoking randomized controlled trials reported biochemical validation of smoking status.

Baseline and Treatment Characteristics

Baseline patient characteristics varied among randomized controlled trials (Tables 1-3). The mean age ranged from 30 to 54 years. The mean number of cigarettes per day varied from 16 to 32, and the mean Fagerström Test for Nicotine Dependence score varied from 4 to 11. Certified acupuncturists were appointed to provide acupuncture for smoking cessation. For hypnotherapy, providers included psychologists and family physicians with training in hypnotherapy. For aversive smoking, providers included psychologists and clinical researchers with training in aversive smoking. Treatment characteristics also varied among randomized controlled trials. The mean number of sessions ranged from 1 to 20. The mean time of treatment ranged from 20 to 600 minutes for acupuncture, 80 to 480 minutes for hypnotherapy, and 150 to 600 minutes for aversive smoking.

Efficacy of Alternative Smoking Cessation Aids

A separate meta-analysis was carried out for each alternative smoking cessation aid for which smoking cessation was defined using the most rigorous criterion reported. The point



estimate for acupuncture intervention (OR, 3.53; 95% CI, 1.03, 12.07) suggested that acupuncture substantially increased smoking cessation compared with sham acupunc-

ture (Figure 2). Hypnotherapy (OR, 4.55, 95% CI, 0.98-21.01) might be efficacious at promoting smoking cessation (Figure 3). However, the CI was wide and included 1.0;

Table 1 Randomized Controlled Trials Investigating Acupuncture

Study (First Author and Year)*	Sample Size	Country	Male (%)	Mean Age (y)	Mean CPD	Treatment Characteristics			Most Rigorous Outcome Reported		Smoking Abstinence (%)	
						Delivered by	Sessions (No.)	Total Duration of Sessions (min)	Follow-up (mo)	Abstinence Classification	Active	Control
Kerr 2008 ¹⁶	258	UK	56.5	—	—	Trained researcher	4	56	6	PP	55	4
Vandevenne 1985 ²⁴	200	France	—	—	—	Trained physician	—	120	12	CA	40	32
Ta-Peng Wu 2007 ²⁵	131	Taiwan	84.8	53.7	—	Acupuncturist	—	—	6	PP	9	6
Bier 2002 ²⁶	103	US	49.6	46.4	27.2	Acupuncturist	20	600	6	PP	13	2
Waite 1998 ²⁷	76	US	55.2	42.5	—	Acupuncturist	1	60	6	PP	3	5
Gillams 1984 ²⁸	55	US	51	37.5	24	—	—	—	6	PP	18	15

CA = continuous abstinence; CPD = cigarettes per day; MC = multicenter; PP = point prevalence; SC = single-center.
*Studies ordered by sample size.

Table 2 Randomized Controlled Trials Investigating Hypnotherapy

Study*	Sample Size	Country	Male (%)	Mean Age (y)	Mean CPD	Treatment Characteristics			Most Rigorous Outcome Reported		Smoking Abstinence (%)	
						Delivered by	Sessions (No.)	Total Duration of Sessions (min)	Follow-up (mo)	Abstinence Classification	Active	Control
Lambe 1986 ²⁹	180	US	31.5	35.6	26.2	Trained family physician	2	80	12	PP	22	20
Williams 1988 ³⁰	40	US	51.7	—	16	Hypnotherapist	1	150	12	CA	45	0
Pederson 1979 ³¹	33	Canada	43.1	41.7	28.2	Hypnotherapist	1	—	6	CA	53	18
Elkins 2006 ³²	20	US	30	42.7	23.95	Trained psychologist	8	480	6	PP	40	0

CA = continuous abstinence; CPD = cigarettes per day; PP = point prevalence.

*Studies ordered by sample size.

thus, we cannot draw strong conclusions about the efficacy of hypnotherapy. Aversive smoking (OR, 4.26, 95% CI, 1.26-14.38) substantially increased smoking abstinence compared with control (Figure 4). The wide CIs for the alternative smoking cessation aids prevented their ranking through indirect comparisons (data not shown).

DISCUSSION

Our study was designed to determine the efficacy of alternative smoking cessation aids (acupuncture, hypnotherapy, and aversive smoking) at promoting long-term smoking cessation. We included only the most rigorous randomized controlled trials, in which alternative smoking cessation aids were compared with an appropriate control and in which smoking cessation outcomes were reported at 6 or 12 months.

Acupuncture, hypnotherapy, and aversive smoking were found to increase smoking abstinence by factors of 3.53, 4.26, and 4.55, respectively. On the surface, these results seem promising, especially when compared with

pharmacotherapies, which are known to increase smoking cessation by a factor of 2 to 2.5.¹⁷ However, these results should be interpreted with caution since the CI for each intervention was wide. There is a lack of randomized controlled trials investigating alternative smoking cessation aids, and the patient population included in our meta-analysis was small. Furthermore, in most randomized controlled trials included in our meta-analysis, reports of smoking cessation were not validated by biochemical means. We recommend that physicians encourage the use of alternative smoking cessation aids, particularly in patients hesitant or unable to use pharmacotherapies proven to be efficacious for smoking cessation.¹⁷ However, more evidence is needed to determine the precise level of efficacy of alternative smoking cessation aids.

Given that up to 40% of individuals trying to quit smoking would consider using an alternative smoking cessation aid, it is surprising to note the lack of research in this area. This lack of research is particularly alarming when one considers that smokers may opt for alternative aids in place of pharmacotherapies. More research is needed to determine

Table 3 Randomized Controlled Trials Investigating Aversive Smoking

Study*	Sample Size	Country	Male (%)	Mean Age (yrs)	Mean CPD	Treatment Characteristics			Most Rigorous Outcome Reported		Smoking Abstinence (%)	
						Delivered by	Sessions (No.)	Total Duration of Sessions (min)	Months	Abstinence Classification	Active	Control
Lando 1975 ³³	32	US	40	30.9	32	Trained researcher	6	270	12	PP	21	18
Barbarin 1978 ³⁴	30	US	—	40.9	—	—	10	600	12	PP	40	0
Lichtenstein 1973 ³⁵	20	US	42.5	32.3	27	Trained psychology graduate students	7	177	6	PP	60	30
Erickson 1983 ³⁶	17	US	61.5	33	28	Trained psychology graduate students	6	270	6	PP	70	14

CA = continuous abstinence; CPD = cigarettes per day; PP = point prevalence.

*Studies ordered by sample size.

Table 4 Quality Assessment of Included Randomized Controlled Trials

Quality Assessment*	Acupuncture						Hypnotherapy				Aversive Smoking				
	Kerr 2008	Vandevenne 1985	Wu 2007	Bier 2002	Waite 1998	Gillams 1984	Lambe 1986	Williams 1988	Pederson 1979	Elkins 2006	Lando 1975	Barbarin 1978	Lichtenstein 1973	Erickson 1983	
1. Sequence generation	High	High	High	High	Low	High	High	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	
2. Allocation concealment	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	
3. Blinding (of patients)	High	High	High	High	Unclear	High	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
4. Incomplete outcome data (smoking cessation)	High	High	High	High	High	High	High	High	High	High	High	High	High	High	
5. Selective outcome reporting	High	High	High	High	High	High	High	High	High	High	High	High	High	High	
6. Other sources of bias†	Low	Low	High	High	Low	Low	Low	Low	Low	High	High	Low	Low	Low	

N/A = not applicable.

*For each criterion, the quality of each randomized controlled trial was classified as high, low, or unclear.

†Other sources of bias include the absence of biochemical validation of self-reports of smoking cessation.

the efficacy of alternative smoking cessation aids when used individually and when used as adjuncts to conventional pharmacologic interventions. The combination of these aids may be more efficacious than their use in isolation.

Acupuncture

Acupuncture is rooted in traditional Chinese medicine, in which energy (called “chi”) is perceived as the main component of the body and illness is seen as an imbalance of chi. The physical and psychologic symptoms experienced by smokers when they quit are seen as an imbalance of chi.¹² Thus, to rebalance the chi, acupuncture points are stimulated by needles or low-level laser, allowing the symptoms experienced by the smoker trying to quit to diminish. Stimulation of acupuncture points may involve the endocrine and neurologic systems. Studies have shown that stim-

ulation of acupuncture points is associated with a decrease of adrenocorticotrophic hormone, a hormone that usually increases in response to stress. Studies also showed that stimulation of acupoints releases beta-endorphins and beta-enkephalin, which are endogenous opiate peptides. By increasing these endogenous opiate peptides, acupuncture may have the capacity to diminish withdrawal symptoms.¹²

Potential mechanisms for acupuncture as a smoking cessation aid are still under investigation. The latest theory is that one of the points stimulated by needles in the ear corresponds to the closest position of the vagus nerve to the cutaneous surface. Therefore, by stimulating this point, the acupuncturist blocks the outflow of withdrawal symptoms coming from the parasympathetic nervous system through the vagus nerves. In the studies included in our meta-analysis, the procedure was similar from

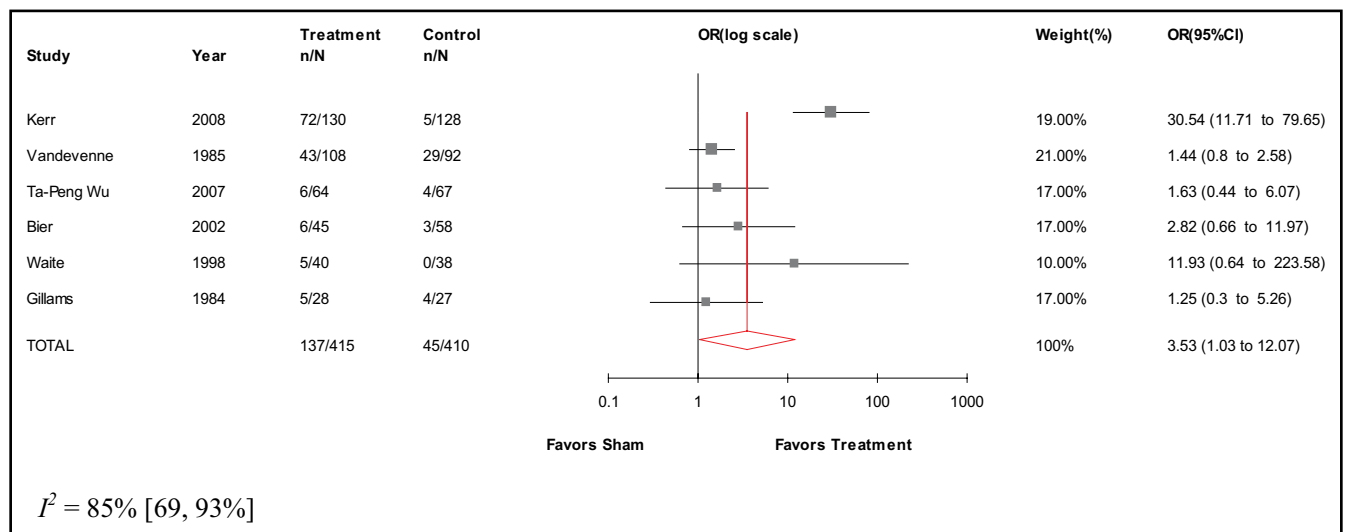


Figure 2 Forest plot comparing acupuncture to sham acupuncture. CI = confidence interval; OR = odds ratio.

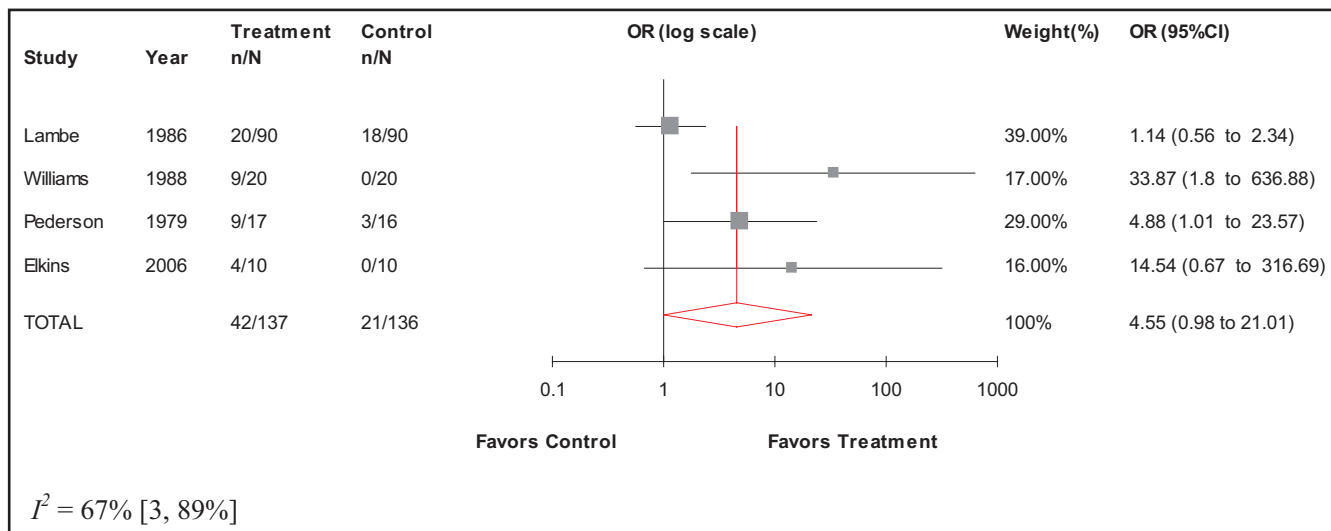


Figure 3 Forest plot comparing hypnotherapy to control. CI = confidence interval; OR = odds ratio.

trial to trial and differed only in the number of sessions (Table 1).

Hypnotherapy

Hypnotherapy consists of a technique of induction that brings the patient to a receptive mind and makes the patient more attentive and adherent to the suggestions of the therapist. Hypnotherapy is used in the medical field to treat anxiety and depressive disorders, and also may be efficacious in promoting smoking cessation. When the patient is hypnotized, the therapist suggests that cigarettes are harmful, associated with terrible sensations, and that the patient is able to cope with the withdrawal symptoms.¹⁸ Given that the patient is hypnotized, he or she is hypothetically more adherent to those suggestions and thus can better cope with withdrawal symptoms. In our meta-analysis, we noted that the hypnotherapy pro-

cedures were not exactly the same from trial to trial. More randomized controlled trials are needed to evaluate this intervention by following a common procedure led by personnel with training in hypnotherapy.

Aversive Smoking

Aversive smoking uses excessive smoke as an aversive stimulus. Aversive smoking exposes the patient to an important amount of smoke in a short period of time. This exposure may make the patient become resistant to the additional intake of cigarettes in the future.¹⁹ During the last decade, aversive smoking has been less practiced because of beliefs that it may induce nicotine poisoning and cardiac arrest. However, many studies showed the safety of aversive smoking with close monitoring of heart rate and blood pressure.²⁰

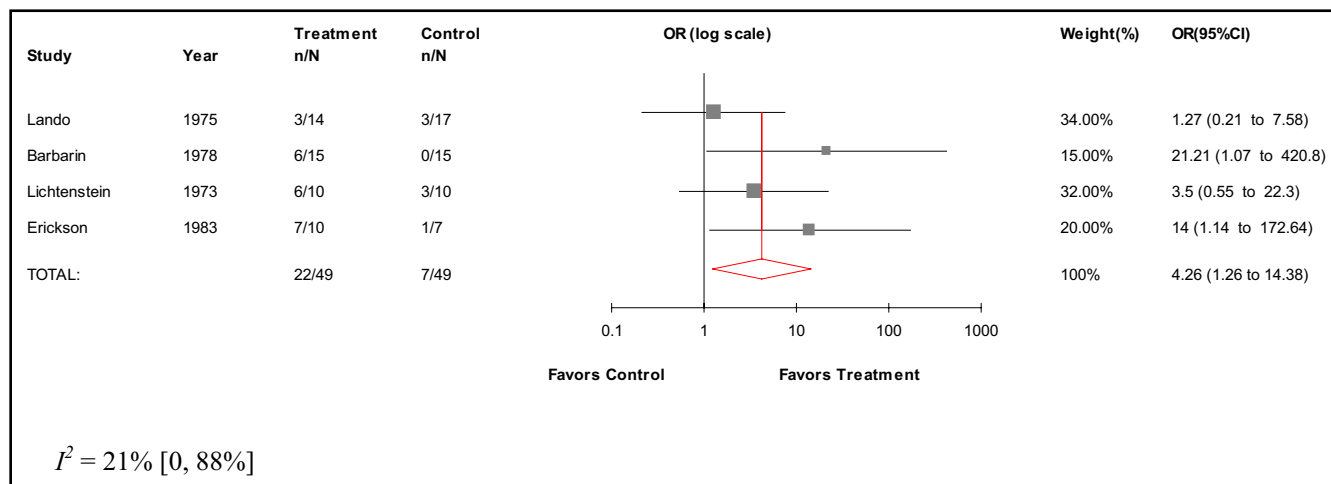


Figure 4 Forest plot comparing aversive smoking to control. CI = confidence interval; OR = odds ratio.

Previous Studies

Separate reviews on acupuncture, hypnotherapy, and aversive smoking have been conducted by the Cochrane Collaboration.²¹⁻²³ We carried out a systematic review and meta-analysis including all 3 alternative interventions and attempted to rank them through indirect comparisons. Our meta-analysis was designed to include only the most rigorous randomized controlled trials to obtain the most precise estimates of smoking cessation. Specifically, we only included randomized controlled trials with long-term smoking cessation outcomes, appropriate control groups, and limited bias. In addition, we used a random effect model to account for the heterogeneity between individual randomized controlled trials.

We provide a comprehensive review of the most commonly used alternative smoking cessation interventions in one article, thus providing evidence-based guidelines to physicians. Our research suggests that alternative smoking cessation aids may be efficacious at promoting smoking cessation. Unlike previous Cochrane reviews, the current review found a statistically significant effect of acupuncture, albeit with a wide confidence interval. In addition, the effect of hypnotherapy would likely have been significant if more patients had been randomized, thus increasing the power of our meta-analysis.

Limitations

Our meta-analysis has several limitations. First, because of our strict inclusion/exclusion criteria, the number of studies included in our meta-analysis was limited, as testified by the wide CIs. However, by including only the most rigorous randomized controlled trials, we were able to obtain the most reliable estimates of the efficacy of alternative smoking cessation aids. Second, randomized controlled trials varied in the total duration of each intervention, the mean cigarettes per day, the Fagerström Test for Nicotine Dependence, and age. We used a random effect model to account for between-trial heterogeneity. Third, publication bias also is a limitation as it is for virtually any meta-analysis. We did not have enough data to interpret publication bias using our funnel plots (data not shown). Finally, we limited our search to randomized controlled trials published in English and French. However, less than 2% of randomized controlled trials identified in our literature search were published in a language other than English or French.

CONCLUSIONS

Acupuncture and hypnotherapy are used by a large number of smokers as alternative smoking cessation aids. Our results suggest that these alternative aids may help smokers quit. Thus, we recommend that physicians promote the use of acupuncture and hypnotherapy. Aversive smoking also may help people quit, but because the studies investigating this intervention were old, we believe that new studies are needed to recommend this intervention to physicians. Finally, we believe that more evidence is needed to determine whether alternative

interventions are as efficacious or perhaps more efficacious than pharmacotherapies at helping smokers quit.

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