Environmental tobacco smoke exposure reduction and smoking cessation interventions targeted at parental populations: A meta-analysis and exploration of implementation measures

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Abstract

Background

Second hand smoke can cause disease and death in both adults and children who do not smoke (US Department of Health and Human Services, 2006). To protect children, interventions with parents who smoke have been conducted. These have the added benefit of protecting multiple people, and arguments have been made that parents are more engaged with the health of their child than their own, both emotionally and for more practical reasons (Agee & Crocker, 2007; Tanski & Wilson, 2011; Winickoff et al., 2003).

Objectives

A number of reviews of studies in this area have been conducted. This study sought to replicate and expand on previous reviews. Intervention implementation measures were explored with a different approach than in previous reviews. This revealed some potential gaps in current reporting that if filled would increase study quality appraisal. Two major outcomes were explored through meta-analysis. Cessation was explored through biochemical and self-report measures. Reduced child exposure to environmental tobacco smoke was explored through the implementation of environmental smoking bans and child cotinine measures.

Search strategy

The databases searched were CINAHL, CENTRAL, PsychINFO, PubMed, and Web of Science. A number of keywords were used pertaining to tobacco smoke, the parental role, and the type of study.

Selection criteria

The results must have separated reports for nonsmokers and smokers and have detailed either environmental tobacco smoke exposure or tobacco consumption. The intervention components

or recruitment strategy must have had some significance to the adult's role as the caregiver of a child or the health of a child in their care.

Data collection and analysis

Data were extracted from studies and inputted into a database in FileMakerPro. Data extracted included study details such as publication information, intervention details including delivery details, and results. Results were inputted into Review Manager and random-effects meta-analysis was conducted for major outcomes. Subgroup analyses were conducted where study grouping sizes permitted.

Main results

Meta-analyses demonstrated that intervention groups were more likely to self-report cessation ($z = 2.70$, $p = 0.007$), implement environmental smoking bans ($z = 1.98$, $p = 0.05$), and lower child cotinine at follow-up ($z = 2.84$, $p = 0.005$), but were not more likely to have biochemically verified cessation ($z = 0.78$, $p = 0.44$). Subgroup analyses revealed that intervention context may be a source of heterogeneity, as the test for subgroup differences when dividing studies into groups based on intervention context was significant ($\chi^2 = 6.37$, $p = 0.04$). Also, more intensive interventions are effective ($a = 2.85$, $p = 0.004$), but brief interventions are not ($z = 1.20$, $p = 0.23$).

Conclusions

Implications for future research include greater reporting of intervention components, detailed participant attrition, and outlined delivery personnel training. Consideration of intervention context as a potential source of heterogeneity is warranted.

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Introduction

Second-hand smoke exposure

Second-hand smoke (SHS) is characterized as the combination of exhaled smoke from a person smoking a tobacco product as well as the side stream smoke that burns from the product that is not inhaled by the smoker (World Health Organization [WHO], 2007). Second-hand smoke exposure can cause disease and death in both adults and children who do not smoke (US Department of Health and Human Services, 2006). The smoke generated from a single cigarette in an enclosed area will cause the air quality to fall below levels deemed acceptable by governmental legislation (Winickoff et al., 2005). The World Health Organization (2007) has reported that there is no safe level of SHS exposure. Universal smoke free homes, cars, and school and work environments has been recommended as a critical policy initiative for reducing the harms caused by SHS and tobacco use (Binns et al., 2009). Completely smoke-free environments have been cited as the only way to effectively protect people from the harms of environmental tobacco smoke (ETS) exposure (WHO, 2007).

Secondhand smoke is known to contain hundreds of toxic or carcinogenic compounds (Narkowitz, Polkowska, Kielbratowska, & Namiesnik, 2013; WHO, 2007). Nonsmokers regularly exposed to high levels of ETS display biological markers of tobacco exposure equivalent to that of light or non-daily active smokers (Schuck et al., 2013), including tobacco specific lung carcinogens (US Department of Health and Human Services, 2006). Environmental tobacco smoke exposure is known to cause a variety of short and long term ailments, including respiratory tract infections, irritations, and diseases, such as wheezing, breathlessness, bronchial asthma, bronchitis, pneumonia, and sinusitis (Narkowitz et al., 2013). The effect of ETS exposure on both children and adults has immediate detrimental effects on the cardiovascular

system. These immediate negative effects on the respiratory and cardiovascular systems relate to the increased long-term risk of cardiovascular and respiratory diseases including atherosclerosis, coronary heart disease, and lung cancer. This risk is thought to be roughly a 20-30% increase in risk of lung cancer or cardiovascular diseases in nonsmokers who live with smokers (US Department of Health and Human Services, 2006). It has been estimated that up to 15000 child hospitalizations a year can be attributable to ETS exposure (Geller et al., 2011), and that ETS is a main contributing factor to disease incidence and mortality in children (Narkowicz et al., 2013). The number of children who die from causes attributable to someone smoking in their environment is three times that of the deaths attributable to childhood cancers (Winickoff et al., 2005).

Some of the negative effects of tobacco use on children start very early in their lives. Tobacco product use by pregnant women has been associated with miscarriage, premature delivery, stillbirth, and low birth weight. Infants exposed to tobacco smoke are at a higher risk of sudden infant death syndrome (SIDS), decreased lung growth and function, obesity and metabolic syndrome, colic, invasive meningitis, middle ear diseases, developmental delay and neurobehavioural problems (Winickoff et al., 2009). Young children are especially vulnerable to the effects of ETS exposure because of their higher ventilation rates, smaller respiratory system and developing immune system (Ashley & Ferrence, 1998; Narkowitz et al., 2013). Young children also spend more of their time at home, and may be unable to remove themselves from sources of exposure. A child will have higher biomarker levels than an adult exposed to the same amount of ETS due to this combination of factors (Ashley & Ferrence, 1998). Children exposed to ETS in the first years of life as well as while in utero are particularly susceptible. Such children are up to twice as likely to fall ill during the first year of life, have stunted lung

development compared to non-exposed peers, and have a greater risk of delayed development (Narkowicz et al., 2013). Later in life, ETS exposure is linked with continued developmental delay and cognitive impairment, increased illness, and higher rates of school absenteeism. One study found that children with more smokers in their home missed more school days than those with fewer, and those with only one smoker in the home missed more school days than those with none. This is likely partially due to an observed increased rate of respiratory and ear related symptoms that followed the same additive pattern in relation to the number of adults who smoke residing with the child. Often, these reported symptoms require some kind of medical care (Levy, Winickoff, & Rigotti, 2011). The burden of missed school days disproportionately disadvantages children from lower income families, as low income families have a higher smoking incidence and are presumably more negatively affected by missed work days or having to arrange alternative childcare for a sick child. The economic impact on a family attributable to a parent's smoking goes beyond the cost of cigarettes (Levy, Winickoff, & Rigotti, 2011; Binns et al., 2009).

Some have characterized tobacco use as a pediatric disease because of the increased harms exposure causes to children and because of the relationship childhood exposure has with negative health outcomes later in life and with future active smoking. Up to 80% of adults who smoke began smoking before the age of 18 (Binns et al., 2009). Children who live with a smoker are up to three times more likely to begin smoking (Winickoff et al., 2005). Some studies have suggested that part of why children exposed to tobacco smoke are more likely to become active smokers is because they are experiencing a low level of addiction before initiating active smoking. It has been suggested that ETS exposure leads to neuronal adaptation and nicotine sensitization in the brain, leading to selectivity for the reinforcing properties of nicotine over the

aversive qualities. A study of exposed children aged 10-12, a small percentage of whom were classified as smoking initiators, found that such children report a variety of withdrawal and craving symptoms following ETS exposure. The most commonly reported symptoms in both groups were negative affect, trouble sleeping, and trouble concentrating. While children who had never smoked reported a variety of symptoms that could be classified as withdrawal related symptoms, initiators were more likely to report these symptoms as well as cue triggered and craving symptoms. Family structure and peer related factors also influenced such symptoms, as those with siblings or peers who smoked were more likely to report cue triggered or craving symptoms (Schuck et al., 2013). Parental smoking cessation decreases smoking uptake by the children in their lives and improves financial resources and overall family health by eliminating the majority of SHS exposure for their family members, while decreasing the risk of house fire mortality (Winickoff et al., 2005).

While the risks of ETS exposure are still being studied, many initiatives and public health campaigns and policies have sought to convey known risks to parents and the public in general. Policy initiatives that have been considered effective in reducing the harms of tobacco use include taxing, media campaigns, advertising restrictions, restrictive legislation and policies, including location based policies and age restrictions, and community interventions (Binns et al., 2009). Smoke-free legislation covering a range of public places has now been implemented in a number of countries and studies of the implementation process have shown that the process is relatively easy and the policies are initially popular but continue to gain popularity over time. Criticisms that such policies negatively impact businesses have been shown to be unfounded and in some cases such policies actually show a positive impact on business. They also are correlated with an immediate reduction in population wide heart attack frequency and respiratory symptom

reports, as well as population health in general (WHO, 2007). As a result of the multiple policy approaches to reducing the harms of tobacco smoke to the public, in a number of countries including the United States and Canada, homes are becoming the primary location of ETS exposure (US Department of Health and Human Services, 2006). This has led some to criticize smoke-free legislation as actually increasing children's exposure at home; as the home is one of the few indoor areas parents can now smoke freely. However, there is no evidence that smoke-free legislation increases the amount of exposure in the home, and there is actually some evidence to support that the prevalence of smoke-free public area policies is related to voluntary smoke-free home policy adoption and smoking cessation. Some studies have shown smoke-free workplace legislation to result in both an increase in cessation rates as well as a decrease in overall consumption in those who continue to smoke (WHO, 2007).

Intervening to protect children

While policy initiatives have been shown to be largely effective, another approach is direct family intervention. Intervention with smokers has been hailed as the most cost-effective preventive health services both in long and short-terms, being so cost-effective that it is second only to childhood immunization routines (Binns et al., 2009). Interventions with the goal of protecting children tend to focus on parents or other prominent caregivers, and tend to target either smoking behaviour with the goal of reducing exposure or encouraging total cessation with the goal of eliminating that source of exposure. Intervening with parents also has the added benefit of protecting more than one person, and some argue that mothers in particular have expressed that they value their child's health above their own, suggesting this route may elicit more motivation for change (Agee & Crocker, 2007). Another major reason to intervene with parents is that many are more engaged with their child's health care than their own, particularly

young and low-income parents. These parents may not have health insurance or reason to visit a doctor regularly for their own health, but will see their child's doctor multiple times a year, particularly in the first few years of their child's life (Tanski & Wilson, 2011; Winickoff et al., 2003). Similarly, while pediatricians and family care practitioners are almost equally likely to ask about home smoking behaviours and policies that may affect family members, pediatricians were more likely to offer time advising about the danger of ETS exposure and benefits to changing behaviours (Winickoff et al., 2003). Further, previous studies have shown that the smoking prevalence in parents visiting a pediatric hospital with their child is higher than population levels, and that a majority of these smokers also had partners who smoked (Miller, Gow, Tappin, & Turner, 2007). Using a child's health care setting as a point of intervention for targeting parents is opportunistic, provides access to some potentially otherwise hard to reach adults, and has been shown to be acceptable to those parents.

Health care workers have cited some barriers to addressing parental smoking. One focus group with workers discovered a number of perceived issues including time constraints, the idea that the parent is not the patient, that the workers are not trained in this service, and that approaching the topic may damage the therapeutic relationship (Winickoff et al., 2008). Previous studies have suggested that less than a tenth of parents were highly resistant to change, nearly a third were likely to respond well to suggestions of change (Ashley & Ferrence, 1998). A survey of parents found that bothparents who were smokers or nonsmokers agreed that it was at least acceptable, and even desirable that pediatricians approach the subject of smoking in their child's environment with them. However, only about half of smokers felt it would be appropriate for their child's doctor to discuss cessation with them, and confirmatory to some previously reported worries of pediatricians in approaching the subject, nearly a third of smokers

reported they would be bothered by this and 15% reported they would be angry. Despite this, 57% of smokers reported cessation advice should be available at a pediatrician's office if it is desired by a parent (Cluss & Moss, 2002; Moss, Cluss, Mesiano, & Kip, 2006). Conversely, a survey of intake nurses in a child emergency department eased another commonly reported perceived hindrance of addressing parental smoking, as 97% of healthcare workers reported that a brief intervention based on the ask and advise framework with a quit line referral did not impede care (Mahabee-Gittens & Gordon, 2008). While there is some reluctance from both health care providers and clients, overall interventions can be done in a way that is not too disruptive to service and is seen as being acceptable to parents.

Smoking parents have been asked in previous studies what makes such interventions more acceptable to them and what would motivate them to change their behaviour. Interviews with parents who smoke revealed many of them feel negatively about their smoking in relation to their role as a parent, citing feeling guilty about negative health consequences and their perception of themselves as a bad role model. However, more parents cited being concerned about being a bad role model than negative health consequences (Chen et al., 2012). Other studies have demonstrated that parent/smoker role conflict is associated with an increased readiness to quit. These parents were also more likely to have made a recent quit attempt, smoke more heavily, and be accompanying a sick child at that visit (Friebely et al., 2013) When asked what helps them to change smoking behaviours, parents described support from their family and a non-blaming attitude as necessary. They mentioned that accusatory language and lack of support would discourage them from changing, while genuine concern, especially from kids, combined with educational materials were listed as being likely to help them be motivated to change (Chen et al., 2012). Another focus group study found similar results. Parents cited not

liking causal language, feeling that it implied they were bad parents because they smoked, and a preference for facts that seemed validated by research. Other important themes identified were focusing on their child's health, respecting their identity as a smoker and not inflicting guilt, and providing well researched assistance for quitting or otherwise changing smoking behaviour to reduce harm to their families (Gupta & Dwyer, 2001). That parents are interested in educational materials is an important finding, as they are often used in interventions, as some theories of behaviour change assert that a person must have knowledge of an issue before they can become motivated to deal with it (Borland, 1999).

Further education on the effects of ETS is desirable because some parents engage in behaviours that are falsely seen to be protective such as increasing ventilation, only smoking near open windows, or only smoking in certain areas of the home or at certain times when children are not present (Ashley & Ferrence, 1998). It has been determined that separating smokers and nonsmokers with ventilating systems cannot control ETS exposure and can actually further distribute it throughout a building (US Department of Health and Human Services, 2006). More recent examination into the dangers of ETS have focused on third-hand smoke (THS), which is defined as residual contamination left by tobacco smoke in an area previously exposed (Winickoff et al., 2009). A study that compared exposure levels by measuring nicotine in household dust, urinary cotinine levels, and air nicotine levels found that parents who smoke inside the home had levels three to eight times higher than parents who smoke outside or engage in other protection measures, but that parents who smoke outdoors still had contamination levels five to seven times greater than nonsmoking households. The two smoking groups were compared and found to have similar smoking rates. The results of this study show that homes with a smoke-free home policy do display a reduction in ETS exposure for family members, but

do not completely eliminate it. Smaller amounts of contaminants are still entering the home, through avenues such as the smoker's skin and clothing or through open doors and windows. Such studies also demonstrate how smoking in the home but away from the child still results in measureable exposure levels and that contamination can remain after a period of no further exposure (Matt et al., 2004). Third-hand smoke similarly presents more of a problem for infants than for older family members, as they have more contact with potentially contaminated surfaces and higher dust ingestion rates (Winickoff et al., 2009). Studies have determined that beliefs of the harm of THS smoke are associated with parental smoking behaviours. Similarly to SHS beliefs, fathers and heavier smokers were less likely to agree with statements about the harms of THS (Drehmer et al., 2012). Interestingly, while SHS beliefs have been found to be uncorrelated with home smoking policy, THS beliefs were found to be correlated. While a high percentage of smokers agree that SHS is harmful, only a small percentage of them have implemented a smoke free home policy. Conversely, a small percentage of smokers agree that THS is harmful, but the majority of these have implemented a smoke-free home policy. Third hand smoke beliefs may be a modifiable avenue for encouraging smoke-free home policy adoption (Winickoff et al., 2009). Interventions have taken the route of modifying beliefs with the goal of changing behaviour in the past with some success.

There are a number of theoretical bases which have informed interventions with parents. Borland (1999) cites six major routes taken to address smoking behaviours, which are influenced by theories of behaviour change and at least partially supported by previous evidence:

1. Addressing beliefs and attitudes surrounding the behaviour in question or the consequences of the continuation or cessation of the behaviour.

2. Addressing self-efficacy, the belief in one's ability to achieve a particular goal, in regards to their ability to enact and maintain certain steps to achieving that goal of behaviour change.
3. Addressing the social context and other contextual factors that can be mediated by or directly affected by the person's beliefs.
4. Changing a person's experiences with the behaviour in question either directly or indirectly through modeling.
5. Changing the priority for action to the desired behaviour change, as some people may see the need for change but see that behaviour as being less of a priority than other goals in their life.
6. Using a stage-based or step-based progression model to move people closer towards the desired behaviour change.

Many individual, community, and policy based approaches have drawn on these fundamental bases for intervention aimed at behaviour change. Each of these approaches may be more appropriate for different delivery methods, populations, or specific intervention outcome goals. While individual studies have reported mixed results, from nonsignificant findings to very high success rates, reviews and meta-analytic studies are a more objective way of assessing overall effectiveness of such interventions.

Past Reviews

Review 1

Emmons et al. (2001) narratively reviewed five studies spanning 1987 through 1997. The main focus of the studies they searched for was the reduction of ETS exposure in young children. They searched the Medline database and provided their search terms and methods for review.

They only surveyed studies published in English. A detailed list of included studies was provided, but a list of excluded studies was not provided. Their populations included pregnant women and women utilizing antenatal care, as well as parents with older children seeing pediatricians. Studies that engaged with older children were most often targeting children with asthma. The studies predominantly reported nonsignificant results. They noted that studies reported differing results when using both biochemical verification measures and self-report measures. They suggested this may be a result of reporting bias, as parents may be inclined to underreport their smoking habits, particularly after an intervention. This narrative review called attention to potential differences when using biochemically verified outcomes compared to self-reported outcomes.

Review 2

Gehrman and Hovell (2003) conducted a largely narrative review of nineteen studies spanning from 1987 through 2002. The focus of their review was to document and make recommendations for interventions aimed at ETS exposure reduction in youth. They did not include interventions that encompassed prenatal care and did include studies aimed at the parental figures of young children and adolescents. They included a number of study designs, though most studies were either randomized or non-randomized controlled trials. They searched the Medline and PsychINFO databases. They provided a detailed list of keywords used during their search. They also consulted reference lists for other potentially relevant studies. Only published studies were included. A list of included studies was provided, but not a list of excluded studies. They calculated an average effect size for the outcomes of ETS exposure and cessation based on either direct report or a calculated score for a study based on their report of multiple outcomes for these primary outcomes. They cited the small number of studies available

as reason for not conducting further meta-analytic analyses. They concluded that results were promising, as eleven of the nineteen studies reviewed found significant reductions in exposure. They concluded that there is a small to moderate effect from such interventions, based on their calculations of study effect sizes. Average effect size was higher for randomized controlled trials(d = .38, N=12) than for nonrandomized controlled trials (d = .10, N=5).

Review 3

Klerman (2004) narratively documented nine studies conducted from 1994 to 2003, most of which were randomized trials. They included behavioural intervention studies that aimed to prevent postpartum relapse, encourage cessation, and those that aimed to modify the smoking behaviour of household members. They included studies that had at least 100 subjects at follow up and at least some component conducted after delivery. It is unclear how they identified the studies reviewed. They provided a list of included studies but did not provide a list of excluded studies. They divided studies into "stronger" and "weaker" categories based on length of the intervention. This narrative review documented intervention settings and characteristics and outlined the need for more detailed reporting of intervention components.

Review 4

Rosen and colleagues have conducted three reviews in the area. The first, in 2011 (Rosen, Noach, Winickoff & Hovell), focused on studies that encouraged parents to quit smoking, and the second, in 2014 (Rosen et al.), expanded on the previous review to include studies that aimed to decrease child ETS exposure. The third, in 2015 (Rosen et al.,) focused on outcomes measured by nicotine air monitors or similar devices. The 2011 review analyzed eighteen controlled trials from 1987 to 2010 that measured parental quit rates following an intervention aimed at parents of infants or young children who smoked. They searched the PubMed, Web of Science, Psych

INFO and Cochrane Library databases. They provided a detailed list of search keywords including MESH terms used in their search strategy. They had at least two reviewers extract data. A detailed list of included studies was provided, and although a list of excluded studies was not provided they explained their reasoning for excluding studies and the number of studies excluded at each stage of the search process. They assessed methodological quality of the studies as determined by the study type, whether the randomization was concealed, whether it included blinding and biochemical verification, the follow-up time periods, and whether it included fidelity to treatment information. Intervention quality and intensity were measured by reporting the number of intervention sessions and whether or not the intervention was theoretically based. They investigated both heterogeneity and possible publication bias. While publication bias tests were unconcerning, studies did present to be heterogeneous. They examined a number of subgroups to attempt to determine the source of heterogeneity. They used the DerSimonian and Laird (1986) random-effects method to pool study results. Through subgroup analyses they found significant results in groups of parents who had children who were 4 years old or older, in interventions that included cessation medication, interventions that prioritized cessation as their primary purpose, and those with high follow-up rates of above 80%. Sixteen subgroups (41%) had nonsignificant levels of heterogeneity, with I^2 ranging from 0% to 56% and p values ranging from 0.08 to 0.97. The main effect analysis revealed an overall risk difference (RD) of 0.04 which demonstrated an additional 4% of intervention group parents quit smoking than did control group parents. This was concluded to be a modest but statistically significant improvement favouring intervention groups, and it had high heterogeneity (I^2 = 82%, p = < .001).

Review 5

The 2014 review (Rosen et al.) looked at studies that aimed to decrease children's ETS exposure. It included thirty studies published from 1994 through 2013 that included biochemical measures at follow-up after an intervention study that was either a randomized controlled trial, a quasi-randomized randomized controlled trial or a controlled trial. They searched the Medline, PubMed, Web of Science, PsycNet, and EMBASE databases. They provided a list of search terms and MESH terms. Again, study quality was reported through reporting of study blinding, study design, percent at follow-up, treatment fidelity, and whether the control group received any kind of intervention. Intervention intensity was reported through the number of intervention sessions. Outcomes varied more than in cessation studies and were characterized as parentally reported exposure or protection (PREP). These measures included a wide variety of smoking behaviours and regulations including smoke-free home policy, smoke-free vehicle policy, and strategies to reduce exposure such as ventilation or only smoking in certain areas of the home, or parental report of number of cigarettes a child was exposed to. Parental smoking behaviours and both parents' and children's biochemical markers are also included as PREP measures. Biomarker outcomes included cotinine or nicotine measures in urine, blood, saliva, or hair. They used dual data extraction, where two researchers extracted the same data and then compared their extraction results and resolved any differences. Tests for publication bias indicated bias was likely for the PREP and biomarker outcomes. The DerSimonian and Laird (1986) random-effects method was used to pool study results. There was a significant advantage in intervention groups in PREP outcomes at follow-up (RD 0.07, CI 0.05-0.09, p<.0001, N=17) indicating a 7% benefit to intervention families. Heterogeneity was not significant for this analysis (I^2 = 23%, p = .18). There were nonsignficant results in their analysis of change from baseline to follow-up (RR 1.44, CI 0.90 – 2.29, p = .13, N=7). Heterogeneity was significant for this analysis (I^2 = 87%, p =

<.0001). There was a significant decrease in the number of cigarettes parents reported their children to be exposed to (RD -0.24, CI -0.46 - -0.03, p = .03, N=8). Heterogeneity was significant for this analysis (I^2 = 62%, p = <.01). However, when assessed by biochemical verification, there was no evidence of an intervention effect at follow-up (RD 0.05, CI -0.13-0.03, p = .20, N=13). Heterogeneity was not significant for this analysis (I^2 = 0%, p = .57). The small benefit in intervention groups was observed in both low (RR 1.18, CI 1.02-1.35, p = .02) and high (RR 1.12, CI 1.07 – 1.18, p < .0001) intensity intervention studies. This study verified what other studies have reported in that control groups in such intervention studies often see small benefits as well. The results were trending in their pooled analysis of control groups suggesting a monitoring or trial participation effect.

Review 6

The Cochrane Collaboration began narratively documenting family and carer smoking control programs for reducing children's exposure to ETS in 2002, with the most recent update being in 2014 (Baxi et al.). They included 57 controlled trials that targeted those involved with caring for infants and children under 12 that aimed to reduce a child's exposure to environmental tobacco smoke. They searched the CENTRAL, Medline, PsychInfo, EMBASE, CINAHL, ERIC and Web of Knowledge databases. They provided a detailed search strategy including keywords used. They utilized dual assessment for data extraction and study assessment. They cited heterogeneity as being the reason for summarizing results narratively. They included smoking behaviours in their outcomes variables as well as other variables such as health care service utilization and child illness indicators. They characterized methodological quality through documenting randomization, blinding and allocation concealment, and level of completeness of reported data. They ultimately reported that more research is needed to determine whether such

interventions are effective, though they suggested that their narrative review suggests that intensive interventions may be effective. They also reported a possible monitoring effect, as a number of studies reported small improvements in the control group. They also suggested that it is possible that exposure related behaviours change over time and such studies are simply documenting this change, much like how a small percentage of smokers quit on their own over time.

Review 7

In 2015, Rosen and colleagues conducted another meta-analysis related to this area of study. This time, they focused on outcomes from air monitoring equipment such as air nicotine or particulate matter results. Again, they searched the Medline, PubMed, Web of Science, PsychInfo, and EMBASE databases. They limited their results to studies published in English. They utilized duplicate study appraisal, and triplicate data extraction, where multiple people extracted data from studies and then worked to resolve any differences. Justification for study exclusion was provided, and a list of included studies was outlined. They assessed study quality by appraising blinding, treatment fidelity, and whether the control group received an intervention. Tests of publication bias were nonsignificant. Studies included were randomized controlled trials, controlled trials, or quasi-randomized trials. Participants were parents or caregivers of children under twelve. Studies must have reported air nicotine or particulate matter measurements and have followed participants for a minimum of one month after an intervention aimed to reduce child tobacco smoke exposure was conducted. Study quality was assessed by considering study design, blinding practices, attrition rates, treatment fidelity, and what kind of treatment the control group was given, if any. Tests of heterogeneity were nonsignificant. Change in air quality was greater in intervention groups than in control groups (SMD = -0.18, CI

-0.34 - -0.03, p = 02, N = 6). Particulate matter readings alone showed a significant benefit for the intervention group (SMD = -0.33, CI -0.62 - -0.05, p = .02, N = 3); however air nicotine monitor readings alone displayed only a trend (SMD -0.17, CI -0.37 – 0.02, p = .08, N = 4).

Review 8

Daly et al. (2015) conducted a secondary analysis on the Cochrane review by performing meta-analysis on some the studies outlined by the Cochrane Collaboration's previous reviews of the area, focusing on interventions delivered by health care providers. They also contacted authors for supplementary studies found as well as some of those included in the Baxi et al. (2014) review. They utilized dual data extraction. They assessed methodological quality and bias probability through the Cochrane Collaboration guidelines. The guidelines address study design, consent rate, sample size, randomization concealment, group allocation methods, observer masking, attrition, biochemical validation measures, and intervention fidelity. Their meta-analysis of nine studies revealed no overall intervention effect for parental smoking cessation (RR 1.05, CI 0.74 – 1.50, p = .78, N = 9). However, they analyzed three studies of postpartum maternal relapse prevention which did demonstrate an overall intervention effect (RR 1.53, CI 1.10 – 2.14, p = .01, N = 3). Tests for publication bias were not concerning. Tests of heterogeneity revealed substantial heterogeneity in the studies that aimed at parental cessation (I^2 = 60%, p = .01), but not in the postpartum relapse prevention studies (I^2 = 49%, p = .14). They cited varying follow up lengths, intervention procedures, variability in outcomes, and unknown treatment fidelity as possible sources of heterogeneity.

Reasons to replicate and expand on previous reviews

While there have been a number of previous reviews in the area, many of these have been narrative reviews, reviews with no significant results, or results had substantial heterogeneity.

Narrative reviews can provide a descriptive overview of studies in a field, but may also be subject to the subjective views of the authors and the samples of the reviewed studies. Conversely, meta-analysis applies statistical procedures to a collection of empirical findings from a group of studies with the purpose of making sense of them (Wolf, 1986). This is more favourable to narrative reviews when possible as it can account for other factors that may influence how authors and readers view reported results. Any reviews in this area that have reported meta-analytic results have reported slight significant findings, if any. It is possible this is due to the use of biochemical verification as a sort of gold standard in the measurement of cessation and ETS exposure, which is common in not only these reviews but also in cessation and exposure studies in general. Biochemical verification is often used as a standard where available in empirical studies. This is because it is seen as being more objective and less prone to reporter and recorder biases in alternative measures such as self-report or interview. Typically, biochemical verification is seen as preferred to self-reported continuous or sustained abstinence, which is preferred over point prevalence abstinence (Rigotti et al., 2008). It has been suggested that these measures be used in conjunction with each other, but when not possible, to use more preferred measures over those less preferred (Hughes et al., 2003). However, in studies in the area of smoking exposure there are sometimes significant results when using self-report measures which then disappear when using biochemical verification measures in the same study (Rosen et al., 2014). This may be due to a number of reasons and raises question as to whether biochemical verification should be prioritized over self-report in all cases.

Self-report measures have a number of disadvantages. In the context of smoking behaviours, such measures often include self-report, proxy-report, interview style questioning, diary format reporting, retrospective recall, or questionnaire. Most of these types of reporting can

be subject to recall bias. While diary reporting can decrease recall bias, it is not always appropriate (Avila-Tang et al., 2013b). To ensure adequate measurement through self-report measures, steps should be taken to decrease recall bias and to ensure honest disclosure. Recall accuracy can be improved through asking more specific questions. For instance, providing examples of exposure sources can help people to remember exposure they may otherwise have forgotten (Hovell et al., 2000). Making sure to include prompts to recall exposure from different locations and different lengths of exposure, as well as including any relevant definitions can increase accuracy of reports. Accuracy can also be increased by decreasing the amount of time between the event and the recall, and this strategy can be used if it makes sense in the context of the behaviour you are trying to measure (Avila-Tang et al., 2013b). While ensuring the questions asked are specific and the people being asked have any tools necessary to answer them can result in generally accurate reporting, often there is a concern in research into behaviours that have a stigma attached to them, such as smoking, that participants will downplay or otherwise falsify their reports.

Studies investigating smokers who falsify information about their smoking to health care professionals have been conducted and have produced interesting results. A study that used random digit dialing to survey smokers found that about 8% reported previous nondisclosure of their smoking status. Nondisclosure was more likely to be found in people who felt stigmatized by their smoking status or who had home no smoking policies. This is potentially problematic for studies in parents, as the study shows that people in a setting where smoking is seen as unacceptable are more likely to falsify their reports, and some intervention components would inherently portray smoking as being somewhat unacceptable. However, the study did not account for what setting the nondisclosure occurred or whether it was active falsification or passive

nondisclosure (Stuber & Galea, 2009). Interestingly, another study that surveyed parents with varying smoking statuses reported concordance in smoke free home policy reports is increasing over time. Houses where both parents smoked were more likely to provide discordant responses than households with never smokers or one smoker. It is suggested that the source of these discordant reports may be a lack of clarity in home smoking rules and what constitutes a smoke free home to each person surveyed. Regardless, discordant reports make up less than 12% of the reports in this study (Zhang et al., 2012). In studies looking at various types of falsified reports from smokers, it seems that a very small proportion of people are likely to falsify their smoking behaviour reports, and that this may be largely curbed by asking more precise questions.

Due to studies showing that a small proportion of people may respond less than honestly when prompted about their smoking status, biochemical verification and other more objective monitoring methods have been turned to as a method to avoid this problem. However, biochemical verification has its own set of disadvantages that can potentially arise alongside its use as a measure of smoking behaviours. Cotinine has become the biomarker of choice because it is a metabolite of nicotine with a half-life of about 16 hours (Avila-Tang et al., 2013a). However, the half-life of cotinine is said to vary from up to 160 hours in infants to anywhere from 24 to 40 hours in adults (Hovell et al., 2000). It can be measured through blood and saliva, but urinary cotinine is often the measure of choice as cotinine concentrations are approximately four to six times higher in urine and collection is often seen as less intrusive for participants (Avila-Tang et al., 2013a). A study on the variability of cotinine levels in young children found high within-subject variability which increased over measurement time and was approximately three to five times higher than what would be expected if it were solely a result of measurement error. This study recommended that using cotinine measurements to determine clinically significant changes

in behaviour or exposure cannot be determined by two samples alone and should be based on a greater number of samples averaged to create baselines and endpoints. In summary, the researchers found that in order to make reliable inferences relating to exposure changes, multiple biological samples are necessary (Matt et al., 2007). Despite these recommendations, this does not seem to be common practice in exposure studies. Aside from these potentially mediated difficulties, cotinine metabolism can also be affected by genetics, race, gender, hormonal function, kidney function, and drug use including hormonal contraceptives, rifampin, and anticonvulsants (Avila-Tang et al., 2013a). While kidney function can be assessed and questions can be asked about medication use, these present further challenges in cotinine analyses. Hovell et al. (2000) also point out that the methods seen as being more objective can also be falsified to a certain extent, as participants can smoke away from air monitors or time their smoking differently than they would have if they had not been being monitored.

Both self-report and biochemical verification methods commonly used in cessation and exposure studies have their own advantages and disadvantages. Previous studies have suggested that despite these difficulties, agreement between cotinine measurements and self-report of a child's exposure can be as high as 80% (Seifert et al., 2002). Other similar studies have reported a much wider range of agreement between measures with correlation coefficients ranging from .28 to .71. These researchers suggested that the reason for such variance in results is that biochemical verification and self-report often are not assessing the same thing, and that neither measurement alone can be considered to fully or flawlessly represent exposure (Hovell et al., 2000). Velicer et al. (1992) outline how in exposure or smoking studies, we are typically looking to measure either point prevalence, prolonged abstinence, or continuous abstinence. It is important to be clear on what we are measuring as point prevalence potentially represents a

much more heterogeneous group than prolonged or continuous abstinence. Hughes et al. (2003) recommend using prolonged abstinence as a preferred measure and point prevalence as a secondary measure. With the nature of relapses, point prevalence is more likely to produce a higher quit rate than prolonged abstinence or continuous abstinence. An advantage to prolonged abstinence is that it is likely to be a more homogenous group than point prevalence but still allows for some amount of relapse or variation in quit time. Considering the potential different advantages and disadvantages of exposure and smoking behaviour measures, it seems unfounded to always prioritize biochemical verification over report measures. Further, considering point prevalence typically results in the most heterogeneous group of participants, it seems other abstinence measures may be more appropriate for meta-analytic analyses when they are available.

Another area that may be improved upon in meta-analytic studies in the area of such interventions is that of study intensity ratings. Downer and Yazejian (2013) explain that when we are looking at intervention implementation, we often focus on quantity measures and ignore quality measures. Quantity measures are typically easier to obtain and include aspects such as dosage, the total amount of intervention; intensity, how much intervention is delivered per session; frequency, how often the intervention sessions are delivered; exposure, the duration of each individual session; duration, the length of time dedicated to each individual session; and adherence, the proportion of the intervention delivered per session. These details are much more often reported than quality measures, which may include things like the qualifications and perceived standing of the person delivering the intervention, and how engaging they are, whether they have good delivery skills such as pacing, as well as other indicators of participants' overall engagement with the intervention process. These researchers suggest that if we wish to assess

intervention effectiveness we must assess these factors in order to be able to identify the active ingredients of such interventions. Another potentially important quantifier, which is somewhat related to quality measures, is treatment fidelity. Johnson-Kozlow et al., (2008) define treatment fidelity as the extent to which the intervention is delivered in a way which adheres to the planned protocol or theoretical basis for intervention. They found it to be associated with treatment satisfaction and significant outcomes. The question of how to approach quantifying intervention intensity in meta-analysis is a difficult but important one.

Typically, when past meta-analyses have quantified intervention intensity they have done so by assessing the number of contacts with participants (Rosen et al., 2011; Rosen et al., 2014). Some meta-analytic studies have gone further by trying to quantify the amount of time spent with participants (Johnson-Kozlow et al., 2008), or by developing a rating system that includes both number of contacts and time spent (Rigotti et al., 2008). In order to properly characterize all studies in this diverse field while including as many relevant components of intervention intensity as possible an exploration of different categorization methods may be needed. Categories for treatment intensity should be included in both quantity and quality measures, but would have to be informed largely by the available information included in the reviewed studies. Categories for intervention components will be guided by the data, but also by those outlined by Michi, van Stralen, and West (2011). They outlined nine intervention types and seven policy types to guide intervention categorization. The nine intervention components are education, persuasion, incentivisation, coercion, training, restriction, environmental restructuring, modelling and enablement. Education refers to increasing knowledge. Persuasion refers to aiming to stimulate some kind of action or induce positive or negative feelings. Incentivisation and coercion are similar, with incentivisation creating the expectation of some kind of reward, and

coercion creating the expectation of some kind of cost or punishment. Training refers to increasing skills, while restriction refers to reducing opportunity or removing barriers to either encourage or discourage the engagement in a target behaviour. Environmental restructuring is when the social or physical context is changed, while modelling is when an example to imitate is provided. Finally, enablement refers to reducing barriers or increasing capability or opportunity over and above education, training, or environmental restructuring. The policy components are communication or marketing, guidelines, fiscal, regulation, legislation, environmental or social planning, and service provision. Communication or marketing refers to the provision of various types of media. Guidelines refer to the creation of guiding documents that affect service provision. Fiscal refers specifically to changing the tax system to encourage or discourage behaviour, while regulation refers to the establishment of rules relating to the behaviour or practice. Legislation is simply changing or introducing new laws, while environmental or social planning refers to exerting control over or designing the physical or social context. Finally, service provision refers to delivering some kind of service. A brief summary of the reasons to expand on previous reviews can be found in Table 1.

Heterogeneity

Heterogeneity is an important concept in meta-analysis but can sometimes be confused as there are a few different types of heterogeneity. Clinical heterogeneity, or clinical diversity, refers to the variability in interventions, participants, and outcomes in the studies being reviewed. Methodological heterogeneity, or methodological diversity, is included in clinical diversity but more specifically refers to the variability in included studies designs and risks of bias. Finally, statistical heterogeneity, which is the type of heterogeneity most commonly being referred to when talking about meta-analysis, is the variability in the intervention effects in the studies being

evaluated (Higgins & Green, 2011). Heterogeneity of the data partially determines the difficulty in drawing conclusions from the result of a meta-analysis (Higgins & Thompson, 2002). This is because heterogeneity describes the degree to which the intervention effects in question differ from each other above what one would expect due to chance alone. However, because heterogeneity is presumably always present to some degree in any summary of studies, tests of heterogeneity, such as I^2, actually focus on the extent to which heterogeneity influences the meta-analysis and not whether it exists (Higgins & Green, 2011). Considering the diversity in the studies included in exposure reduction literature, clinical heterogeneity may also be an issue to explore through subgroup analyses, providing enough data for such categorization is available.

Subgroup analyses

Because there is some evidence that smokers who receive an intervention after admission to a health care facility due to illness are more likely to successfully quit (Rigotti et al., 2008) subgroup analyses were conducted to see if this also applies to the admission of a sick child in their care. Friebly et al. (2013) conducted a study which suggested that this may be the case by showing that parents at a sick-child visit were more likely to report wanting to quit than parents accompanying a child who was not sick. It may be necessary to further break down the sick-child category, as an intervention specifically targeting parents of children with asthma may be found to be more effective than those targeting parents at a general emergency room visit. Rigotti et al. (2008) found that adults admitted for cardiovascular complaints were the most likely group to respond to cessation advice, so it is possible that the context of a sick-child visit is important.

Table 1
Summary of reasons to replicate and expand on previous reviews

Study	Areas for improvement
Emmons 2001	no reported bias or quality measures, narrative review
Gehrman 2003	no reported bias or quality measures, narrative review
Klerman 2004	no reported bias or quality measures, narrative review
Rosen 2011	intervention intensity ratings could be improved (used number of sessions), focus on cessation, focus on biochemical verification
Baxi 2014	narrative review
Rosen 2014	intervention intensity ratings could be improved (used number of sessions), focuses on young children, focus on biochemical verification
Rosen 2015	focus on air quality measures
Daly 2015	focus on clinical setting

Study Objectives

The primary goal of the narrative review is to explore implementation measure characterization using two different guidelines. The first categorization (Downer & Yazejian, 2013) is further outlined in Table 2. The second, outlined by Bellg et al., (2004) is further outlined in Table 3. It is likely that studies will provide this information inconsistently, but identifying potential gaps in reporting on these variables may inform future studies reporting and enable improved implementation appraisal.

The meta-analyses and subgroup analyses conducted will be informed based on outcome availability within studies. Subgroups of interest include those previously outlined in past reviews and meta-analyses, such as intervention setting and intervention intensity. Instead of combining outcome measures as in Rosen et al. 2011 or Rosen et al., 2014, outcomes will be grouped according to self-report or biochemically verified outcomes. Other possible categorization was considered based on availability of reported results.

Table 2
Downer and Yazejian guidelines for implementation measure appraisal

Implementation measure	Description
Intensity	How much is delivered per session
Frequency	How often sessions are delivered
Exposure	Duration of delivery
Adherence	Proportion of intervention delivered
Qualifications	Delivery personnel training
Engagement	Participant satisfaction with delivery

Table 3
Bellg et al., guidelines for implementation measure appraisal

Type of Fidelity	Description
Fidelity to theory	Whether the intervention included relevant active ingredients based on theory
Provider training	Whether the treatment providers were capable of delivering the intervention as designed
Treatment implementation	Whether the treatment providers implemented the intervention as designed
Treatment receipt	Whether the participants received the active ingredients as intended
Treatment enactment	Whether the participants put new skills or behaviour into practice and whether all necessary steps were completed

Method

Search Protocol

A number of relevant databases to be searched were selected based on previous reviews. A number of keywords were selected to be included in the search, pertaining to tobacco smoke, the parental role, and the type of study. A list of search keywords can be found in Table 4. The databases searched were CINAHL, CENTRAL, PsychINFO, PubMed, and Web of Science.

Table 4
Search Keywords

Content	Population	Study type
Passive smok*, second-hand smok*, secondary smok*, smoke pollution, environmental smok*, involuntary smok*, tobacco smoke exposure	Maternal smok*, parental smok*, child health, maternal care, well baby, child welfare, parent educat*, pediatric*, caregiv*	Randomized controlled trial, clinical trial, controlled trial, follow-up, intervention, treatment assessment

Study and Population Inclusion and Exclusion Criteria

After identifying potentially relevant studies, the studies were reviewed in further detail and eliminated or included based on a number of criteria. The population must have included adults who were smokers and outcomes must have not been combined with results from nonsmokers. The outcomes of the study must have detailed either ETS exposure or tobacco consumption. Measures included were nicotine air monitor readings, self-reported or biochemically validated quit rates, self-reported measures of exposure or consumption such as number of cigarettes smoked in a specified time frame or smoked in the presence of a child, as well as changes in biochemical measures such as child cotinine or nicotine levels. The intervention components or recruitment strategy must have had some significance to the adult's role as the caregiver of a child or the health of a child in their care. As interventions with pregnant populations often focus on reduction and relapse prevention, and any educational intervention components tend to have a specific and different focus, such studies were not included. The type of study must have been a controlled trial with or without randomization or a quasi-experimental study. Studies must be published in English.

Data Extraction

Data were extracted from studies and inputted into a database in FileMakerPro. Data extracted included study details such as publication information, intervention details including delivery details, and results. Detailed intervention information was used to assess intervention intensity. Categories were defined based on the treatment intensity components outlined by Downer and Yazejian (2013). Data on treatment fidelity was guided by categories outlined by Bellg et al. (2004) which included detailed information on treatment adherence, provider training, intervention dosage, and delivery consistency.

Study Quality and Bias

Studies were first assessed using the Jadad score quality measure. The Jadad score is a common quality measure that entails scoring a study out of a possible total score of 5. A total of 2 points can be awarded in the randomization category, one for mentioning randomization, and a second for using an appropriate method for randomization. Similarly, 2 points can be awarded for blinding, one point if the study is double blinded and another if the method for double-blinding is appropriate. Finally, a point can be awarded for a description of withdrawals or drop-outs (Jadad et al., 1996).

Study quality was also assessed following the guidelines outlined in the Cochrane Review Study Quality Guide (Ryan, Hill, Prictor, & McKenzie 2012). Categories outlined in the guide included allocation concealment and randomization, attrition, blinding, participant flow and follow-up, and publication bias. Funnel plots were created to assess the possibility of publication bias, as an asymmetrical funnel plot can be indicative of such bias as when significant results are favoured for publication the funnel plot with present more asymmetrically (Higgins & Green, 2011). Funnel plots and graphical representation of bias ratings were generated in Review Manager 5 (Cochrane Collaboration, 2014).

Analyses

Descriptive Statistics

Studies were described using frequencies for study qualities including country of origin, setting of intervention, time frames surrounding intervention length and follow-up procedures, quality and potential bias findings, and intervention intensity category reporting.

Meta-Analysis

The purpose of meta-analysis is to combine effect sizes across related studies in an area to provide an estimate of the overall effect (Thompson & Sharp, 1999). Due to the nature of the studies being included, a random effects meta-analysis was conducted. Because this review is looking at exposure reduction generally, the number of potential outcome measures that could be used in studies assessing exposure would suggest that the random-effects model's incorporation of the assumption of different but related intervention effects is most appropriate (Higgins & Green, 2011). Further, previous studies have suggested heterogeneity is present in this area (Baxi et al., 2014, Daly et al., 2015), so a random effects model is likely to be more appropriate than a fixed-effects model, which assumes that each study is examining the same measure (Higgins & Green, 2011).

Meta-analyses were conducted on two primary outcomes, using two different measures each. The first outcome, cessation, was divided by self-reported study results and biochemically validated quit rates. The second outcome, reduced exposure, was measured by reduced child cotinine and by self-reported implementation of environmental smoking bans. All meta-analyses except for the child cotinine analysis were conducted using odd ratios, and event rates for the intervention and control groups were entered into Review Manager 5 for analysis. The child cotinine analysis utilized standardized mean difference, and means and standard deviations for the intervention and control groups were entered into Review Manager 5 for analysis. In some cases, standard deviations were not provided but confidence intervals were. When this happened, standard deviations were calculated dividing the length of the confidence interval by 3.92 then multiplying that by the square root of N. The value 3.92 represents the number of standard errors wide a 95% confidence interval is in samples over 100 (Higgins & Green, 2011). When sample sizes were small, exact t distribution values were calculated in Microsoft Excel using the formula

=TINV(1-0.95,X-1) where X is the sample size. This value was then used in place of 3.92 in the above formula. Meta-analyses were conducted using the random effects method based on the Mantel-Haenszel method (Higgins & Green, 2011). When multiple time points were presented in studies, the longest time point was used for analysis. In these analyses, the events of interest were cessation or the implementation of a new smoking ban, or decreases in child cotinine measured.

Heterogeneity

Heterogeneity was assessed in the meta-analyses conducted in this study using Review Manager 5 (Cochrane Collaboration, 2014). Because biochemical verification is a point prevalence measure, and point prevalence measures are thought to produce the most heterogeneous group of participants, tests of heterogeneity were conducted on the self-report and biochemically verified outcomes separately, to see if this presumption may be a concern for meta-analyses in this area. Heterogeneity was assessed for the meta-analyses and subgroup analyses to determine whether study effects varied significantly more than would be expected due to chance.

Subgroup analyses

As discussed previously, subgroup analyses were performed based on self-report or biochemical verification result type. Further study characteristics considered for subgroup analysis included brief versus intensive interventions, and tests conducted based on the more thorough implementation measures. Length of follow up time and intervention components were also considered for subgroup analyses. Subgroup analyses were informed by results type as well as whether different study characteristics allowed for reasonably comparable group sizes. The self-reported cessation grouping had the largest number of studies with result information, so the

majority of subgroup analyses were conducted with this outcome. Subgroup analyses conducted with this group were based on the ill, well, or any healthcare setting; follow-up times of less than six months, six months, or twelve months, whether an intervention was considered brief or intensive, and whether an intervention was based on theory. The subgroup analysis of whether an intervention was based on theory was also able to be replicated using the biochemically verified reduced exposure outcome and the reduced exposure measured by the implementation of environmental smoking bans. The most extreme study outcome was favoured for coding. For example, if both home and car bans were presented together, that outcome would be favoured over vehicle or home bans separately. Similarly, the longest time frame was preferred for study results. For example, if studies presented results for multiple timeframes, the longest follow up time results were used.

Results

Search Results

Article databases were searched in January 2016. Inclusion and exclusion results are outlined in a flow chart (Figure 1). Table 3 provides the first author's name and year of publication of the studies included in the narrative review.

Study characteristics

All descriptive analyses were conducted on all 60 studies unless otherwise specified. A large portion of the studies reviewed were conducted in the United States (57%). The next most represented country was China, with 7 studies (12%). There were three or less studies from each of Armenia, Australia, Canada, Germany, Iran, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Turkey, and the United Kingdom. When considering intervention components (N 60), provision of educational sessions was the most common, with 43 studies (72%) reporting using

this type of intervention. Educational materials were the second most common, with 28 studies (47%) reporting distributing some kind of educational material. Sixteen studies cited using motivational interviewing (27%), and 11 studies (18%) used cotinine feedback. Eight studies used advice (13%). Following the categories outlined by Michi, van Stralen, and West (2011) 39 studies used educational components, 40 used persuasion, 2 used incentivisation, 24 used coercion, 22 used training, 12 used environmental restructuring, 1 used modelling, 23 used enablement, 26 used communication/marketing, 4 used environmental restructuring, and 14 used service provision. Twenty-five studies (42%) targeted an ill child setting, with asthmatic children and children with any other illness representing close to the same amount of studies. Children in the "other ill" category presented with any respiratory complaint, were children with cancer, or were children who had spent time in the NICU. Eleven studies (18%) were targeted at well-child visits, while 7 studies (12%) were health care based but accepted all children regardless of reason for visit. Seventeen studies (28%) were not health care based, although sometimes healthcare records were used for sample identification. Twenty studies utilized telephone contact as an intervention delivery method, 21 used home-visits, 18 used a healthcare setting contact, 17 specifically used a pediatric health care setting, 4 used the emergency department, 3 used mail contact, and 3 used school contacts. Twenty-nine of the sixty studies (48%) provided enough detail about the foundation of their intervention that they could be considered evidence or theory based. Further description of study characteristics can be found in the Appendix.

Figure 1

Database search results flowchart

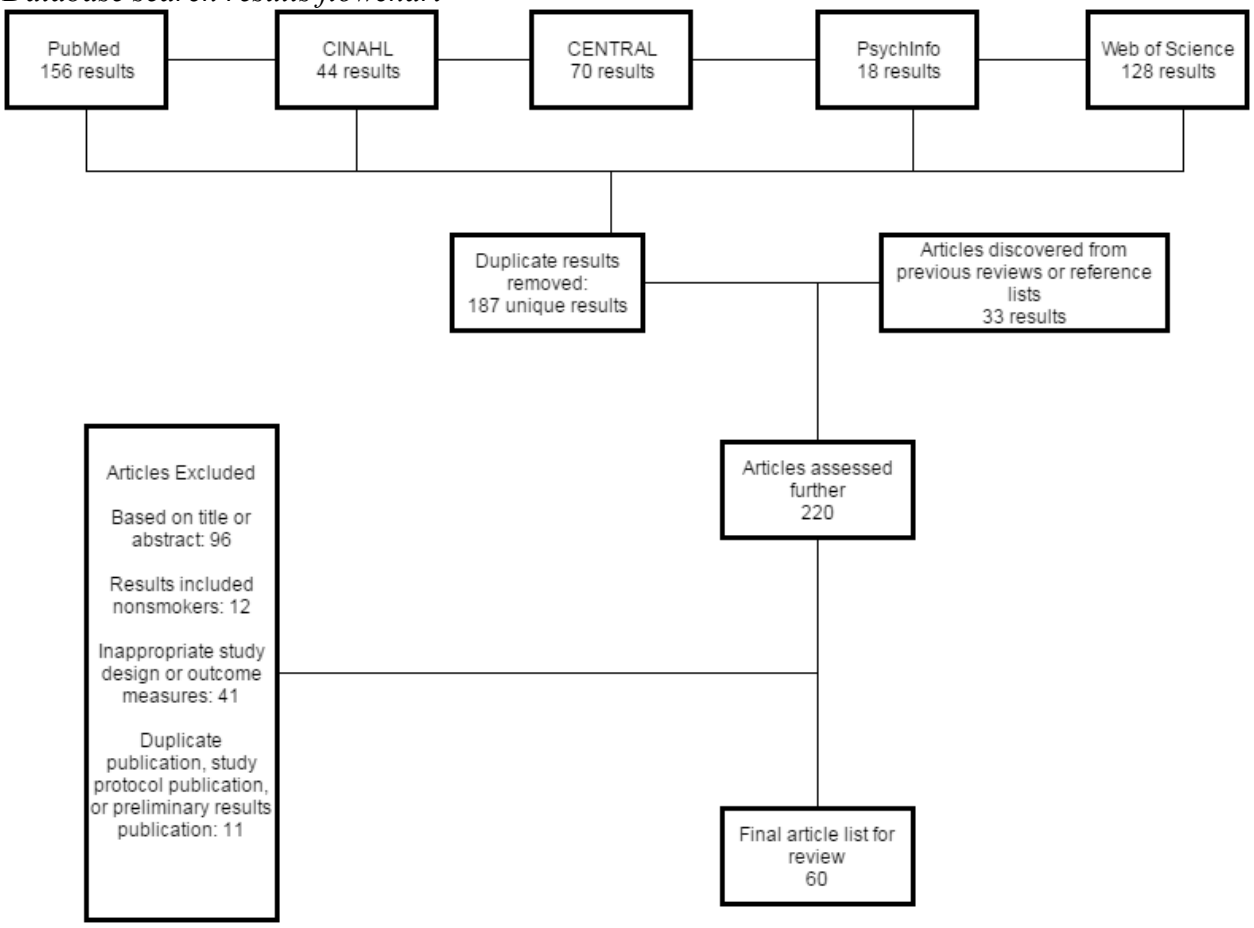


Table 5

List of studies included in narrative review

Abdullah 2005	*Crone 2003*	Hovell 2002	Schuck 2014	Wilson 2001
Abdullah 2015	Culp 2007	Hovell 2009	Stepans 2006	Wilson 2011
Baheiraei 2011	*Curry 2003*	Irvine 1999	*Stotts 2013*	*Winickoff 2003a*
Blaakman 2015	Eakin 2014	Mahabee-Gittens	Streja 2014	*Winickoff 2003b*
Borelli 2010	Ekerbicer 2007	2009	Tyc 2013	Winickoff 2010
Butz 2011	Eriksen 1996	*McIntosh 1994*	Ulbricht 2014	Yilmaz 2006
Carlsson 2013	*Fossum 2004*	*Meltzer 1993*	Vineis 1993	Yucel 2014
Chan 2003	*Greenberg 1994*	Nicholson 2015	Wahlgren 1997	Zakarian 2004
Chan 2005	Groner 2000	Ortega 2015	Wakefield 2002	Zhang 1993
Chan 2006	*Harutyunyan 2013*	*Peck 2015*	Walker 2015	
Chilmonczyk 1992	*Herbert 2011*	Prokhorov 2013	Wall 1995	
Collins 2015	Hovell 1994	Ralston 2008	Wang 2015	
Conway 2004	*Hovell 2000*	Ralston 2013	Wiggins 2005	

Italicized studies are those included in the narrative review only and excluded from meta-analyses

Table 6
Countries in which reviewed study interventions were conducted

Study ID	Country	Study ID	Country
Abdullah 2005	China	McIntosh 1994	United States
Abdullah 2015	China	Meltzer 1993	United States
Baheiraei 2011	Iran	Nicholson 2015	United States
Blaakman 2015	United States	Ortega 2015	Spain
Borelli 2010	United States	Peck 2015	United States
Butz 2011	United States	Prokhorov 2013	United States
Carlsson 2013	Sweden	Ralston 2008	United States
Chan 2003	China	Ralston 2013	United States
Chan 2005	China	Schuck 2014	Netherlands
Chan 2006	China	Stepans 2006	United States
Chilmonczyk 1992	United States	Stotts 2013	United States
Collins 2015	United States	Streja 2014	United States
Conway 2004	United States	Tyc 2013	United States
Crone 2003	Netherlands	Ulbricht 2014	Germany
Culp 2007	United States	Vineis 1993	Italy
Curry 2003	Portugal	Wahlgren 1997	United States
Eakin 2014	United States	Wakefield 2002	Australia
Ekerbicer 2007	Turkey	Walker 2015	Australia
Eriksen 1996	Norway	Wall 1995	United States
Fossum 2004	Sweden	Wang 2015	China
Greenberg 1994	United States	Wiggins 2005	United Kingdom
Groner 2000	United States	Wilson 2001	United States
Harutyunyan 2013	Armenia	Wilson 2011	United States
Herbert 2011	Canada	Winickoff 2003a	United States
Hovell 1994	United States	Winickoff 2003b	United States
Hovell 2000	United States	Winickoff 2010	United States
Hovell 2002	United States	Yilmaz 2006	Turkey
Hovell 2009	United States	Yucel 2014	Turkey
Irvine 1999	United Kingdom	Zakarian 2004	United States
Mahabee-Gittens 2009	United States	Zhang 1993	China

Table 7
Michi intervention components included in studies reviewed

Study ID	Michi components	Study ID	Michi components
Abdullah 2005	1, 5, 9, 10	Meltzer 1993	1, 2, 5, 9
Abdullah 2015	1, 2, 4, 5, 6, 7, 9, 10	Nicholson 2015	1, 2, 4, 7
Baheiraei 2011	2, 10	Ortega 2015	2
Blaakman 2015	1, 2, 4, 7, 9, 16	Peck 2015	1, 2, 4, 5
Borelli 2010	1, 2, 5, 9	Prokhorov 2013	1
Butz 2011	1, 7 10	Ralston 2008	2, 9
Carlsson 2013	2, 9, 10	Ralston 2013	2, 9, 16
Chan 2003	1, 2, 10	Schuck 2014	2, 3, 5, 7
Chan 2005	2	Stepans 2006	1, 2, 4, 15
Chan 2006	1, 2, 9	Stotts 2013	2
Chilmonczyk 1992	1, 4	Streja 2014	1, 4, 10
Collins 2015	1, 4, 5, 10	Tyc 2013	1, 2, 3, 4, 5, 7, 10
Conway 2004	2, 5, 7, 9	Ulbricht 2014	2
Crone 2003	1, 4, 9	Vineis 1993	1, 4
Culp 2007	1	Wahlgren 1997	1
Curry 2003	2, 5, 9, 10, 16	Wakefield 2002	1, 2, 4, 10
Eakin 2014	2, 6, 7, 9, 10, 16	Walker 2015	1, 4, 5, 9, 16
Ekerbicer 2007	1, 4	Wall 1995	1, 5, 10, 16
Eriksen 1996	1, 2, 4,9, 10, 16	Wang 2015	1, 2, 4, 5, 7, 10
Fossum 2004	2, 4, 5	Wiggins 2005	5, 9, 16
Greenberg 1994	1, 2, 4, 5, 7, 10	Wilson 2001	1, 2, 8
Groner 2000	5	Wilson 2011	1, 5, 9
Harutyunyan 2013	2, 4, 5, 10	Winickoff 2003a	1, 2, 9, 10, 16
Herbert 2011	2	Winickoff 2003b	1, 2, 9, 10, 16
Hovell 1994	5	Winickoff 2010	1, 2, 9, 10, 16
Hovell 2000	2, 7, 10	Yilmaz 2006	1
Hovell 2002	1, 2, 10, 15	Yucel 2014	1, 2, 4, 5, 7, 10, 15
Hovell 2009	2	Zakarian 2004	2, 5, 9, 10, 16
Irvine 1999	1, 4, 9, 15, 16	Zhang 1993	1, 4, 10
Mahabee-Gittens 2009	1, 2, 4, 9, 16		
McIntosh 1994	1, 2, 4, 10		

Legend
1. Education: Increasing knowledge or understanding
2. Persuasion: Using communication to induce positive or negative feelings or stimulate action
3. Incentivisation: Creating expectation of reward
4. Coercion: Creating expectation of punishment or cost
5. Training: Improving skills
6. Restriction: Using rules to reduce the opportunity to engage in the target behaviour
7. Environmental restructuring: Changing the physical or social context
8. Modelling: Providing an example for people to aspire to or imitate
9. Enablement: Increasing means/reducing barriers to increase capability/opportunity
10. Communication/marketing: Using print, electronic, telephonic or broadcast media
11. Guidelines: Creating documents that recommend or mandate practice (service provision changes)
12. Fiscal: Using the tax system to reduce or increase financial cost
13. Regulation: Establishing rules or principles of behaviour or practice
14. Legislation: Making or changing laws
15. Environmental/ social planning: Designing and/or controlling the physical or social environment
16. Service provision: Delivering a service

Table 8
Intervention components of interest in reviewed studies

Advice	**Educational Materials**	**Educational Session(s)**	**Motivational Interviewing**	**Cotinine Feedback**
Ekerbicer 2007	Abdullah 2005	Abdullah 2005	Abdullah 2005	Blaakman 2015
Eriksen 1996	Abdullah 2015	Abdullah 2015	Baheiraei 2011	Borelli 2010
Irvine 1999	Baheiraei 2011	Borelli 2010	Blaakman 2015	Chilmonczyk 1992
Mahabee-Gittens 2009	Butz 2011	Butz 2011	Borelli 2010	Ekerbicer 2007
McIntosh 1994	Carlsson 2013	Carlsson 2013	Carlsson 2013	McIntosh 1994
Ralston 2013	Chan 2003	Chan 2003	Chan 2005	Ulbricht 2014
Wall 1995	Chan 2006	Chan 2006	Eakin 2014	Wakefield 2002
Yucel 2014	Curry 2003	Collins 2015	Harutyunyan 2013	Wang 2015
	Eriksen 1996	Conway 2004	Ortega 2015	Wilson 2001
	Irvine 1999	Crone 2003	Ralston 2013	Wilson 2011
	McIntosh 1994	Culp 2007	Stotts 2013	Yucel 2014
	Nicholson 2015	Curry 2003	Ulbricht 2014	
	Prokhorov 2013	Eakin 2014	Walker 2015	
	Ralston 2008	Fossum 2004	Wang 2015	
	Ralston 2013	Greenberg 1994	Winickoff 2003b	
	Stepans 2006	Groner 2000	Winickoff 2010	
	Streja 2014	Herbert 2011		
	Ulbricht 2014	Hovell 1994		
	Vineis 1993	Hovell 2000		
	Wakefield 2002	Hovell 2002		
	Wall 1995	Hovell 2009		
	Wang 2015	Meltzer 1993		
	Wiggins 2005	Nicholson 2015		
	Winickoff 2003a	Ortega 2015		
	Winickoff 2003b	Peck 2015		
	Winickoff 2010	Ralston 2013		
	Zakarian 2004	Schuck 2014		
	Zhang 1993	Stepans 2006		
		Streja 2014		
		Tyc 2013		
		Ulbricht 2014		
		Vineis 1993		
		Wahlgren 1997		
		Walker 2015		
		Wang 2015		
		Wiggins 2005		
		Wilson 2001		
		Wilson 2011		
		Winickoff 2003a		
		Winickoff 2003b		
		Yilmaz 2006		
		Yucel 2014		
		Zakarian 2004		

Table 9
Intervention delivery contexts in studies reviewed

Ill Child	Well Child	Both	Not healthcare based
Blaakman 2015	Baheiraei 2011	Carlsson 2013	Abdullah 2005
Borelli 2010	Chilmonczyk 1992	Curry 2003	Abdullah 2015
Butz 2011	Crone 2003	Groner 2000	Collins 2015
Chan 2003	Eriksen 1996	Herbert 2011	Conway 2004
Chan 2005	Fossum 2004	Stepans 2006	Culp 2007
Chan 2006	Greenberg 1994	Wall 1995	Eakin 2014
Hovell 1994	Ortega 2015	Winickoff 2010	Ekerbicer 2007
Hovell 2002	Vineis 1993		Harutyunyan 2013
Irvine 1999	Walker 2015		Hovell 2000a
Mahabee-Gittens 2009	Yilmaz 2006		Hovell 2009
McIntosh 1994	Zakarian 2004		Prokhorov 2013
Meltzer 1993			Schuck 2014
Nicholson 2015			Ulbricht 2014
Peck 2015			Wang 2015
Ralston 2008			Wiggins 2005
Ralston 2013			Yucel 2014
Stotts 2013			Zhang 1993
Streja 2014			
Tyc 2013			
Wahlgren 1997			
Wakefield 2002			
Wilson 2001			
Wilson 2011			
Winickoff 2003a			
Winickoff 2003b			

Table 10
Intervention delivery methods in studies reviewed

Telephone	Pediatric	Emergency	Healthcare	School	Home	Mail
Abdullah 2005	Chan 2003	Mahabee-Gittens 2009	Baheiraei 2011	Ekerbicer 2007	Abdullah 2005	Irvine 1999
Abdullah 2015	Chan 2005	Ralston 2008	Blaakman 2015	Wang 2015	Abdullah 2015	Prokhorov 2013
Baheiraei 2011	Chan 2006	Ralston 2013	Borelli 2010	Zhang 1993	Blaakman 2015	Yucel 2014
Blaakman 2015	Chilmonczyk 1992	Tyc 2013	Butz 2011		Borelli 2010	
Borelli 2010	Crone 2003		Carlsson 2013		Butz 2011	
Collins 2015	Curry 2003		Herbert 2011		Carlsson 2013	
Conway 2004	Eriksen 1996		Hovell 2000		Collins 2015	
Eakin 2014	Fossum 2004		Meltzer 1993		Conway 2004	
Harutyunyan 2013	Groner 2000		Nicholson 2015		Culp 2007	
Hovell 2000a	Hovell 1994		Peck 2015		Eakin 2014	
Hovell 2002	McIntosh 1994		Stotts 2013		Greenberg 1994	
Nicholson 2015	Ortega 2015		Streja 2014		Harutyunyan 2013	
Peck 2015	Vineis 1993		Wakefield 2002		Hovell 2002	
Schuck 2014	Wahlgren 1997		Wilson 2011		Hovell 2009	
Wakefield 2002	Wall 1995		Winickoff 2003a		Irvine 1999	
Wilson 2011	Wilson 2001		Winickoff 2003b		Stepans 2006	
Winickoff 2003a	Yilmaz 2006		Winickoff 2010		Stotts 2013	
Winickoff 2003b			Zakarian 2004		Streja 2014	
Yucel 2014					Walker 2015	
Zakarian 2004					Wiggins 2005	
					Yucel 2014	

Note that interventions could have used more than one setting for delivery of components
The healthcare category is comprised of any health care setting that was not strictly a pediatric clinic or emergency department, or was comprised of multiple healthcare settings

Implementation measures review

Treatment intensity measures were guided by the implementation measures outlined by Downer and Yazejian (2013). Another guide used to direct this quality measures review was established by Bellg et al. (2004). These measures were designed to account for both the quality

and quantity of implementation. Twenty-five studies had a retention rate under 80%, and 35 studies had a retention rate over 80%. Seventeen studies (28%) provided reasons for the participant attrition, and 12 studies (20%) provided enough detail to demonstrate at which stage of the study participants had dropped-out. Twenty studies (33%) outlined completion rates for different parts of their interventions. When it came to procedural details about the intervention procedures, 29 of the 60 (47%) studies provided information on both the number of sessions and the length of each session. However, 34 of the 60 studies (57%) provided information on either the length of sessions or number of sessions, but not necessarily both. Of those that provided enough information to determine total intervention length, 8 studies were 15 minutes or less, 8 were 20-45 minutes in length, 6 were 1-2 hours, and 7 were over 2 hours. The longest total intervention length was approximately 6 hours and 45 minutes. Ten studies conducted their intervention in 1 session, 12 in 3-4 sessions, and 9 in 5 or more sessions. In terms of follow up times, 19 studies followed up after less than 6 months, 12 followed up at 6 months, 22 followed up at 12 months, and 2 followed up at 2 years or more.

Delivery personnel were varied in their backgrounds. Fifty-five of the 60 (92%) studies provided some detail about their delivery personnel. In 31 studies (52%), the primary delivery personnel were the researchers themselves or study specific staff. In 4 studies (0.07%), they were primary care physicians or pediatricians. In 12 studies (20%) they were community nurses or similarly trained community level health educators. Seven studies (12%) had hospital floor nurses as their primary delivery personnel, while one (0.02%) study utilized quitline staff. While most studies provided some information on the type of delivery personnel they used, few studies provided much detail on how their personnel were trained. Thirty-three studies (55%) mentioned any type of training involved in preparing their delivery personnel, and only 19 studies (32%)

provided detail on the content or quantity of this training. However, 9 studies (15%) included mention of continuing supervision, refresher courses, or other continuing quality checks during intervention delivery. Other types of quality check during delivery were mentioned in 18 studies (30%), and standardized delivery was mentioned in 9 studies (15%).

Table 11
Specified use of theories in studies

Theory	**No theory**
Abdullah 2005	Butz 2011
Abdullah 2015	Carlsson 2013
Baheiraei 2011	Chan 2003
Blaakman 2015	Chan 2005
Borelli 2010	Chan 2006
Conway 2004	Chilmonczyk 1992
Curry 2003	Collins 2015
Eakin 2014	Crone 2003
Fossum 2004	Culp 2007
Greenberg 1994	Ekerbicer 2007
Groner 2000	Eriksen 1996
Harutyunyan 2013	Hovell 1994
Herbert 2011	Hovell 2000
Hovell 2009	Hovell 2002
McIntosh 1994	Irvine 1999
Meltzer 1993	Mahabee-Gittens 2009
Peck 2015	Nicholson 2015
Ralston 2008	Ortega 2015
Ralston 2013	Prokhorov 2013
Schuck 2014	Stepans 2006
Stotts 2013	Tyc 2013
Streja 2014	Vineis 1993
Ulbricht 2014	Wahlgren 1997
Wang 2015	Wakefield 2002
Wilson 2011	Walker 2015
Winickoff 2003a	Wall 1995
Winickoff 2003b	Wiggins 2005
Winickoff 2010	Wilson 2001
Zakarian 2004	Yilmaz 2006
	Yucel 2014
	Zhang 1993

Table 12
Participant retention rates

Under 80%	**Over 80%**
Abdullah 2015	Abdullah 2005
Borelli 2010	Baheiraei 2011
Carlsson 2013	Blaakman 2015
Chilmonczyk 1992	Butz 2011
Collins 2015	Chan 2003
Conway 2004	Chan 2005
Eakin 2014	Chan 2006
Groner 2000	Curry 2003
Harutyunyan 2013	Ekerbicer 2007
Mahabee-Gittens 2009	Eriksen 1996
McIntosh 1994	Greenberg 1994
Prokhorov 2013	Herbert 2011
Ralston 2008	Hovell 1994
Ralston 2013	Hovell 2000a
Stepans 2006	Hovell 2002
Stotts 2013	Hovell 2009
Streja 2014	Irvine 1999
Vineis 1993	Meltzer 1993
Wilson 2001	Nicholson 2015
Winickoff 2010	Ortega 2015
Chan 2008	Peck 2015
Crone 2003	Schuck 2014
Culp 2007	Tyc 2013
Fossum 2004	Ulbricht 2014
Wall 1995	Wahlgren 1997
Winickoff 2003b	Wakefield 2002
	Walker 2015
	Wang 2015
	Wiggins 2005
	Wilson 2011
	Winickoff 2003a
	Yilmaz 2006
	Yucel 2014
	Zakarian 2004

Table 13
Longest follow up time points of studies reviewed

Less than 6 months	6 months	12 months	18 months or more
Baheiraei 2011	Abdullah 2005	Carlsson 2013	Crone 2003
Blaakman 2015	Abdullah 2015	Chan 2003	Vineis 1993
Borelli 2010	Butz 2011	Conway 2004	
Chan 2005	Ekerbicer 2007	Curry 2003	
Chan 2006	Groner 2000	Eakin 2014	
Chilmonczyk 1992	Ortega 2015	Greenberg 1994	
Collins 2015	Ralston 2008	Hovell 1994	
Eriksen 1996	Stotts 2013	Hovell 2000a	
Fossum 2004	Wakefield 2002	Hovell 2002	
Harutyunyan 2013	Walker 2015	Hovell 2009	
Herbert 2011	Wang 2015	Irvine 1999	
Mahabee-Gittens 2007	Zhang 1993	Nicholson 2015	
McIntosh 1994		Peck 2015	
Ralston 2013		Prokhorov 2013	
Stepans 2006		Schuck 2014	
Winickoff 2003a		Streja 2014	
Winickoff 2003b		Tyc 2013	
Winickoff 2010		Ulbricht 2014	
Yucel 2014		Wiggins 2005	
		Wilson 2001	
		Wilson 2011	
		Zakarian 2004	

Table 14
Number of intervention sessions in studies reviewed

1-2	3-4	5+
Chan 2005	Abdullah 2005	Abdullah 2015
Eriksen 1996	Baheiraei 2011	Eakin 2014
Harutyunyan 2013	Blaakman 2015	Hovell 2000a
Ralston 2013	Greenberg 1994	Hovell 2002
Stotts 2013	Herbert 2011	Hovell 2009
Ulbricht 2014	Ortega 2015	Nicholson 2015
Vineis 1993	Ralston 2008	Schuck 2014
Winickoff 2010	Stepans 2006	Tyc 2013
Yilmaz 2006	Walker 2015	Zakarian 2004
Yucel 2014	Wilson 2001	
	Winickoff 2003a	
	Winickoff 2003b	

Table 15
Total intervention length in minutes

15 or less	20-45	60-120	100+
Chan 2006	Chan 2005	Stotts 2013	Hovell 2000a
Groner 2000	Ortega 2015	Abdullah 2005	Greenberg 1994
Yilmaz 2006	Ralston 2008	Blaakman 2015	Nicholson 2015
Ralston 2013	Winickoff 2003a	Yucel 2014	Tyc 2013
Eriksen 1996	Ulbricht 2014	Abdullah 2015	Hovell 2009
Vineis 1993	Harutyunyan 2013	Eakin 2014	Herbert 2011
Winickoff 2010	Baheiraei 2011		Hovell 2002
Walker 2015	Winickoff 2003b		

Quality measures review

Fifty-five of the 60 studies reviewed (90%) had enough information to calculate a Jadad score. Fifteen studies (25%) had a score of 2 or less, while 20 (36%) had a score of 3. Fourteen studies (23%) had the highest possible score of 5.

Table 16
Jadad scores of studies reviewed

1	2	3	4	5
Crone 2003	Chan 2003	Baheiraei 2011	Chan 2005	Abdullah 2005
Ekerbicer 2007	Conway 2004	Chan 2006	Greenberg 1994	Abdullah 2015
Nicholson 2015	Eriksen 1996	Chilmonczyk 1992	Ralston 2013	Blaakman 2015
Peck 2015	Fossum 2004	Curry 2003	Wahlgren 1997	Borelli 2010
Vineis 1993	Ortega 2015	Eakin 2014	Wang 2015	Butz 2011
Wakefield 2002	Stotts 2013	Groner 2000	Yilmaz 2006	Collins 2015
Winickoff 2003a	Wall 1995	Harutyunyan 2013		Hovell 2000a
Winickoff 2003b		Herbert 2011		Hovell 2002
		Hovell 1994		Hovell 2009
		Mahabee-Gittens 2009		Irvine 1999
		McIntosh 1994		Streja 2014
		Prokhorov 2013		Wilson 2011
		Ralston 2008		Yucel 2014
		Schuck 2014		Zakarian 2004
		Stepans 2006		
		Ulbricht 2014		
		Walker 2015		
		Wiggins 2005		
		Wilson 2001		
		Winickoff 2010		

Meta-analysis

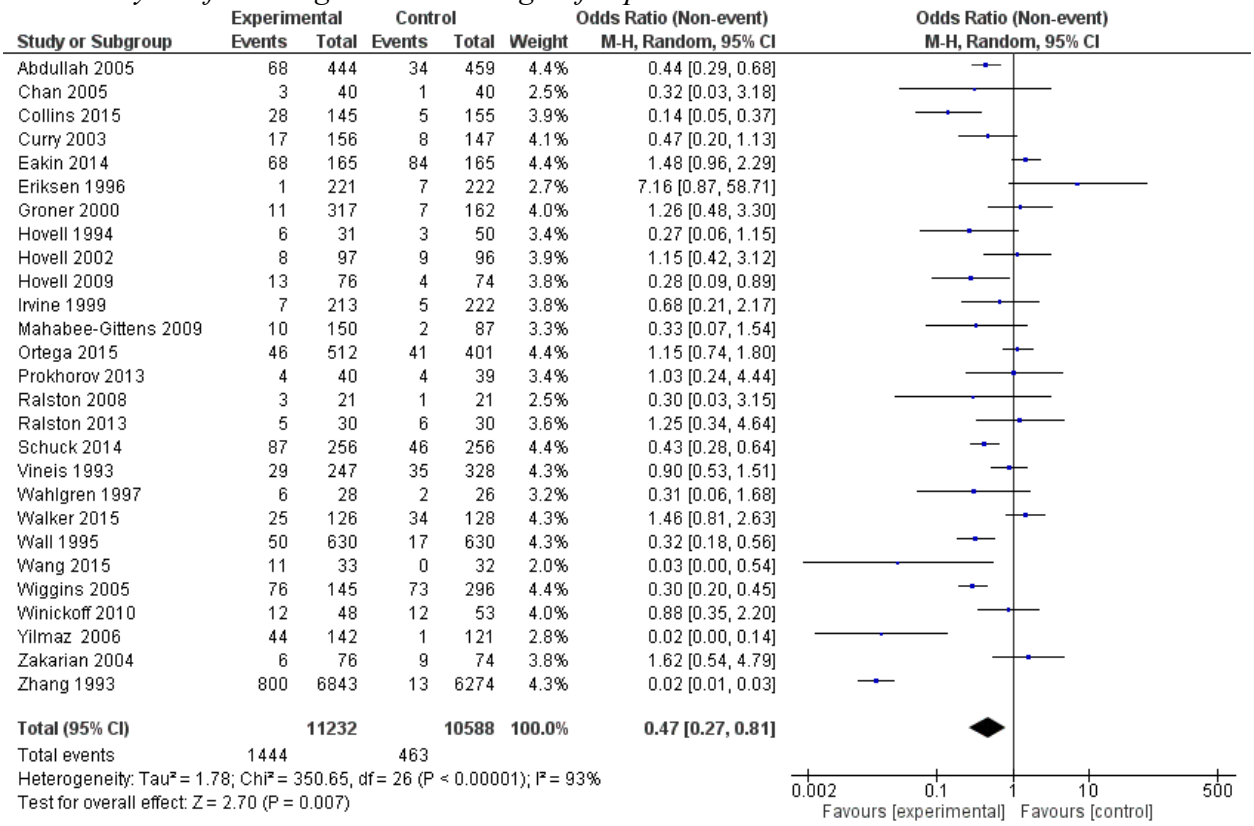
Meta-analyses were grouped based on two different outcomes and two different outcome types. The first outcome, cessation, was grouped by biochemically verified and self-reported measures. The second outcome, reduced child exposure, was grouped based on biochemically measured exposure and self-reported smoking bans. Some analyses may show different results from the same study, as the study included results that fit into multiple outcome categories. Analyses were repeated to see if excluding one particularly large study, Zhang 1993, resulted in significantly different results, which it did not.

Meta-analysis assessing cessation using self-reported measures

Figure 2 outlines the twenty-seven studies included and the results of the meta-analysis of smoking cessation using self-reported outcomes. Meta-analysis was conducted using the random effects method based on the Mantel-Haenszel method using odds ratios in RevMan 5 (Higgins & Green, 2011). Heterogeneity in this analysis was substantial ($I^2 = 93\%$, $p < 0.0001$), suggesting study effects varied more than would be expected due to chance alone. Meta-analysis revealed results favoured the intervention group ($z = 2.70$, $p = 0.007$) suggesting those in the intervention group were more likely to quit smoking. A funnel plot of the study results was largely symmetrical, suggesting publication bias was not an issue in this area (Figure 3).

Figure 2

Meta-analysis of smoking cessation using self-report outcomes



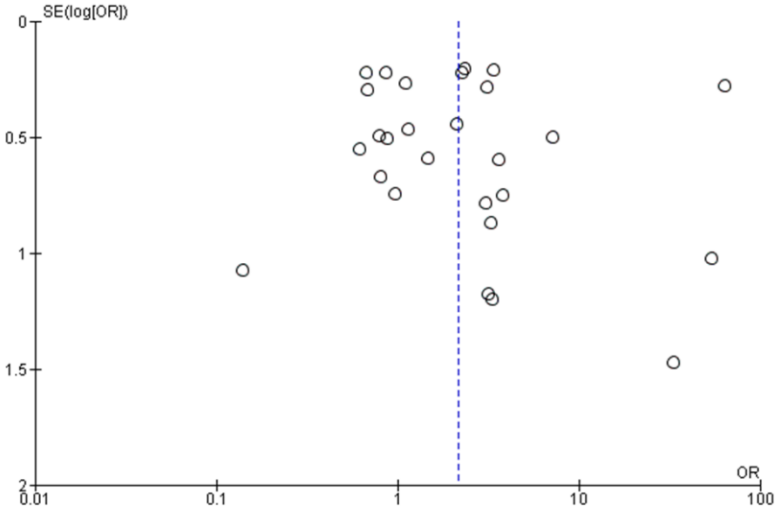
Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio (Non-event) M-H, Random, 95% CI
Abdullah 2005	68	444	34	459	4.4%	0.44 [0.29, 0.68]
Chan 2005	3	40	1	40	2.5%	0.32 [0.03, 3.18]
Collins 2015	28	145	5	155	3.9%	0.14 [0.05, 0.37]
Curry 2003	17	156	8	147	4.1%	0.47 [0.20, 1.13]
Eakin 2014	68	165	84	165	4.4%	1.48 [0.96, 2.29]
Eriksen 1996	1	221	7	222	2.7%	7.16 [0.87, 58.71]
Groner 2000	11	317	7	162	4.0%	1.26 [0.48, 3.30]
Hovell 1994	6	31	3	50	3.4%	0.27 [0.06, 1.15]
Hovell 2002	8	97	9	96	3.9%	1.15 [0.42, 3.12]
Hovell 2009	13	76	4	74	3.8%	0.28 [0.09, 0.89]
Irvine 1999	7	213	5	222	3.8%	0.68 [0.21, 2.17]
Mahabee-Gittens 2009	10	150	2	87	3.3%	0.33 [0.07, 1.54]
Ortega 2015	46	512	41	401	4.4%	1.15 [0.74, 1.80]
Prokhorov 2013	4	40	4	39	3.4%	1.03 [0.24, 4.44]
Ralston 2008	3	21	1	21	2.5%	0.30 [0.03, 3.15]
Ralston 2013	5	30	6	30	3.6%	1.25 [0.34, 4.64]
Schuck 2014	87	256	46	256	4.4%	0.43 [0.28, 0.64]
Vineis 1993	29	247	35	328	4.3%	0.90 [0.53, 1.51]
Wahlgren 1997	6	28	2	26	3.2%	0.31 [0.06, 1.68]
Walker 2015	25	126	34	128	4.3%	1.46 [0.81, 2.63]
Wall 1995	50	630	17	630	4.3%	0.32 [0.18, 0.56]
Wang 2015	11	33	0	32	2.0%	0.03 [0.00, 0.54]
Wiggins 2005	76	145	73	296	4.4%	0.30 [0.20, 0.45]
Winickoff 2010	12	48	12	53	4.0%	0.88 [0.35, 2.20]
Yilmaz 2006	44	142	1	121	2.8%	0.02 [0.00, 0.14]
Zakarian 2004	6	76	9	74	3.8%	1.62 [0.54, 4.79]
Zhang 1993	800	6843	13	6274	4.3%	0.02 [0.01, 0.03]
Total (95% CI)		**11232**		**10588**	**100.0%**	**0.47 [0.27, 0.81]**
Total events	1444		463			

Heterogeneity: Tau² = 1.78; Chi² = 350.65, df = 26 (P < 0.00001); I² = 93%

Test for overall effect: Z = 2.70 (P = 0.007)

Figure 3

Funnel plot of smoking cessation using self-report outcomes



Meta-analysis assessing cessation using biochemically verified outcomes

Figure 4 outlines the five studies included and the results of the meta-analysis of smoking cessation using biochemically verified outcomes. Meta-analysis was conducted using the random effects method based on the Mantel-Haenszel method using odds ratios in RevMan 5 (Higgins & Green, 2011). In this analysis, cessation was considered the event of interest. When multiple time points were presented in studies, the longest time point was used for analysis. Heterogeneity in this analysis was considerable (I^2 = 76%, p = 0.002), suggesting study effects varied more than would be expected from chance alone. Meta-analysis revealed results did not significantly favour the intervention group (z = 0.78, p = 0.44), suggesting those in the intervention group were not more likely to quit smoking. A funnel plot of the study results was largely symmetrical, suggesting publication bias was not an issue in this area (Figure 5).

Figure 4

Meta-analysis of smoking cessation using biochemical verification

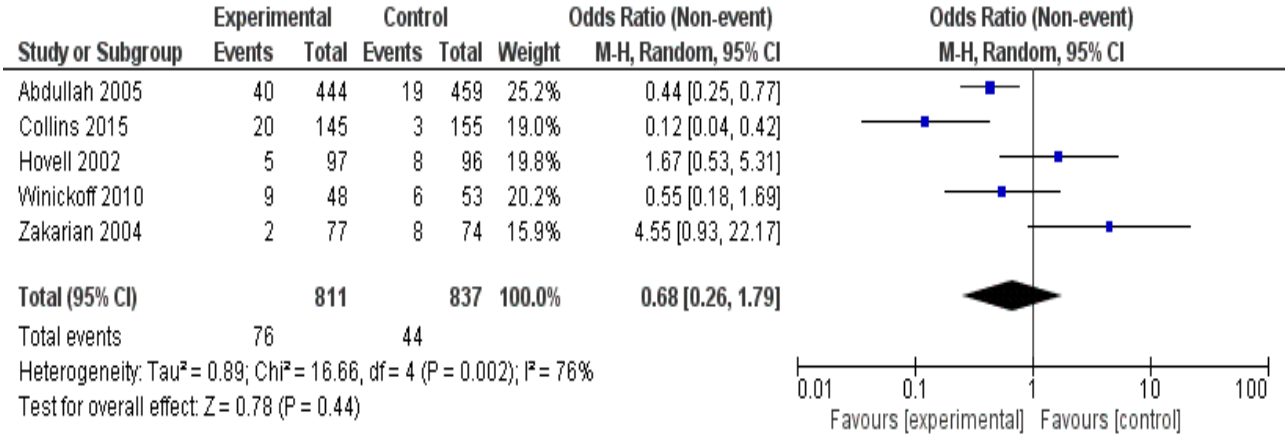
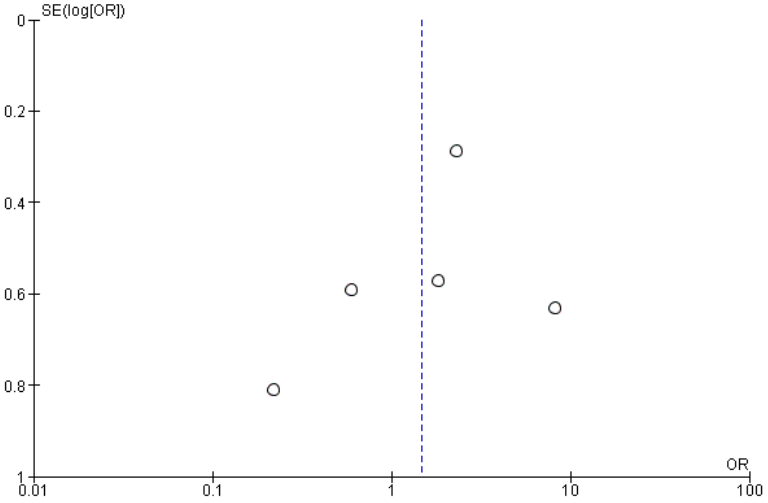


Figure 5
Funnel plot of smoking cessation using biochemical verification



Meta-analysis assessing reduced exposure using child cotinine measures

Figure 6 outlines the eleven studies included and the results of the meta-analysis of reduced exposure using child cotinine measures. Meta-analyses were conducted using the random effects method based on the Mantel-Haenszel method using the standardized mean difference in RevMan 5 (Higgins & Green, 2011). The standardized mean difference was used in this analysis as it partially compensates for different measures such as differing units for cotinine results or cotinine to creatinine ratio measures. In this analysis, means and standard deviations were used to determine the difference between intervention and control groups. When confidence intervals were presented instead of standard deviations, the standard deviation was calculated (Higgins & Green, 2011). Heterogeneity in this analysis was considerable (I^2 = 80%, $p < 0.0001$), suggesting study effects varied more than would be expected due to chance. Meta-analysis revealed results favoured the intervention group ($z = 2.84$, $p = 0.005$), suggesting intervention groups were more likely to have lower child cotinine at follow-up. A funnel plot of the study results was mostly symmetrical suggesting publication bias was not an issue in this area (Figure 7).

Figure 6

Meta-analysis of reduced exposure using child cotinine

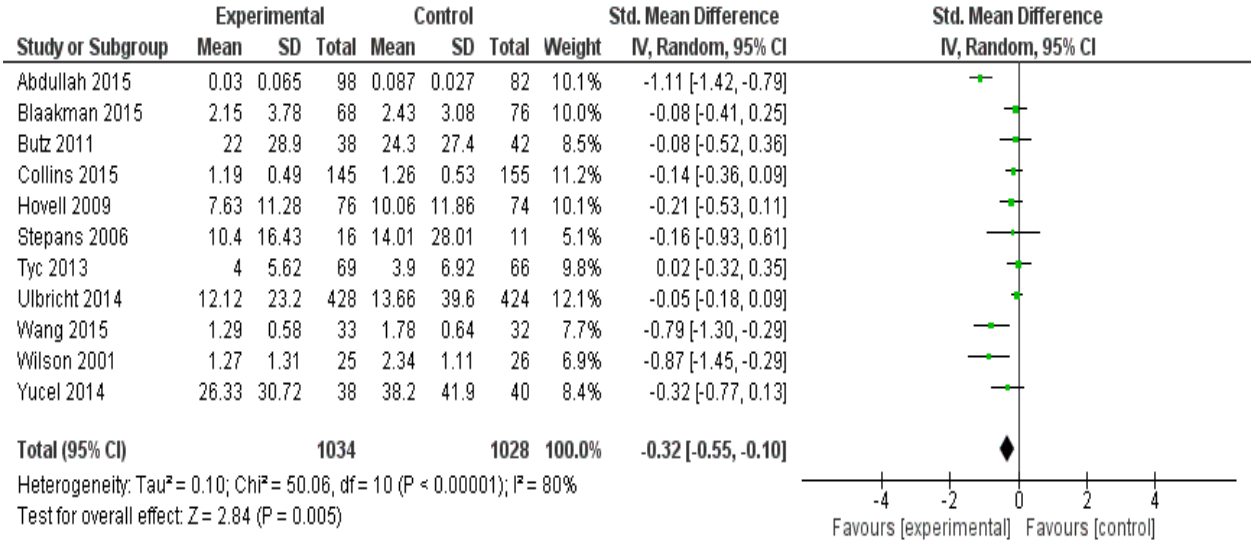
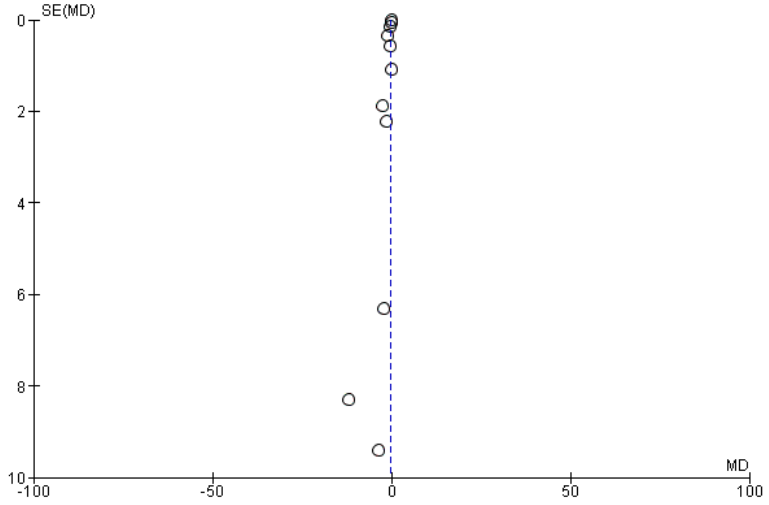


Figure 7

Funnel plot of reduced exposure using child cotinine



Meta-analysis assessing reduced exposure using environmental ban implementation rates

Figure 8 outlines the sixteen studies included and the results of the meta-analysis of reduced exposure using smoking bans. Meta-analyses were conducted using the random effects method based on the Mantel-Haenszel method using odds ratios in RevMan 5 (Higgins & Green, 2011). In this analysis, implementation of a home or car ban was the event of interest. The most

extreme study outcome was favoured for coding. For example, if both home and car bans were presented together, that outcome would be favoured over vehicle or home bans separately. Similarly, the longest time frame was selected. For example, if studies presented results for multiple timeframes, the longest follow up time results were used. Heterogeneity in this analysis was moderate (I^2 = 55%, p = 0.005), suggesting study effects varied more than would be expected due to chance alone. Meta-analysis revealed results favoured the intervention group (z = 1.98, p = 0.05), suggesting those in the intervention group were more likely to have implemented environmental bans at follow-up. A funnel plot of the study results was largely symmetrical, suggesting publication bias was not an issue in this area (Figure 9).

Figure 8

Meta-analysis of reduced exposure using smoking bans

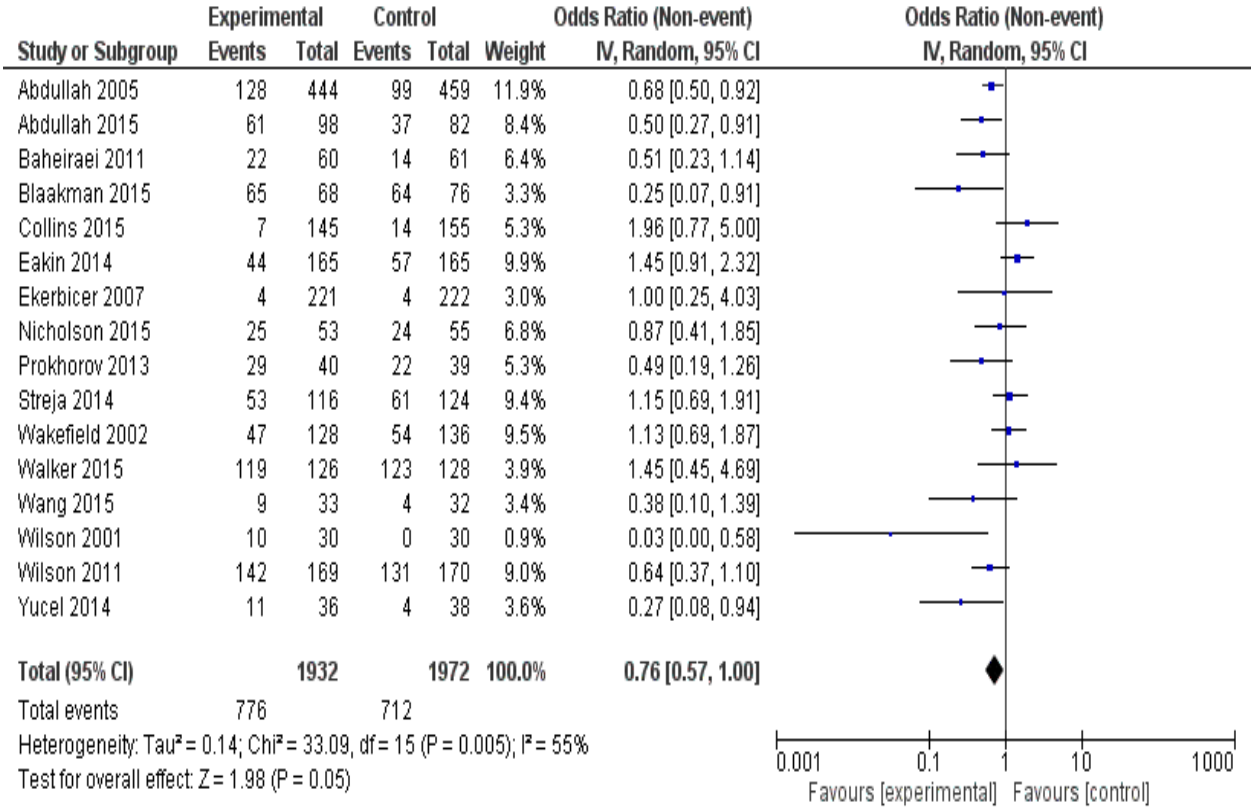
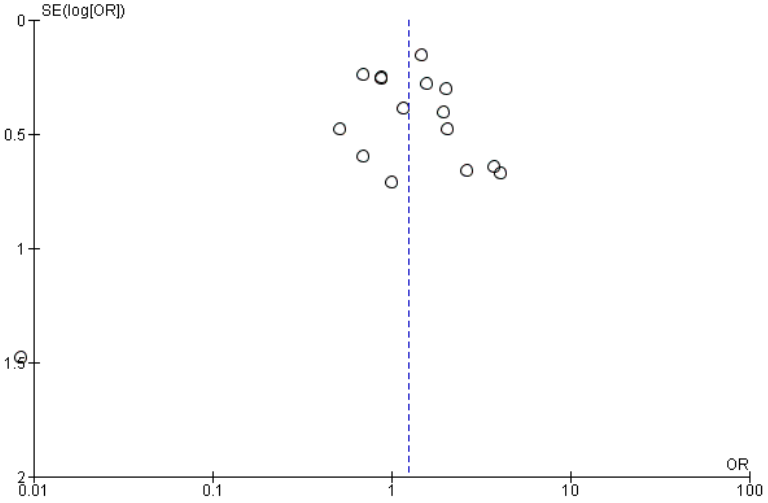


Figure 9
Funnel plot of reduced exposure using smoking bans



Subgroup analyses

Study characteristic distribution permitted for a number of subgroup analyses. Using the self-reported cessation outcome, subgroup analyses were conducted based on intervention context (Figure 10), grouping studies by follow-up time frame (Figure 11), whether the intervention was considered brief or intensive (Figure 12), and whether the intervention had a theoretical basis (Figure 13). Subgroup analyses for theoretical basis (Figure 14) and follow up timeframes (Figure 15) were also possible using the reduced exposure via bans outcome. Investigating theoretical basis of interventions using the biochemically verified reduced exposure outcomes (Figure 16) was the only other subgroup analyses possible due to small or uneven grouping sizes.

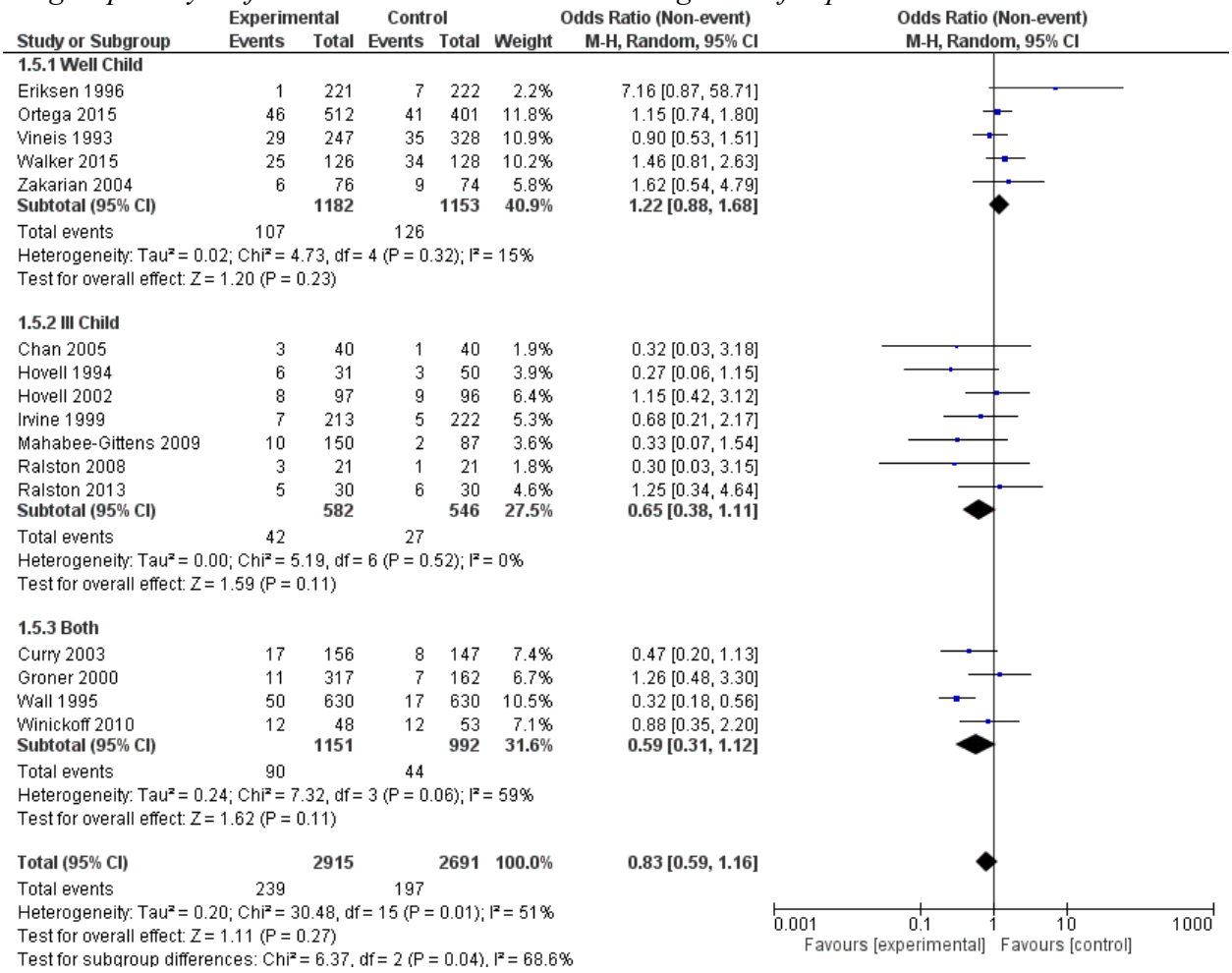
Subgroup analysis of intervention context using self-reported cessation results

One subgroup of interest was the intervention setting and whether the parents intervened with accompanied a well-child or an ill child. Subgroup analysis for this category of interest was possible using the self-report cessation outcome. Study distribution prevented this analysis being carried out with the other outcomes of reduced exposure and biochemically verified cessation, as

too few studies using those outcomes fell into the ill child or well child groups. For this analysis, studies conducted outside of a healthcare setting were excluded. Although data was coded for asthmatic and other ill visits, these groups were combined for this analysis. Further, interventions conducted in a healthcare setting that did not focus on either well child or ill child visits were included in the category "both", as they included both well and ill children with no way to determine differences in outcome for these groups. Results of the analysis are outlined in Figure 10. The subgroup analysis was statistically significant for subgroup differences ($\chi^2 = 6.37$, $p = 0.04$), suggesting the groups did not come from the same distribution. Heterogeneity was quite low for the ill ($I^2 = 0\%$, $p = 0.52$) and well ($I^2 = 15\%$, $p = 0.32$) child groups, but moderate for the both group ($I^2 = 59\%$, $p = 0.06$) and for the total analysis ($I^2 = 51\%$, $p = 0.04$). This suggests that intervention setting is in fact a source of heterogeneity in this area of study. None of these analyses significantly favoured the intervention group, providing no statistical evidence that interventions improved chances of cessation. However, the ill child group and both groups were approaching significance (both $p = 0.11$) compared to the well group ($p = 0.23$), and the total analyses ($p. = 0.27$).

Figure 10

Subgroup analyses for ill child or well child visit using the self-reported cessation outcome



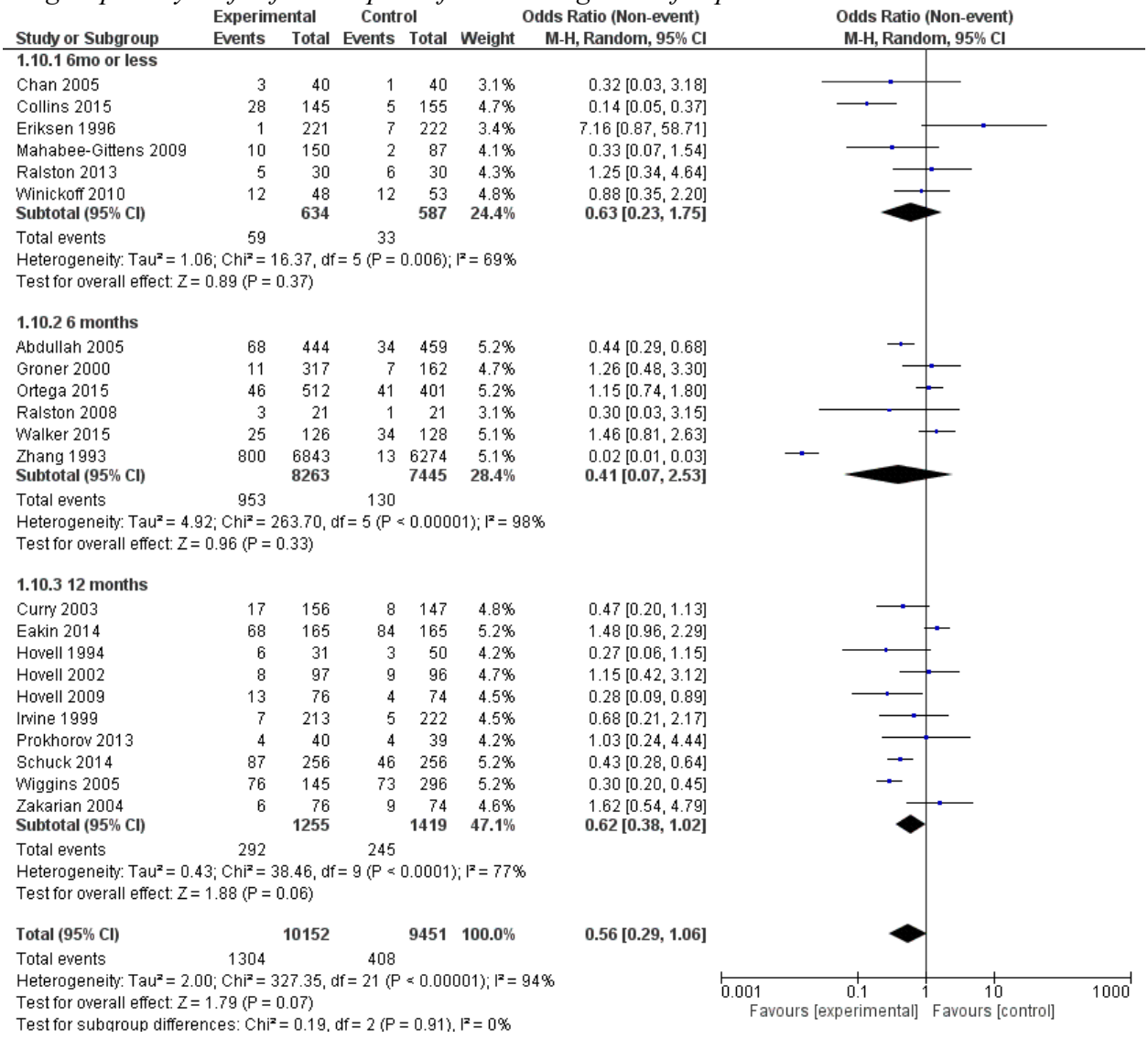
Subgroup analysis of follow up timeframes using self-reported cessation outcomes

The subgroup analysis for follow up timeframes using the self-reported cessation outcome was not statistically significant for subgroup differences ($\chi^2 = 0.19$, p = .91), meaning groups based on follow up time likely came from the same distribution. Only the twelve month group approached significantly favouring the intervention group, (less than 6 months: z = 0.89, p = 0.37; 6 months: z = 0.96, p = 0.33; 12 months: z = 1.88, p = 0.06), suggesting that interventions with longer follow-up time frames may be more effective. Heterogeneity was considerable in all three groups, but was lower for the 6 months or less ($I^2 = 69\%$, p = 0.006) and

the 12 month groups (I^2 = 77%, p < 0.0001) than for the total analysis (I^2 = 94%, p < 0.0001) and the 6 months group (I^2 = 98%, p < 0.0001).

Figure 11

Subgroup analyses for follow up timeframes using the self-reported cessation outcome



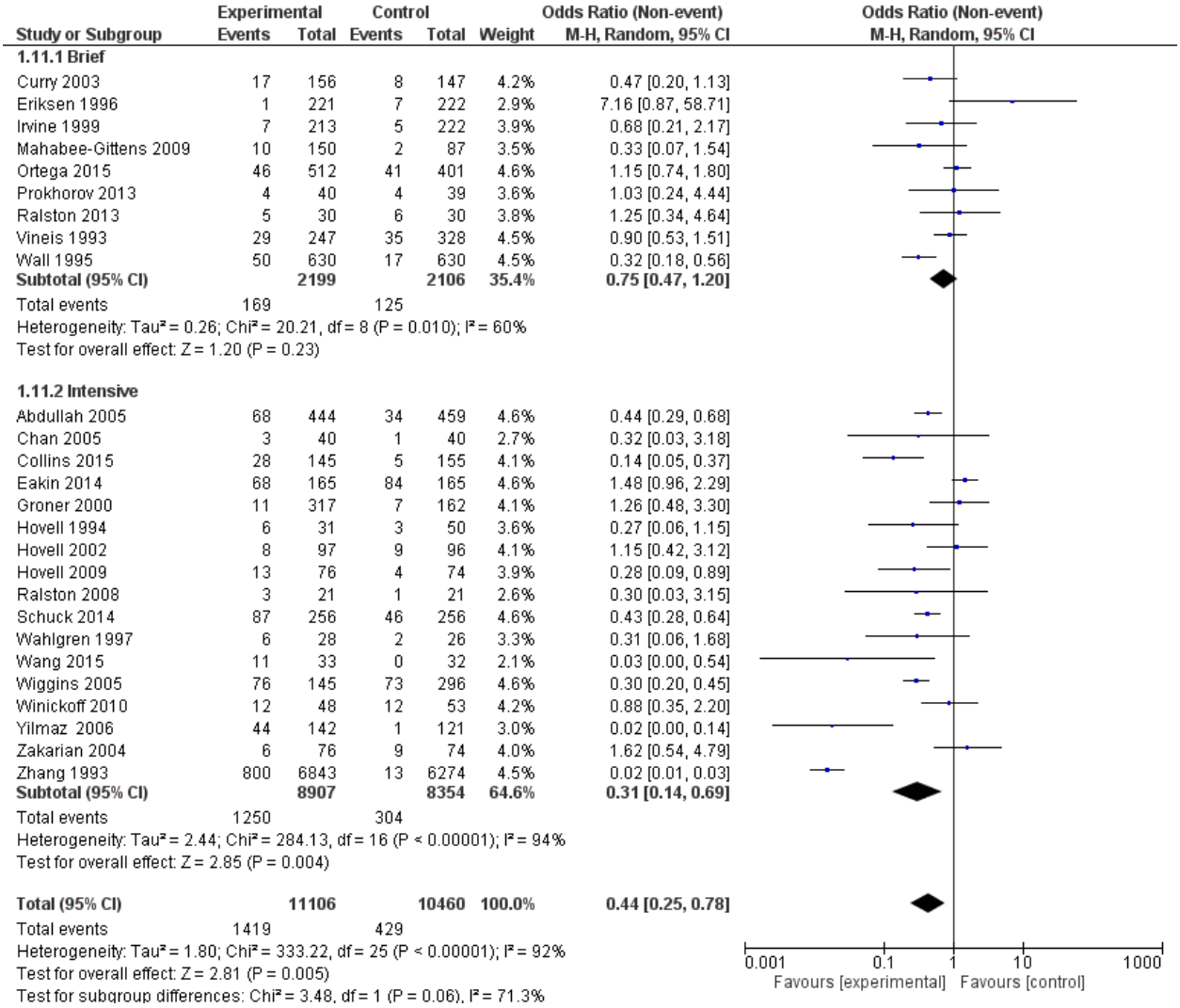
Subgroup analysis for intervention length using self-reported cessation outcomes

The subgroup analysis for intervention length using the self-reported cessation outcome approached statistical significance for subgroup differences (χ^2 = 3.48, p = 0.06), meaning these groups likely came from different distributions. Heterogeneity was moderate for the brief group (I^2 = 60%, p = 0.01) and considerable for the intensive group (I^2 = 94%, p < 0.0001) and the total

analysis (I^2 = 92%, p < 0.0001). Only the intensive group statistically significantly favoured the intervention group (brief: z = 1.2, p = 0.23; intensive: z = 2.85, p = 0.004), suggesting that intensive interventions are effective in encouraging cessation within intervention groups, but brief interventions may not be. The overall analysis was also significant (z = 2.81, p = 0.005).

Figure 12

Subgroup analyses for intervention length using the self-reported cessation outcome



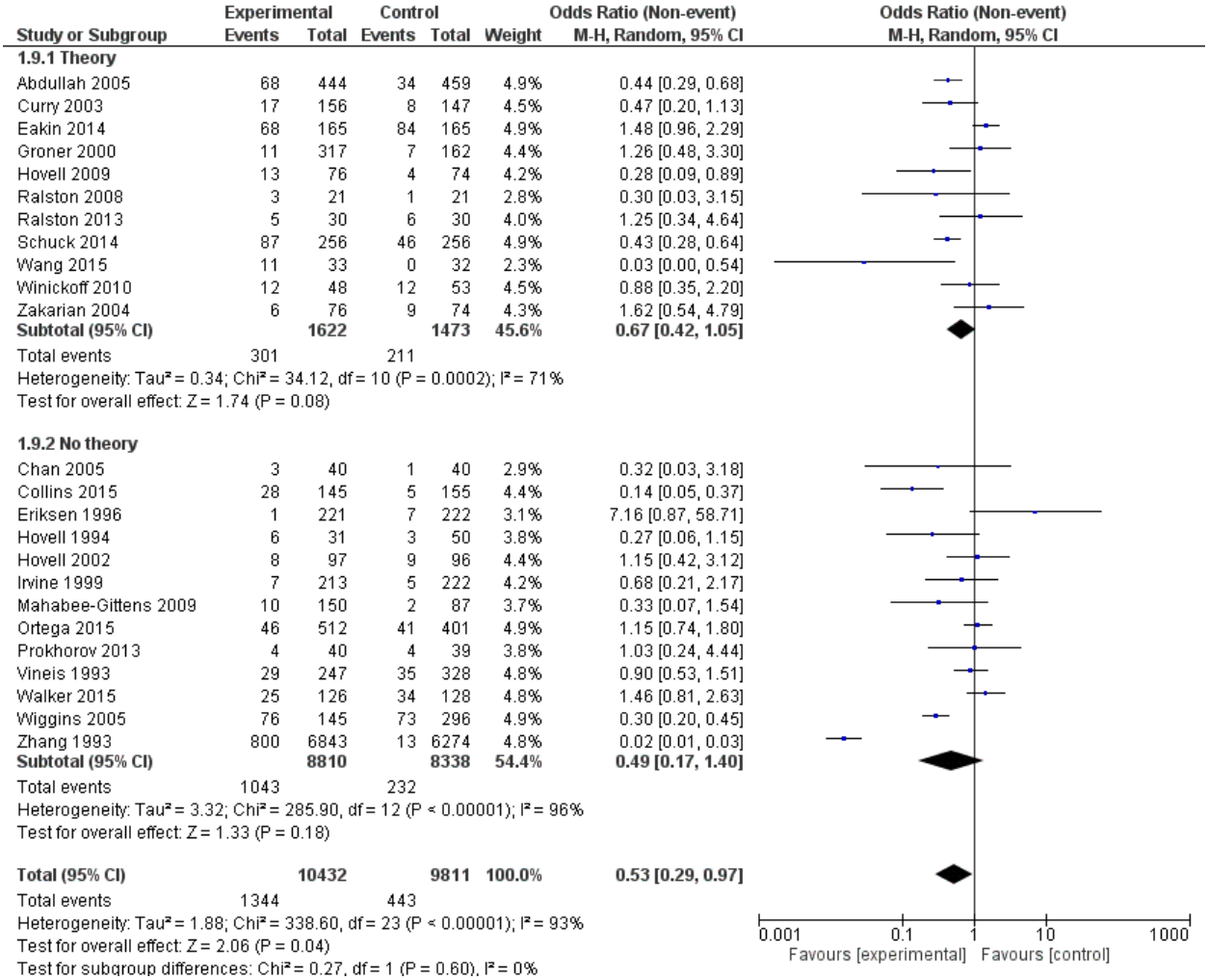
Subgroup analysis for theoretical basis using self-reported cessation outcome

The subgroup analysis for theoretical basis using the self-reported cessation outcome was not statistically significant for subgroup differences (χ^2 = 0.27, p = 0.60), suggesting groups were not from different distributions. Heterogeneity was fairly high in all groups, but was lower in the

theory group (I^2 = 71%, p = 0.0002) than in the no theory group (I^2 = 96%, p < 0.0001) or the total analysis (I^2 = 93%, p < 0.0001). The theory group was approaching statistical significance (z = 1.74, p = 0.08) while the no theory group was not (z = 1.33, p = 0.18). The overall analysis did significantly favour the intervention group (z = 2.06, p = 0.04). This suggests that separating studies by theoretical basis does not resolve heterogeneity in this area.

Figure 13

Subgroup analyses for theoretical basis using the self-reported cessation outcome

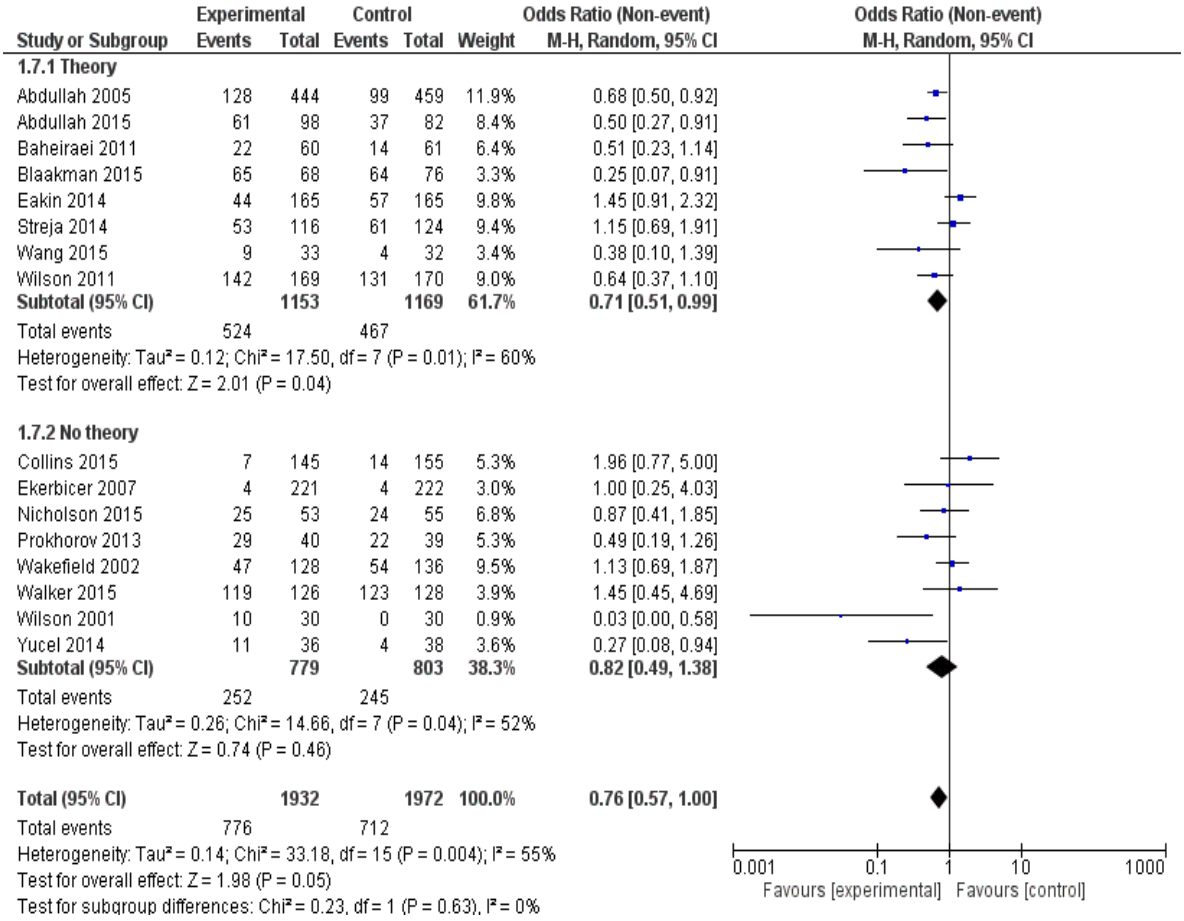


Subgroup analysis for theoretical basis using reduced exposure outcomes via environmental bans

The subgroup analysis for theoretical basis using the reduced exposure via smoking bans outcome was not statistically significant for subgroup differences ($\chi^2 = 0.23$, $p = 0.63$), suggesting this groups were not from different distributions. The no theory group did not statistically significantly favour the intervention group ($z = 0.74$, $p = 0.46$), but the theory group did ($z = 2.01$, $p = 0.04$), suggesting in this case interventions based on theory were more likely to result in the implementation of a home ban in the intervention group. The overall effect test was also statistically significant ($z = 1.98$, $p = 0.05$). Heterogeneity was moderate in both the theory group ($I^2 = 60\%$, $p = 0.01$) and the no theory group ($I^2 = 52\%$, $p = 0.04$), as well as the overall test ($I^2 = 55\%$, $p = 0.004$). This suggests that dividing studies based on theoretical basis of the intervention did not resolve heterogeneity.

Figure 14

Subgroup analyses for theoretical basis using the reduced exposure via bans outcome

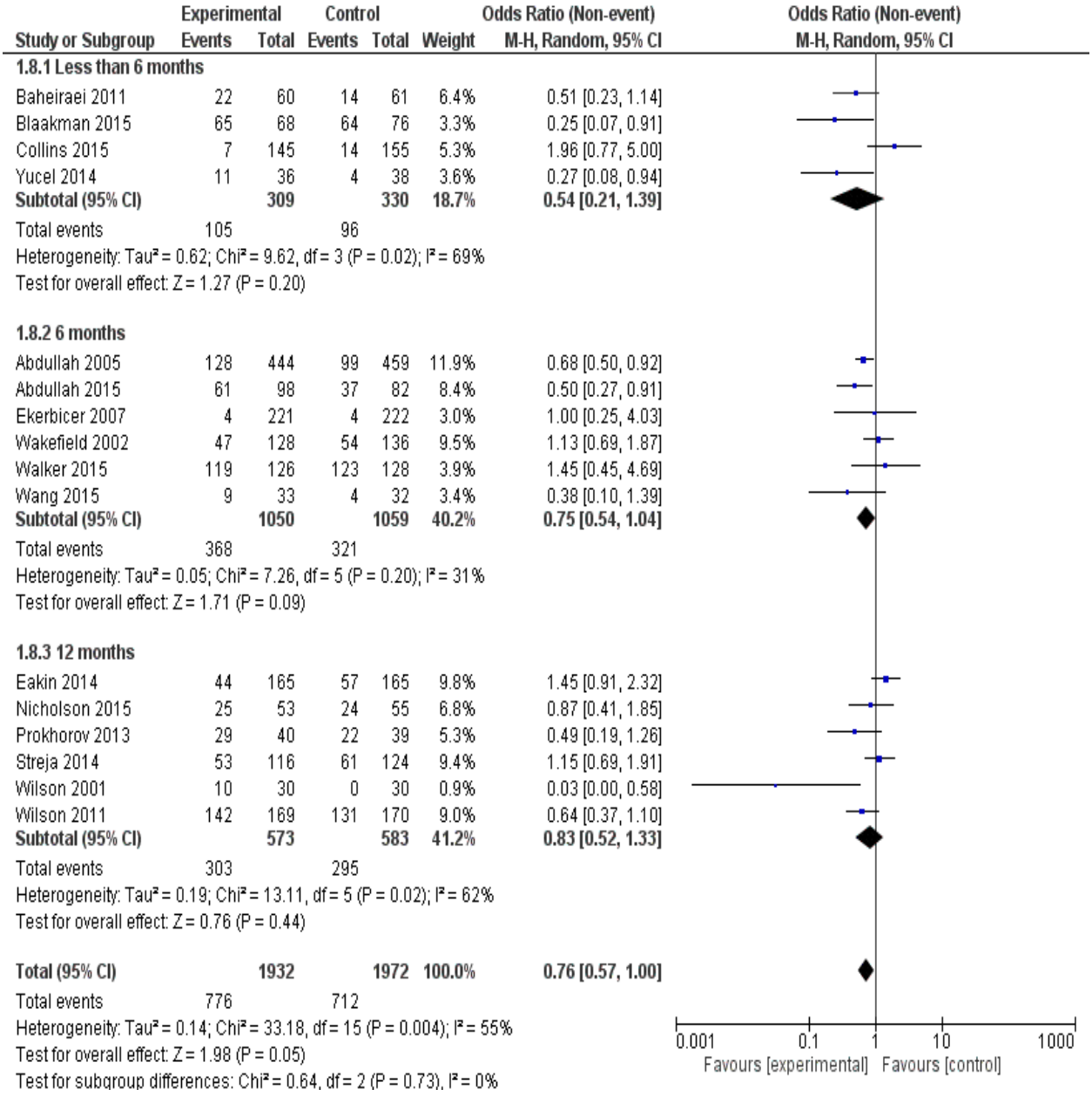


Subgroup analysis for follow up timeframes using reduced exposure outcomes via environmental bans

The subgroup analysis for follow up time frames using the reduced exposure via smoking bans outcome was not statistically significant for subgroup differences ($\chi^2 = 0.64$, $p = 0.73$), suggesting they did not come from different distributions. None of the groups statistically significantly favoured the intervention group on their own (less than 6 months: $z = 1.27$, $p = 0.20$; 6 months: $z = 1.71$, $p = 0.09$; 12 months: $z = 0.76$, $p = 0.44$), but the overall test effect did ($z = 1.98$, $p = 0.05$). The six months group approached statistical significance, and was the only group without significant heterogeneity ($I^2 = 31\%$, $p = 0.20$). The less than 6 months group ($I^2 = 69\%$, $p = 0.02$), 12 months group ($I^2 = 62\%$, $p = 0.02$), and total analysis ($I^2 = 55\%$, $p = 0.004$) all had significant heterogeneity. This suggests that it is possible there is something related to follow up timeframes that is a source of heterogeneity in this area.

Figure 15

Subgroup analyses for follow up timeframes using the reduced exposure via bans outcome



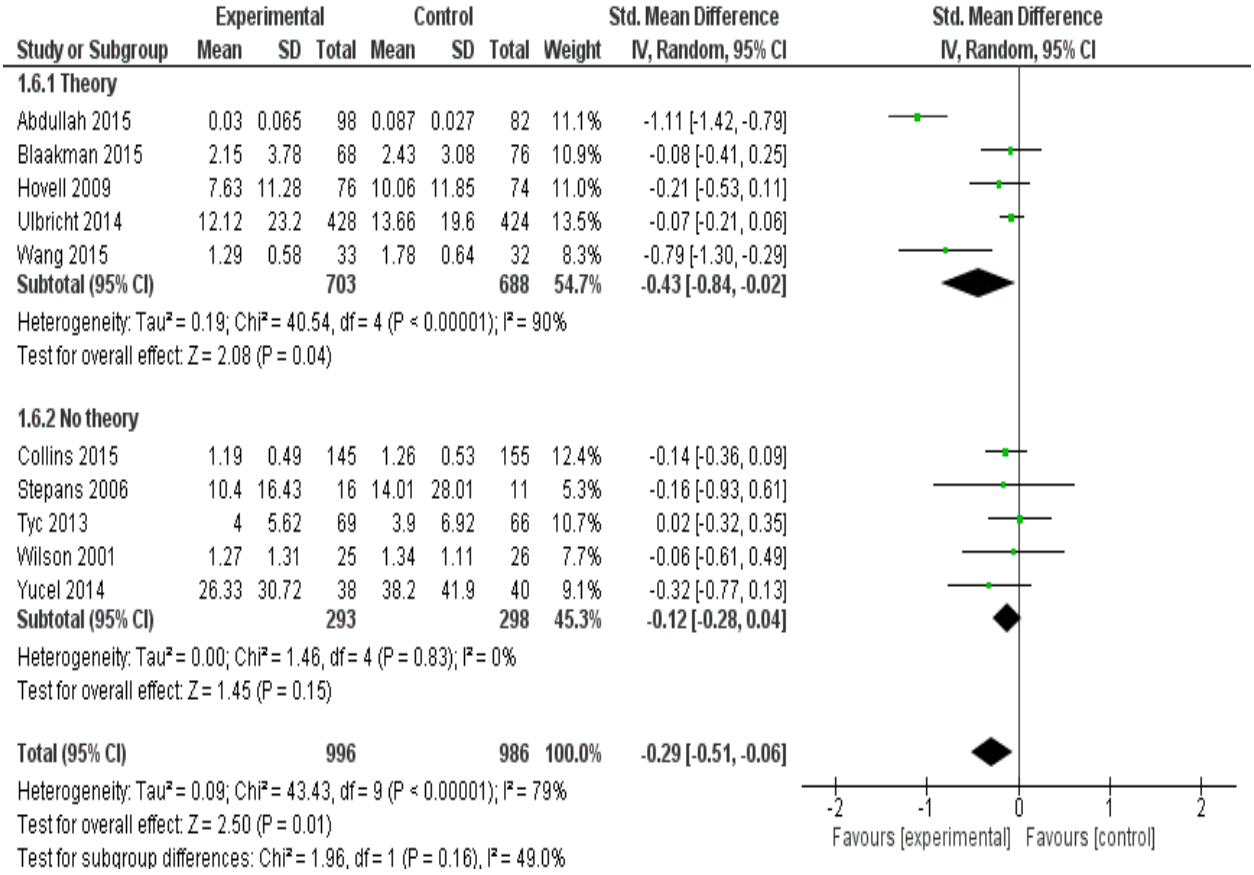
Subgroup analyses for theoretical basis using biochemically verified reduced exposure

The subgroup analysis for theoretical basis using the biochemically verified reduced exposure measures was not statistically significant for subgroup differences ($\chi^2 = 1.96$, $p = 0.16$), suggesting the groups did not come from different distributions. Heterogeneity was quite high for the theory group ($I^2 = 90\%$, $p < 0.0001$) and remarkably low for the no theory group ($I^2 = 0\%$, p

= 0.83). Heterogeneity was also significant for the total analysis (I^2 = 79%, p < 0.0001). The no theory group was did not significantly favour the intervention group (z = 1.45. p = 0.15), while the theory group did statistically significantly favour the intervention group (z = 2.08, p = 0.04). The overall test also statistically significantly favoured the intervention group (z = 2.50, p = 0.01), suggesting that both the overall and no theory groups in this case were more likely to have lower child cotinine in the intervention group.

Figure 16

Subgroup analyses for theoretical basis using the biochemically verified reduced exposure outcome



Discussion

The purpose of this study was to duplicate and expand on previous reviews and meta-analyses in the area of interventions with parents who smoke. Previous studies of this area were often more specifically focused in their goals. Reviews that were narrative in nature often devoted more detailed attention to implementation and quality measures, but did not offer a statistical summary of intervention results. Those that conducted meta-analysis were often required to focus very specifically on outcomes and not spend as much time on outlining implementation measures. This study sought to explore and expand on both these areas.

Implementation measures and quality assessment review

The narrative synthesis of implementation and quality measures found a number of areas for improvement. Only about half of the studies surveyed for the narrative synthesis provided enough information about their intervention to determine an approximate total time of the intervention. This makes categorization for intervention intensity based on time quite difficult, but in some cases intervention components were informed by participant interest. Such interventions are difficult to categorize in terms of intensity and components. Less than a third of studies (28%) provided reasons for participant attrition. However, most of these studies (70%) provided enough detail that the reason and time frame of participant attrition was clear. It seems the use of participant flow charts is encouraged and it is possible this practice will increase in the coming years, reducing this potentially unspecified source of study bias. Most studies mentioned their delivery personnel (90%) however few outlined the content or quantity of training provided to their delivery personnel (32%). This is another area that could be improved upon that would give a better overall picture of intervention intensity and possible variability between studies. Downer and Yazejian (2013) noted that study reporting often includes quantitative

implementation measures, but that the reporting of qualitative implementation measures is less frequent. However, it seems both of these areas could be improved upon, and qualitative measures like delivery personnel training are actually reported at similar rates to some quantitative measures such as accounts of participant attrition.

Meta-analyses

Another interesting result of these analyses was that the only meta-analysis conducted that did not significantly favour the intervention group was the one that used biochemically verified quit rates. The other three meta-analyses conducted all demonstrated significant improvements in the intervention groups at follow-up in their respective outcomes of self-reported cessation, decreased exposure demonstrated by child cotinine, and decreased exposure demonstrated through environmental ban implementation. This may be due to a smaller sample size, as many subgroup analyses with smaller group sizes did not reach significance either, but it also mirrors what a number of studies in the area have found. In past studies, self-report values displayed significant quit rates, but when biochemical verification is introduced this effect disappears. This is an interesting problem that warrants further attention. Not only was the group of studies with biochemically verified outcome smaller, but typically those studies had smaller group sizes overall. The total pooled participant number for biochemically verified quit rates was 811 in the intervention group and 837 in the control group. The self-reported cessation analysis had 11232 in the intervention group and 10588 in the control group in comparison. The child cotinine analysis was much closer, with 1034 in the intervention group and 1028 in the control group, and the environmental bans analysis was a little larger at 1932 in the intervention group and 1972 in the control group. While smaller sample sizes may contribute to the lack of statistical significance when using biochemically verified quit measures, it seems possible that

there is another explanation considering some of these other analyses achieved significance with a few hundred more participants in their groups.

Subgroup analyses

More studies reported self-report outcomes than other types of outcomes, so more subgroup analyses were possible using this group of studies. Unfortunately, too few studies reported biochemically verified quit rates to explore this group through subgroup analyses. Interestingly, the subgroup analysis conducted that grouped studies by ill child visit or well child visit seems to support the literature in that intervention context matters. Rigotti et al., (2008) reported that interventions with adults who were approached during a sick visit resulted in participants being more likely to quit. It seems this may be the case in intervening with parents as well, as subgroup analyses revealed that interventions with sick children's parents or parents in a health care setting that included both well and sick children trended toward significantly favouring the intervention group, but those that focused on well child visits did not. Further, heterogeneity was nonsignificant for the ill child ($p = 0.52$) and well child groups ($p = 0.32$), but significant for the general healthcare group and total analysis ($p = 0.04$). This suggests that these intervention contexts are in fact different in some important way, and that this area is an important consideration in reducing heterogeneity between studies in future analyses. Because the test for differences between subgroups was significant, this seems to suggest that well child interventions may be skewing ill child interventions away from statistical significance when they are combined. Another important finding that replicates previous findings and assumptions was that the subgroup analyses that divided interventions into brief or intense categories approached significance for subgroup differences, and only the intensive grouping significantly favoured the intervention group.

Another interesting point of investigation was that biochemical verification, as a point prevalence measure, should be a highly heterogeneous group. However, there was no evidence in these analyses that this group was any more heterogeneous than the self-report outcome grouped studies. Another interesting finding was that aside from the ill child well child division, separating studies into subgroups did not drastically reduce heterogeneity within the self-reported cessation group. It seems likely that these studies are heterogeneous because of differences in context buy may also be heterogeneous for some other reason. One potential avenue of heterogeneity is intervention intensity and follow up time intervals. There were two subgroup analyses conducted investigating follow-up times. Neither of these analyses was statistically significant for subgroup differences. Interestingly, heterogeneity was lowest for the 6 month follow-up group in the environmental bans analysis. Further, the only subgroup that significantly favoured the intervention group out of both analyses was the 12 month group in the self-report cessation analysis. It is difficult to separate intervention intensity from follow up time frames, as substantially more intense interventions are also likely have longer follow up periods, due to not only time invested as part of the intervention but also discrepancies in funding levels between studies. Further investigation into how to separate these variables may results in a more illuminating picture of heterogeneity and study effectiveness.

Study Limitations

There were many challenges in categorizing studies for analyses. In some cases, intervention design would not have allowed for an accurate estimation of time spent with participants, as some interventions were informed by participant receptiveness, so that interventions would be more or less involved depending on participant interest. Some other challenges include studies publishing protocols elsewhere, publishing protocol much in advance

of results, or duplicate publication of results. A number of studies which were appropriate for narrative review were not appropriate for meta-analysis. This was often because of a lack of control group or because of varying definitions of reduced exposure, such as number of cigarettes exposed, amount of time exposed, or number of cigarettes smoked by a caregiver. Occasionally, it was due to inadequate results reporting, such as reporting means without standard deviations, reporting difference scores, or reporting interquartile ranges instead of standard deviations or confidence intervals. The study also could have been improved by using duplicate data extraction to improve accuracy in data extraction. Heterogeneity was higher in the intensive intervention grouping than in the brief intervention grouping, suggesting that exploring coding these differently in the future may be warranted, as it is possible that grouping studies that lasted just over fifteen minutes with those that lasted several hours contributed to the heterogeneity in the intensive grouping.

Conclusions

Better reporting of participant flow and attrition details, more detailed reporting on delivery personnel training and qualifications, and more focused results reporting will facilitate future studies in narrowing down the conditions which enable effective intervention with parents who smoke. Future studies should consider intervention context as a potential source of heterogeneity, as this study revealed it is a likely source. Further investigation into what the differences between self-reported and biochemically validated quit rates are may shed light on the interesting finding that is further confirmed by this study that self-reported quit rates more frequently achieve statistical significance than biochemically validated quit rates. Further investigation of the source of heterogeneity related to follow-up times and their possible relation

to study intervention intensity may reveal further ways to reduce heterogeneity in future analyses.

References

Abdullah, A. S. M., Mak, Y. W., Loke, A. Y., & Lam, T (2005). Smoking cessation intervention in parents of young children: a randomised controlled trial. *Addiction, 100*(11), 1731-1740. doi:10.1111/j.1360-0443.2005.01231.x

Abdullah, A. S. M., Hua, F., Khan, H., Xia, X., Bing, Q., Tarang, K., Winickoff, J. (2015). Secondhand smoke exposure reduction intervention in Chinese households of young children: A randomized controlled trial. *Academic Pediatrics, 15*(6), 588-598. doi: 10.1016/j.acap.2015.06.008

Agee, M. D., & Crocker, T. D. (2007). Children's health benefits of reducing environmental tobacco smoke exposure: evidence from parents who smoke. *Empirical Economics, 32*(1), 217-237. doi:10.1007/s00181-006-0079-0

Arborelius, E., Hallberg, A., & Hakansson, A. (2000). How to prevent exposure to tobacco smoke among small children: A literature review. *Acta Paediatrica, 89,*(s434), 65-70.

Ashley, M. J., Cohen, J., Ferrence, R., Bull, S., Bondy, S., Poland, B., & Pederson, L. (1998). Smoking in the home: Changing attitudes and current practices. *American Journal of Public Health, 88*(5), 797-800.

Ashley, M. J., & Ferrence, R. (1998). Reducing children's exposure to environmental tobacco smoke in homes: Issues and strategies. *Tobacco Control, 7*(1), 61-65.

Avila-Tang, E., Al-Delaimy, W. K., Ashley, D. L., Benowitz, N., Bernert, J. T., Kim, S., …& Hecht, S. S. (2013a). Assessing secondhand smoke using biological markers. *Tobacco Control, 22*(3), 164-171. doi:10.1136/tobaccocontrol-2011-050298

Avila-Tang, E., Elf, J. L., Cummings, K. M., Fong, G. T., Hovell, M. F., Klein, J. D., … & Samet, J. M. (2013b). Assessing secondhand smoke exposure with reported measures. *Tobacco Control, 22*(3), 156-163. doi:10.1136/tobaccocontrol-2011-050296

Baheiraei, A., Kharaghani, R., Mohsenifar, A., Kazemnejad, A., Alikhani, S., Milani, H. S., Mota, A., et al (2011). Reduction of secondhand smoke exposure among healthy infants in Iran: Randomized controlled trial. *Nicotine & Tobacco Research, 13*(9), 840-847. doi:10.1093/ntr/ntr085

Blaakman, S., Borrelli, B., Wiesenthal, E., Fagnano, M., Tremblay, P., Stevens, T., Halterman, J. (2015). Secondhand smoke exposure reduction after NICU discharge: Results of a randomized trial. *Acta Paediatrica, 15*(6):605-12. doi: 10.1016/j.acap.2015.05.001

Borrelli, B., McQuaid, E. L., Novak, S. P., Hammond, S. K., & Becker, B. (2010). Motivating Latino caregivers of children with asthma to quit smoking: a randomized trial. *Journal of Consulting and Clinical Psychology,78*(1), 34–43. http://doi.org/10.1037/a0016932

Butz, A. M., Matsui, E. C., Breysse, P., Curtin-Brosnan, J., Eggleston, P., Diette, G., ... & Rand, C. (2011). A randomized trial of air cleaners and a health coach to improve indoor air quality for inner-city children with asthma and secondhand smoke exposure. *Archives of pediatrics & adolescent medicine,165*(8), 741-748.

Baxi, R., Sharma, M., Roseby, R., Polnay, A., Priest, N., Waters, E., ... & Webster, P. (2014). Family and carer smoking control programmes for reducing children's exposure to environmental tobacco smoke. *The Cochrane Library*.

Bellg, A. J., Borrelli, B., Resnick, B., Hecht, J., Minicucci, D. S., Ory, M., ... & Czajkowski, S. (2004). Enhancing treatment fidelity in health behavior change studies: Best practices and

recommendations from the NIH Behavior Change Consortium. *Health Psychology*, *23*(5), 443.

Binns, H. J., Forman, J. A., Karr, C. J., Paulson, J. A., Osterhoudt, K. C., Roberts, J. R., ... & Kim, S. (2009). Policy statement-tobacco use: A pediatric disease. *Pediatrics, 124*(5), 1474-1487.

Carlsson, N., Johansson, A., Abrahamsson, A., & Gare, B. A (2013). How to minimize children's environmental tobacco smoke exposure: an intervention in a clinical setting in high risk areas. *BMC Pediatrics, 13*(76), 1-12. doi:10.1186/1471-2431-13-76

Chan, S., & Lam, T. H. (2003). Preventing exposure to second-hand smoke. *Seminars in Oncology Nursing,19*(4), 284–290.

Chan, S. S., Lam, T. H., Salili, F., Leung, G. M., Wong, D. C., Botelho, R. J., ... & Lau, Y. L. (2005). A randomized controlled trial of an individualized motivational intervention on smoking cessation for parents of sick children: a pilot study. *Applied Nursing Research, 18*(3), 178-181.

Chan, S., & Lam, T. H. (2006). Protecting sick children from exposure to passive smoking through mothers' actions: a randomized controlled trial of a nursing intervention. *Journal of advanced nursing, 54*(4), 440-449.

Chilmonczyk, B. A., Palomaki, G. E., Knight, G. J., Williams, J., & Haddow, J. E. (1992). An unsuccessful cotinine-assisted intervention strategy to reduce environmental tobacco smoke exposure during infancy. *American Journal of Diseases of Children, 146*(3), 357-360.

Cochrane Collaboration. (2014). Review Manager (RevMan)[Computer Program] Version 5.2. 3. Copenhagen: The Nordic Cochrane Centre; 2012.

Collins, B., Nair, U., Hovell, M., DiSantis, K., Jaffe, K., Tolley, N., Wileyto, E., Audrain-McGovern, J. (2015). Reducing underserved children's exposure to tobacco smoke a randomized counseling trial with maternal smokers. *American Journal of Preventive Medicine, 49*(4), 534-44. doi: 10.1016/j.amepre.2015.03.008.

Conway, T. L., Woodruff, S. I., Edwards, C. C., Hovell, M. F., & Klein, J. (2004). Intervention to reduce environmental tobacco smoke exposure in Latino children: null effects on hair biomarkers and parent reports. *Tobacco control,13*(1), 90-92.

Crone, M. R., Reijneveld, S. A., Willemsen, M. C., & Sing, R. A. H. (2003). Parental education on passive smoking in infancy does work. *European Journal of Public Health,13*(3), 269–274. doi:10.1093/eurpub/13.3.269

Culp, A. M., Culp, R. E., Anderson, J. W., & Carter, S. (2007). Health and safety intervention with first-time mothers. *Health education research, 22*(2), 285-294.

Curry, S. J., Ludman, E. J., Graham, E., Stout, J., Grothaus, L., & Lozano, P. (2003). Pediatric-based smoking cessation intervention for low-income women: a randomized trial. *Archives of pediatrics & adolescent medicine, 157*(3), 295-302.

Chen, Y., Chung, M., Hsiao, F., Miao, N., & Chen, P. (2012). Exploration of parental smokers experience, perceptions, and family's influence on their smoking in the presence of children. *Advances in Nursing Science, 35*(1), 1-13. doi:10.1097/ans.0b013e3182445525

Cluss, P. A., & Moss, D. (2002). Parent attitudes about pediatricians addressing parental smoking. *Ambulatory Pediatrics, 2*(6), 485-488. doi: 10.1367/1539-4409(2002)0022.0.CO;2

Daly, J. B., Mackenzie, L. J., Freund, M., Wolfenden, L., Roseby, R., & Wiggers, J. H. (2015). Interventions by health care professionals who provide routine child health care to reduce

tobacco smoke exposure in children: A review and meta-analysis. *JAMA Pediatrics, 170*(2),138-147. doi:10.1001/jamapediatrics.2015.3342.

DerSimonian, R., & Laird, N. (1986). Meta-analysis in clinical trials. *Controlled clinical trials*, *7*(3), 177-188.

Downer, J. & Yazejian, N. (2013). Measuring the quality and quantity of implementation in early childhood interventions (OPRE Research Brief OPRE 2013-12). Washington, DC: Office of Planning, *Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services.*

Drehmer, J. E., Ossip, D. J., Rigotti, N. A., Nabi-Burza, E., Woo, H., Wasserman, R. C., …& Winickoff, J. P. (2012). Pediatrician interventions and thirdhand smoke beliefs of parents. *American Journal of Preventive Medicine, 43*(5), 533-536. doi:10.1016/j.amepre.2012.07.020.

Emmons, K. M., Wong, M., Hammond, S. K., Velicer, W. F., Fava, J. L., Monroe, A. D., & Evans, J. L. (2001). Intervention and policy issues related to children's exposure to environmental tobacco smoke. *Preventive Medicine, 32*, 321-331. doi:10.1006/pmed.2000.0822.

Eakin, M. N., Rand, C. S., Borrelli, B., Bilderback, A., Hovell, M., & Riekert, K. A. (2014). Effectiveness of motivational interviewing to reduce head start children's secondhand smoke exposure. a randomized clinical trial. *American Journal of Respiratory and Critical Care Medicine,189*(12), 1530–1537. doi: 10.1164/rccm.201404-0618OC

Ekerbicer, H. C., Celik, M., Guler, E., Davutoglu, M., & Kilinc, M. (2007). Evaluating environmental tobacco smoke exposure in a group of Turkish primary school students and developing intervention methods for prevention. *BMC Public Health, 7*(1), 202.

Eriksen, W., Serrum, K., & Bruusgaard, D. (1996). Effects of information on smoking behaviour in families with preschool children. *Acta Paediatrica, 85*(2), 209-212.

Fossum, B., Arborelius, E., & Bremberg, S (2004). Evaluation of a counseling method for the prevention of child exposure to tobacco smoke: an example of client-centered communication. *Preventive Medicine, 38*(3), 295-301. doi:10.1016/j.ypmed.2003.10.008

Friebely, J., Rigotti, N. A., Chang, Y., Hall, N., Weiley, V., Dempsey, J ,... & Winickoff, J. P. (2013). Parent smoker role conflict and planning to quit smoking: A cross-sectional study. BMC *Public Health, 13*, 164-7. doi:10.1186/1471-2458-13-164

Gehrman, C., & Hovell, M. (2003). Protecting children from environmental tobacco smoke (ETS) exposure: A critical review. *Nicotine & Tobacco Research, 5*(3), 289-301. doi:10.1080/1462220031000094231

Geller, A. C., Brooks, D. R., Woodring, B., Oppenheimer, S., McCabe, M., Rogers, J., ... & Winickoff, J. P. (2011). Smoking cessation counseling for parents during child hospitalization: A national survey of pediatric nurses. *Public Health Nursing, 28*(6), 475-484.

Greenberg, R. A., Strecher, V. J., Bauman, K. E., Boat, B. W., Fowler, M. G., Keyes, L. L., ... & Loda, F. A. (1994). Evaluation of a home-based intervention program to reduce infant passive smoking and lower respiratory illness. *Journal of behavioral medicine, 17*(3), 273-290.

Groner, J. A., Ahijevych, K., Grossman, L. K., & Rich, L. N. (2000). The impact of a brief intervention on maternal smoking behavior. Pediatrics,105(Supplement 2), 267-271.

Gupta, R., & Dwyer, J. J. (2001). Focus groups with smokers to develop a smoke-free home campaign. *American Journal of Health Behavior, 25*(6), 564-571.

Harutyunyan, A., Movsisyan, N., Petrosyan, V., Petrosyan, D., & Stillman, F. (2013). Reducing children's exposure to secondhand smoke at home: a randomized trial. *Pediatrics,132*(6), 1071–1080. http://doi.org/10.1542/peds.2012-2351

Herbert, R. J., Gagnon, A. J., O'Loughlin, J. L., & Rennick, J. E (2011). Testing an Empowerment Intervention to Help Parents Make Homes Smoke-free: A Randomized Controlled Trial. *Journal of Community Health, 36*(4), 650-657. doi:10.1007/s10900-011-9356-8

Higgins, J. P. T., Green S. (2011). Cochrane handbook for systematic reviews of interventions version 5.1. 0. *The Cochrane Collaboration*, *5*(0).

Higgins, J. P., & Thompson, S. G. (2002). Quantifying heterogeneity in a meta-analysis. *Statistics in Medicine*, *21*(11), 1539-1558.

Hovell, M. F., Meltzer, S. B., Zakarian, J. M., Wahlgren, D. R., Emerson, J. A., Hofstetter, C. R., … O'Connor, R. D. (1994). Reduction of environmental tobacco smoke exposure among asthmatic children: a controlled trial. *Chest,106*(2), 440–446.

Hovell, M. F., Zakarian, J. M., Matt, G. E., Hofstetter, C. R., Bernert, J. T., & Pirkle, J (2000). Effect of counselling mothers on their children's exposure to environmental tobacco smoke: Randomised controlled trial. *British Medical Journal, 321*(7257), 337-342.

Hovell, M. F., Meltzer, S. B., Wahlgren, D. R., Matt, G. E., Hofstetter, C. R., Jones, J. A., ... & Pirkle, J. L. (2002). Asthma management and environmental tobacco smoke exposure reduction in Latino children: a controlled trial. *Pediatrics, 110*(5), 946-956.

Hovell, M. F., Zakarian, J. M., Wahlgren, D. R., Matt, G. E., & Emmons, K. M. (2000). Reported measures of environmental tobacco smoke exposure: Trials and tribulations. *Tobacco Control, 9*(suppl 3), iii22-iii28.

Hovell, M. F., Zakarian, J. M., Matt, G. E., Liles, S., Jones, J. A., Hofstetter, C. R., Larson, S. N., et al (2009). Counseling to reduce children's secondhand smoke exposure and help parents quit smoking: A controlled trial. *Nicotine & Tobacco Research, 11*(12), 1383-1394. doi:10.1093/ntr/ntp148

Hughes, J. R., Keely, J. P., Niaura, R. S., Ossip-Klein, D. J., Richmond, R. L., & Swan, G. E. (2003). Measures of abstinence in clinical trials: Issues and recommendations. *Nicotine & Tobacco Research, 5*(1), 13-25. doi:10.1093/ntr/5.1.13

Irvine, L., Crombie, I. K., Clark, R. A., Slane, P. W., Feyerabend, C., Goodman, K. E., & Cater, J. I. (1999). Advising parents of asthmatic children on passive smoking: randomised controlled trial. *British Medical Journal, 318*(7196), 1456-1459.

Jadad, A. R., Moore, R. A., Carroll, D., Jenkinson, C., Reynolds, D. J. M., Gavaghan, D. J., & McQuay, H. J. (1996). Assessing the quality of reports of randomized clinical trials: Is blinding necessary?. *Controlled Clinical Trials, 17*(1), 1-12.

Johnson-Kozlow, M., Hovell, M., Rovniak, L., Sirikulvadhana, L., Wahlgren, D., & Zakarian, J (2008). Fidelity issues in secondhand smoking interventions for children. *Nicotine & Tobacco Research, 10*(12), 1677-1690. doi:10.1080/14622200802443429

Klerman, L. V. (2004). Protecting children: reducing their environmental tobacco smoke exposure. *Nicotine & Tobacco Research, 6*(suppl 2), S239-S252.

Levy, D. E., Winickoff, J. P., & Rigotti, N. A. (2011). School absenteeism among children living with smokers. *Pediatrics, 128*(4), 650-656.

Mahabee-Gittens, E. M., & Gordon, J. (2008). Acceptability of tobacco cessation interventions in the pediatric emergency department. *Pediatric Emergency Care, 24*(4), 214-216. doi: 10.1097/PEC.0b013e31816a8d6f

Mahabee-Gittens, E. M., Huang, B., Slap, G. B., & Gordon, J. (2008). Smoking cessation intervention plus proactive quitline referral in the pediatric emergency department: A pilot study. *Nicotine and Tobacco Research, 10*(12), 1645-1751. doi: 10.1080/14622200802443494

Matt, G. E., Hovell, M. F., Quintana, P. J., Zakarian, J., Liles, S., Meltzer, S. B., & Benowitz, N. L. (2007). The variability of urinary cotinine levels in young children: implications for measuring ETS exposure. *Nicotine & Tobacco Research, 9*(1), 83-92.

Matt, G. E., Quintana, P. J. E., Hovell, M. F., Bernert, J. T., Song, S., Novianti, N., ... & Larson, S. (2004). Households contaminated by environmental tobacco smoke: sources of infant exposures. *Tobacco Control, 13(*1), 29-37.

McIntosh, N. A., Clark, N. M., & Howatt, W. F. (1994). Reducing tobacco smoke in the environment of the child with asthma: a cotinine-assisted, minimal-contact intervention. *The Journal of Asthma : Official Journal of the Association for the Care of Asthma,31*(6), 453–462.

Meltzer, S. B., Hovell, M. F., Meltzer, E. O., Atkins, C. J., & de Peyster, A (1993). Reduction of secondary smoke exposure in asthmatic children: Parent counseling. *Journal of Asthma, 30*(5), 391-400.

Michi, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterizing and designing behaviour change interventions. *Implementation Science, 6*(42), 1-11. doi: 10.1186/1748-5908-6-42.

Miller, M., Gow, D., Tappin, D., & Turner, S. (2007). Smoking habits of parents attending a children's hospital. *Archives of Disease in Childhood, 92*(12), 1118-1119. doi:10.1136/adc.2007.122754

Moss, D., Cluss, P., Mesiano, M., & Kip, K. (2006). Accessing adult smokers in the pediatric setting: What do parents think?. *Nicotine & Tobacco Research, 8*(1), 67-75. doi:10.1080/14622200500431809

Narkowicz, S., Polkowska, Ż., Kiełbratowska, B., & Namieśnik, J. (2013). Environmental tobacco smoke: Exposure, health effects, and analysis. *Critical Reviews in Environmental Science and Technology, 43*(2), 121-161. doi: 10.1080/10643389.2011.604253

Nicholson, J. S., McDermott, M. J., Huang, Q., Zhang, H., & Tyc, V. L. (2014). Full and home smoking ban adoption after a randomized controlled trial targeting secondhand smoke exposure reduction. *Nicotine & Tobacco Research, 17(*5),612-6. doi: 10.1093/ntr/ntu201.

Ortega Cuelva, G., Cabezas Peña, C., Almeda Ortega, J., Saez Zafra, M., Ballvé Moreno, J. L., Pascual Esteban, J. A., … Checa, M. J. (2015). Effectiveness of a brief primary care intervention to reduce passive smoking in babies: a cluster randomised clinical trial. *Journal of Epidemiology & Community Health,69*(3), 249–260 12p. http://doi.org/10.1136/jech-2014-204708

Peck, K. R., Tyc, V. L., Huang, Q., & Zhang, H. (2015). Reduction of Secondhand Smoke Exposure in the Cars of Children With Cancer. *Journal of Pediatric Oncology Nursing, 32*(6), 401-409.

Petticrew, M., Anderson, L., Elder, R., Grimshaw, J., Hopkins, D., Hahn, R., ... & Welch, V. (2013). Complex interventions and their implications for systematic reviews: A pragmatic approach. *Journal of Clinical Epidemiology, 66*(11), 1209-1214.

Prokhorov, A. V., Hudmon, K. S., Marani, S. K., Bondy, M. L., Gatus, L. A., Spitz, M. R., Wilkinson, A. V., et al (2013). Eliminating second-hand smoke from Mexican-American

households: Outcomes from Project Clean Air–Safe Air (CASA). *Addictive Behaviors, 38*(1), 1485-1492. doi:10.1016/j.addbeh.2012.06.023

Ralston, S., & Roohi, M. (2008). A randomized, controlled trial of smoking cessation counseling provided during child hospitalization for respiratory illness. *Pediatric pulmonology, 43*(6), 561-566.

Ralston, S., Grohman, C., Word, D., & Williams, J. (2013). A randomized trial of a brief intervention to promote smoking cessation for parents during child hospitalization. *Pediatric pulmonology, 48*(6), 608-613.

Rigotti, N. A., Munafo, M. R., & Stead, L. F. (2008). Smoking cessation interventions for hospitalized smokers: a systematic review. *Archives of internal medicine, 168*(18), 1950-1960.

Rosen, L. J., Myers, V., Hovell, M., Zucker, D., & Noach, M. B. (2014). Meta-analysis of parental protection of children from tobacco smoke exposure. *Pediatrics 133*(4), 698-714. doi:10.1542/peds.2013-0958.

Rosen, L. J., Myers, V., Winickoff, J. P., & Kott, J. (2015). Effectiveness of interventions to reduce tobacco smoke pollution in homes: A systematic review and meta-Analysis. *International journal of environmental research and public health, 12*(12), 16043-16059.

Rosen, L. J., Noach, M. B., Winickoff, J. P., & Hovell, M. F. (2011). Parental smoking cessation to protect young children: A systematic review and meta-analysis. *Pediatrics, 129*(1), 141-152. doi:10.1542/peds.2010-3209.

Ryan, R., Hill, S., Prictor, M., & McKenzie, J. (2012). Cochrane Consumers and Communication Review Group: Study Quality Guide. 2011.

Seifert, J. A., Ross, C. A., & Norris, J. M. (2002). Validation of a five-question survey to assess a child's exposure to environmental tobacco smoke. *Annals of Epidemiology, 12*(4), 273-277.

Schuck, K., Kleinjan, M., Otten, R., Engels, R. C., & DiFranza, J. R. (2013). Responses to environmental smoking in never-smoking children: Can symptoms of nicotine addiction develop in response to environmental tobacco smoke exposure. Journal of *Psychopharmacology, 27*(6), 533-540. doi:10.1177/0269881112466184

Schuck, K., Bricker, J. B., Otten, R., Kleinjan, M., Brandon, T. H., & Engels, R. C. M. E. (2014). Effectiveness of proactive quitline counselling for smoking parents recruited through primary schools: results of a randomized controlled trial. *Addiction, 109*(5), 830–841. http://doi.org/10.1111/add.12485

Stepans, M. B. F., Wilhelm, S. L., & Dolence, K. (2006). Smoking hygiene: reducing infant exposure to tobacco. *Biological Research for Nursing,8*(2), 104–114. http://doi.org/10.1177/1099800406290643

Streja, L., Crespi, C. M., Bastani, R., Wong, G. C., Jones, C. A., Bernert, J. T., … Berman, B. A. (2014). Can a minimal intervention reduce secondhand smoke exposure among children with asthma from low income minority families? Results of a randomized trial. *Journal of Immigrant and Minority Health / Center for Minority Public Health,16*(2), 256–264. http://doi.org/10.1007/s10903-012-9713-4

Stotts, A. L., Green, C., Northrup, T. F., Dodrill, C. L., Evans, P., Tyson, J., ... & Hovell, M. F. (2013). Feasibility and efficacy of an intervention to reduce secondhand smoke exposure among infants discharged from a neonatal intensive care unit. *Journal of Perinatology, 33*(10), 811-816.

Stuber, J., & Galea, S. (2009). Who conceals their smoking status from their health care provider. *Nicotine & Tobacco Research, 11*(3), 303-307. doi:10.1093/ntr/ntn024

Tanski, S. E., & Wilson, K. M. (2011). Children and secondhand smoke: Clear evidence for action. *Pediatrics, 129*(1), 170-171. doi:10.1542/peds.2011-3190

Thompson, S. G., & Sharp, S. J. (1999). Explaining heterogeneity in meta-analysis: a comparison of methods. *Statistics in Medicine, 18*(20), 2693-2708.

Tyc, V. L., Huang, Q., Nicholson, J., Schultz, B., Hovell, M. F., Lensing, S., ... & Zhang, H. (2013). Intervention to reduce secondhand smoke exposure among children with cancer: a controlled trial. *Psycho-Oncology, 22*(5), 1104-1111.

Ulbricht, S., Groß, S., Meyer, C., Hannöver, W., Nauck, M., & John, U. (2014). Reducing tobacco smoke exposure in children aged below 4years—A randomized controlled trial. *Preventive medicine,69*, 208-213.

US Department of Health and Human Services. (2006). The health consequences of involuntary exposure to tobacco smoke: a report of the Surgeon General. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 709.

Vineis, P., Ronco, G., Ciccone, G., Vernero, E., Troia, B., D'Incalci, T., & Gogliani, F. (1993). Prevention of exposure of young children to parental tobacco smoke: effectiveness of an educational program. *Tumori, 79*(3), 183-186.

Wahlgren, D. R., Hovell, M. F., Meltzer, S. B., Hofstetter, C. R., & Zakarian, J. M. (1997). Reduction of environmental tobacco smoke exposure in asthmatic children: a 2-year follow-up. *CHEST Journal, 111*(1), 81-88.

Wakefield, M., Banham, D., McCaul, K., Martin, J., Ruffin, R., Badcock, N., & Roberts, L. (2002). Effect of feedback regarding urinary cotinine and brief tailored advice on home smoking restrictions among low-income parents of children with asthma: a controlled trial. *Preventive medicine, 34*(1), 58-65.

Walker, N., Johnston, V., Glover, M., Bullen, C., Trenholme, A., Chang, A., … Thomas, D. (2015). Effect of a family-centered, secondhand smoke intervention to reduce respiratory illness in indigenous infants in Australia and New Zealand: a randomized controlled trial. *Nicotine & Tobacco Research ,17*(1), 48–57. http://doi.org/10.1093/ntr/ntu128

Wall, M. A., Severson, H. H., Andrews, J. A., Lichtenstein, E., & Zoref, L. (1995). Pediatric office-based smoking intervention: impact on maternal smoking and relapse. *Pediatrics, 96*(4), 622-628.

Wang, Y., Huang, Z., Yang, M., Wang, F., & Xiao, S. (2015). Reducing environmental tobacco smoke exposure of preschool children: a randomized controlled trial of class-based health education and smoking cessation counseling for caregivers.*International journal of environmental research and public health, 12*(1), 692-709.

Wiggins, M., Oakley, A., Roberts, I., Turner, H., Rajan, L., Austerberry, H., ... & Barker, M. (2005). Postnatal support for mothers living in disadvantaged inner city areas: a randomised controlled trial. *Journal of epidemiology and community health, 59*(4), 288-295.

Wilson, S. R., Yamada, E. G., Sudhakar, R., Roberto, L., Mannino, D., Meija, C., & Huss, N (2001). A controlled trial of an environmental tobacco smoke reduction ntervention in low-income children with asthma. *Chest, 120*(5), 1709-1722.

Wilson, S. R., Farber, H. J., Knowles, S. B., & Lavori, P. W. (2011). A randomized trial of parental behavioral counseling and cotinine feedback for lowering environmental tobacco smoke exposure in children with asthma: Results of the LET'S manage asthma trial. *CHEST Journal, 139*(3), 581-590.

Winickoff, J. P., Berkowitz, A. B., Brooks, K., Tanski, S. E., Geller, A., Thomson, C., … & Best, D. (2005). State-of-the-art interventions for office-based parental tobacco control. Pediatrics, 115(3), 750-760. doi:10.1542/peds.2004-1055

Winickoff, J. P., Buckley, V. J., Palfrey, J. S., Perrin, J. M., & Rigotti, N. A (2003a). Intervention with parental smokers in an outpatient pediatric clinic using counseling and nicotine replacement. *Pediatrics, 112*(5), 1127-1133.

Winickoff, J. P., Friebely, J., Tanski, S. E., Sherrod, C., Matt, G. E., Hovell, M. F., & McMillen, R. C. (2009). Beliefs about the health effects of "thirdhand" smoke and home smoking bans. *Pediatrics, 123*(1), e74-e79.

Winickoff, J. P., Hillis, V. J., Palfrey, J. S., Perrin, J. M., & Rigotti, N. A (2003b). A Smoking Cessation Intervention for Parents of Children Who Are Hospitalized for Respiratory Illness: The Stop Tobacco Outreach Program. *Pediatrics, 111*(1), 140-145.

Winickoff, J. P., Van Cleave, J., & Oreskovic, N. M. (2010). Tobacco smoke exposure and chronic conditions of childhood. Pediatrics, 126 (1), e251-e252.

World Health Organization. (2007). Protection from exposure to second-hand tobacco smoke: Policy recommendations. Tobacco Control.

Yılmaz, G., Karacan, C., Yöney, A., & Yılmaz, T. (2006). Brief intervention on maternal smoking: a randomized controlled trial. *Child care, health and development, 32*(1), 73-79.

Yücel, U., Öcek, Z. A., & Çiçeklioğlu, M. (2014). Evaluation of an intensive intervention programme to protect children aged 1–5 years from environmental tobacco smoke exposure at home in Turkey. *Health education research, 29*(3):442-55. doi: 10.1093/her/cyu005.

Zakarian, J., Hovell, M., Sandweiss, R., Hofstetter, C. R., Matt, G., Bernert, J. T., Pirkle, J., et al (2004). Behavioral counseling for reducing children's ETS exposure: Implementation in community clinics. *Nicotine & Tobacco Research, 6*(6), 1061-1074. doi:10.1080/1462220412331324820

Zhang, X., Martinez-Donate, A. P., Kuo, D., & Jones, N. R. (2012). "How is smoking handled in your home?": Agreement between parental reports on home smoking bans in the United States, 1995-2007. *Nicotine & Tobacco Research, 14*(10), 1170-1179. doi:10.1093/ntr/nts005

Zhang, D., & Qiu, X. (1993). School-based tobacco-use prevention - People's Republic of China, May 1989-January 1990. *Journal of the American Medical Association, 269*(23), 2972-2972.

Appendix

Study descriptions

Studies included in meta-analysis

Abdullah 2005

- China, RCT
- 952 parents who were current or recent quitters who smoked last 6 months (84% fathers); 87.9% retention at final follow-up. Follow-up periods were 1, 3, and 6 months.
- Community nurses delivered 20-30 minutes of telephone counseling and stage-based self-help materials. Control group received the same materials, but no counseling. Counseling was based on the stages of change theory (Prochaska's Transtheoretical Model), and 5R approach.
- No NRT was provided.
- Cessation was the primary outcome, measured by self-reported 7 day and 24hr prevalence quit rate. Other outcomes were self reported continuous abstinence rate, CO & cotinine, reported total or partial smoking ban at home
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 1

Abdullah 2015

- China, RCT
- 318 parents or caregivers who smoked who had a child aged 5 years or younger at home, and were current smokers within the last month; 56.6% retention at final follow up. Follow up periods were 2 and 6 months.
- Chinese community health centres used for recruitment; community nurses delivered an intervention based on smoking hygiene and motivation theory by Rogers
- No NRT was provided.
- Reducing ETS was the primary outcome, measured by self reported environmental bans and number of cigarettes per week smoked in the home
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 1

Baheiraei 2011

- Iran, RCT
- 130 children under 1 year of age, from a low income family unit which includes a smoker; 93% retention at final follow-up. Follow up period was 3 months.
- Health care centres and phone was for recruitment and delivery; researchers delivered 3 counseling sessions, motivational interviewing, pamphlets and smoke free home stickers, with the aim of increasing self-efficacy, and resolving barriers and ambivalence; usual care control group.
- No NRT was provided.
- Reducing ETS was the primary outcome, measured by implementation of home and car smoking bans, child cotinine, and reported cigarette consumption in the presence of the child.
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Blaakman 2015

- USA, RCT
- 165 caregivers and their infants equal to or under 32 weeks gestational age enrolled after discharge from a NICU unit in Rochester, New York (included nonsmoking parents); 87.2% retention rate at final follow-up. Final follow up was 5 months after NICU discharge.
- Hospital nurses delivered motivational interviewing intervention.
- No NRT was provided.
- Improving respiratory outcomes was the primary outcome. Other outcomes were home smoking bans, reduced infant contact with smokers, salivary cotinine.
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 1

Butz 2011

- USA, RCT
- 126 inner city (Baltimore) families with a child aged 6-12 with asthma residing with a smoker who smoked more than 5 cigarettes a day and resided in the home at least 4 days a week; 91% retention at final follow-up. Follow-up period was 6 months.
- Hospital based recruitment and delivery as well as home delivery.
- Community nurses delivered 4 30-45 minute behavioural interventions focused on asthma education as well as providing air cleaners.
- No NRT provided.
- Reduced ETS was the primary outcome, measured by child urinary cotinine, asthma symptom free days, acute asthma health care events, air quality changes, caregiver smoking frequency and location.
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 1

Chan 2005

- China, RCT
- 80 parents of sick children whose family unit included a smoker who had smoked in the past week, presenting to a clinic or admitted to children's hospital or pediatric ward in Hong Kong; 96% retention at final follow-up. Follow-up period was 1 month.
- Hospital nurses delivered an individualized, stage-matched motivational interview for 30min; the control group received healthy diet counseling for sick children.
- No NRT was provided.
- Cessation was the primary outcome measured by parental report of past 30 day cigarette consumption.
- Jadad randomization score: 2
- Jadad blinding score: 1
- Jadad account of participants score: 1

Collins 2015

- USA, RCT
- 300 randomized maternal smokers with a child under 4 years old exposed to 2 or more maternal cigarettes a day home, in North and West Philadelphia low income neighborhoods; 72.8% retention at final follow-up. Follow-up period was listed as end of treatment, approximately 16 weeks.
- Researchers delivered "evidence based strategies" including problem solving and goal monitoring.
- No NRT was provided.
- Reducing ETS was the primary outcome, measured by child cotinine, reported tobacco smoke exposure vie maternal cigarettes per day, 7 day point prevalence, self reported cigarettes smoked per day and bioverified quit status.
- Jadad randomization score: 2
- Jadad blinding score: 1
- Jadad account of participants score: 1

Eakin 2014

- USA, RCT
- 350 children aged 6 months to 6 years enrolled in Baltimore City Head Start whose caregivers reported a smoker living in the home; 75.5% retention at final follow-up. Follow-up periods were 3, 6, and 12 months.
- Researchers delivered a motivational interviewing and education intervention to the intervention group or an education alone intervention to the control group.
- No NRT was provided.
- Reducing ETS was the primary outcome, measured by household air nicotine levels measured by passive dosimeters, child salivary cotinine, reported home smoking ban, self-reported smoking status
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Ekerbicer 2007

- Turkey, RCT
- 347 parents of children exposed to ETS aged 9-11 attending a private primary school; 100% retention at final follow-up. Follow-up period was 9 months.
- Parents were interviewed by a smoking addiction professional; control group parents were given child's cotinine feedback.
- No NRT was provided.
- Reducing ETS was the primary outcome, measured by child cotinine.
- Jadad randomization score: 1
- Jadad blinding score: 0
- Jadad account of participants score: 0

Eriksen 1996

- Norway, RCT Family unit includes a smoker
- 363 healthy children at 6 weeks, 2 or 4 years of age; (88% female) whose family unit included a smoker who had smoked in the past week; 81.9% retention at final follow-up. Follow-up period was 1 month.
- Researchers delivered a 5 minute contact at well-baby visits, 3 brochures on ETS health effects, what parents can do to reduce, cessation course referrals, and a self-help manual for cessation.
- No NRT provided.
- Cessation and reducing ETS were both primary outcomes, measured by self-reported cigarettes per day, home smoking rules including when and where people smoke, airing rooms & other strategies.
- Jadad randomization score: 1
- Jadad blinding score: 0
- Jadad account of participants score: 1

Groner 2000

- USA, RCT
- 479 mothers who smoked and were accompanying a child under 12 to the hospital; 48% retention at final follow-up. Follow-up period was 6 months.
- Community nurses delivered 2 10-15min sessions at 2 weeks and 4 months, based on the Health Belief Model and behaviour modification, including stimulus control, goals, rewards
- No NRT was provided.
- Cessation was the primary outcome, measured by cigarettes per day, quit rate, location of smoking, and ETS knowledge.
- Jadad randomization score: 1
- Jadad blinding score: 1
- Jadad account of participants score: 1

Hovell 1994

- USA, RCT
- 79 asthmatic children aged 6-17 years whose family unit includes a smoker; 86.8% retention at final follow-up. Follow up periods were 9 and 12 months.
- Researchers delivered 6 30min counseling sessions using behaviour modification (self-monitoring, shaping, stimulus control, contingency); monitoring control group monitored only, usual treatment control group completed final assessments only.
- No NRT was provided.
- Reducing ETS was the primary outcome, measured by number of cigarettes per day exposed, air filter monitor readings and child report.
- Jadad randomization score: 1
- Jadad blinding score: 1
- Jadad account of participants score: 1

Hovell 2002

- USA, RCT
- 204 Latino families with asthmatic children 3-17 years old who lived with at least 1 smoker or were exposed to 6 cigarettes in the last week; 94.6% retention at final follow-up. Follow up periods were 4, 7, 10, and 13 months.
- Researchers delivered 7 30-45min asthma management education sessions at participants' homes, including ETS reduction advice
- No NRT was provided.
- Reducing ETS and cessation were primary outcomes, measured by parent report of ETS exposure, child cotinine, air nicotine levels, parental cotinine.
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 1

Hovell 2009

- USA, CT
- 150 mothers of children aged 4 or under who were exposed to 10 or more cigarettes per week; 87% retention at final follow-up. Follow-up times were 6, 12, and 18 months
- Researchers delivered10 in person at home and 4 telephone counseling session over 6 months biweekly, including pre-and post-quit telephone sessions, behavioural contracting, self-monitoring and problem solving. A usual care control group was used.
- No NRT was provided.
- Reducing ETS and cessation were primary outcomes measured by air nicotine, child cotinine, reported quit rate and attempts, reported SHSe, mothers' smoking and indoor smoking.
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 1

Irvine 1999

- UK, RCT
- 501 parents of asthmatic children aged 2-12 whose family unit includes a smoker; 86.8% retention rate at final follow-up. Follow up period was 12 months.
- Community nurses delivered 2 "brief" sessions and 3 self-help pamphlets as well as a referral for cessation assistance. Control participants received leaflets on smoking with no ETS info or quit advice
- No NRT was provided.
- Reducing ETS and cessation were primary outcomes, measured by reported ETS exposure, smoking habits, and cotinine.
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 1

Mahabee-Gittens 2009

- USA, RCT
- 359 parents who smoked within the last week who attended an emergency department with their child as a patient at Cincinnati Children's Hospital; 52% retention at final follow-up. Follow-up periods were 6 weeks and 3 months.
- Researchers delivered a brief intervention based on the first two A's of the Five A's approach.
- No NRT was provided.
- Cessation was the primary outcome, measured by self-reported point prevalence, quit attempts, and readiness to quit.
- Jadad randomization score: 2
- Jadad blinding score: 1
- Jadad account of participants score: 1

Nicholson 2015

- USA, RCT
- 120 families with at least 1 smoker who reported SHSe for their children who attended a large pediatric oncology hospital; 88% retention at final follow-up. Follow up periods were 6, 9, and 12 months.
- Researchers delivered 3 1 hour long counseling sessions and 3 25 minute long counseling sessions.
- No NRT was provided.
- Reducing ETS was the primary outcome measured by implementation of home bans, household and car smoking behaviour, health care utilization.
- Jadad randomization score: 1
- Jadad blinding score: 0
- Jadad account of participants score: 0

Ortega 2015
- Spain, Randomized field trial
- 1123 parents of infants under 18 months of age in a primary care setting in Catalonia who were smokers; 82.9% retention at final follow-up. Follow up period was 6 months.
- General practitioners delivered a brief intervention based on cognitive theory and motivational interviewing using the 5 A's approach.
- No NRT was provided.
- Reducing ETS was the primary outcome, measured by ETS exposure questionnaire and hair nicotine of infants
- Jadad randomization score: 1
- Jadad blinding score: 0
- Jadad account of participants score: 1

Prokhorov 2013
- USA, RT
- 91 Mexican-American households with a child under 18 and at least one smoker; 78% retention at final follow-up. Follow-up periods were 6 and 12 months.
- Community researchers delivered a culturally specific comic for children and fotonovella for parents
- No NRT was provided.
- Reducing ETS was the primary outcome, measured by informant and self-reported exposure, air nicotine monitor readings, and smoke/ETS harm attitudes
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Ralston 2008
- USA, RCT
- 42 caregivers of children hospitalized for respiratory illness at the University of New Mexico Hospital who were smokers; 67.4% retention at final follow-up. Follow-up periods were 3 and 6 months.
- General practitioners delivered a brief message and quit line referral to the control group or an extensive message and quit line referral to the intervention group.
- NRT was provided to those who asked for it.
- Cessation was the primary outcome, measured by self-reported quit date set, quit attempts, abstinence.
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Ralston 2013

- USA, RCT
- 41 tobacco smoking caregivers with a hospitalized child; 68% retention at final follow-up. Follow-up period was 2 months.
- Researchers delivered a brief recommendation of cessation, state quitline referral, and cessation brochure from the American Cancer Society while using the stages of change theory to tailor approach. Both groups received age-appropriate injury prevention brochures.
- No NRT was provided.
- Cessation was the primary outcome, measured by self-reported quit status , cigarettes smoked per day, perceived importance of quitting, and quitline contact.
- Jadad randomization score: 2
- Jadad blinding score: 1
- Jadad account of participants score: 1

Schuck 2014

- Netherlands, RCT
- 512 parents who smoked were recruited through their children's primary school; 85.5% retention at final follow-up. Follow up period was 12 months.
- Researchers delivered behaviour change techniques and self-help brochures.
- Provided NRT.
- Cessation and home ban implementation were primary outcomes measured by self-reported 7 day point prevalence, use of NRT, implementation of home smoking ban.
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Stepans 2006

- USA, RT
- 27 breastfeeding infant-mother dyads recruited out of postpartum units in New Mexico and Ohio hospitals; 77% retention at final follow-up. Follow-up periods were when the infant was 2, 3, and 5 weeks old.
- Researchers delivered a smoking hygiene intervention.
- No NRT was provided.
- Reducing ETS was the primary outcome measured by improved smoking hygiene, smoking habits questionnaire, smoking hygiene questionnaire, cotinine in breast milk and infant urine
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Streja 2014

- USA, RCT
- 242 adult/child dyads that included a child 2-14years old with asthma from low income minority households in Los Angeles, California and in which there had been smoking at home in the past month; 73.8% retention at final follow-up. Follow-up points were 6 and 12 months.
- Researchers delivered intervention developed according to Health Behaviour Framework and procedures were conducted by trained bicultural/bilingual Spanish/English staff members.
- No NRT was provided.
- Reducing ETS was the primary outcome measured by child cotinine and household nicotine levels
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 1

Tyc 2013

- USA, RCT
- 135 parents of children receiving cancer treatment that lived with at least one adult smoker and were exposed to SHS in home or car; 93% retention at final follow-up. Follow up periods were 3, 6, 9, and 12 months.
- Researchers delivered 3 individual, in person, bi-weekly counseling sessions and 3 telephone sessions that included health risk education and stress management strategies
- No NRT was provided.
- Reducing ETS was the primary outcome measured by parent reported SHS exposure and smoking behaviours and child urinary cotinine.
- Jadad randomization score: 1
- Jadad blinding score: 0
- Jadad account of participants score: 0

Ulbricht 2014

- Germany, RCT
- 917 households with a child aged 4 or younger with at least one parent who was a daily smoker who lived with them; 93% retention at final follow-up. Follow-up period was 12 months.
- Researchers used motivational interviewing principles for the intervention.
- No NRT was provided.
- Reducing ETS was the primary outcome measured by child cotinine.
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Vineis 1993
- Italy, CT
- 1015 families who attended well-baby visits and whose family unit included a smoker; 73.6% retention at final follow-up. Follow-up periods were 2 and 4 years.
- Community nurses delivered brief counseling at visits as well as ETS reduction booklets.
- No NRT was provided.
- Cessation was the primary outcome measured by self-reported quit rate.
- Jadad randomization score: 0
- Jadad blinding score: 0
- Jadad account of participants score: 1

Wahlgren 1997
- USA, RCT
- 91 asthmatic children attending pediatric allergy medical clinics; 79.7% retention at final follow-up. Follow-up period was 2 years.
- Researchers delivered 6 30min counseling sessions using behaviour modification techniques such as self-monitoring, shaping, stimulus control, contingency.
- No NRT was provided
- Reducing ETS was the primary outcome measured by cotinine, reported cigarettes exposed, and air monitor results.
- Jadad randomization score: 2
- Jadad blinding score: 1
- Jadad account of participants score: 1

Wakefield 2002
- Australia, CT
- 292 Low-income asthmatic children aged 1-11 whose family unit included a smoker; 90.4% retention at final follow-up.
- Researchers delivered a letter with cotinine feedback, asthma and ETS reduction booklets, phone calls, and encouraged home smoking bans.
- No NRT provided.
- Reducing ETS was the primary outcome measured by indoor smoking bans, mean cigarette consumption, and cotinine.
- Jadad randomization score: 0
- Jadad blinding score: 0
- Jadad account of participants score: 1

Walker 2015

- Australia, RCT
- 293 mother/infant dyads in which the mother either currently smoked or smoked during pregnancy, the infant was 0-5 weeks, and the mother was self-identified as Maori or Australian Aboriginal/Torres Strait Islander; 98.6% retention rate at final follow-up. Follow up period was when the child was 4 and 12 months of age.
- Community nurses delivered motivational interviewing intervention.
- NRT was provided.
- Primary outcome of interest was to reduce respiratory complaints which was measured by reports of healthcare usage for respiratory complaints, reports of SHS exposure, environmental smoking bans, mothers current status as a smoker (7 day point prevalence)
- Jadad randomization score: 1
- Jadad blinding score: 1
- Jadad account of participants score: 1

Wall 1995

- USA, CT
- 2901 children aged 2 weeks, 2, 4, and 6mos who attended a pediatric office in Oregon with their mother who smoked within a month of pregnancy and the family unit currently included a smoker; 80.5% retention rate at final follow-up;
- General practitioners delivered 2min advice at 2week, 2, 4, and 6 month well-baby visits as well as written advice
- No NRT was provided.
- Cessation was the primary outcome, measured by self-reported quit and relapse rates, stage of change, knowledge of ETS, and home smoking rules.
- Jadad randomization score: 1
- Jadad blinding score: 0
- Jadad account of participants score: 1

Wang 2015

- China, RCT
- 65 children aged 5-6 and their caregivers who were smokers were recruited through child's preschool in Changsha, China; 100% retention rate at final follow-up. Follow-up period was 6 months.
- Researchers used motivational interviewing and protective motivation theory, trans-theoretical model of behavior change, and provided materials that were stage matched.
- No NRT was provided.
- Cessation and reducing ETS were primary outcomes, measured by self-reported 7-day and 24-hr point prevalence
- Jadad randomization score: 2
- Jadad blinding score: 1
- Jadad account of participants score: 1

Wiggins 2005

- UK, RCT
- 731 mothers who lived in deprived London districts; 82.3% retention rate at final follow-up. Follow-up periods were 12 and 18 months.
- Health Visitors conducted monthly supportive listening visits to mother's home, beginning at baby's age 10 weeks.
- No NRT was provided.
- ETS reduction and cessation were outcomes included in the study, but so were childhood injury, maternal depression, maternal smoking, uptake and cost of health services, household resources, maternal and child health, mother reported experiences
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Wilson 2001

- USA, RCT
- 87 low socio-economic status, minority asthmatic children aged 3-12 years who accessed pediatric pulmonary services; 69% retention at final follow-up. Follow-up periods were 6 and 12 months.
- No NRT was provided
- Reducing ETS was the primary outcome, measured by asthma related medical visits, asthma hospitalization, cotinine, and reported indoor smoking
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Wilson 2011

- USA, RCT
- Caregivers of 519 children aged 3-12yrs with asthma and smoke exposure who attended a Kaiser Permanente Northern California facility; 95% retention at final follow-up. Follow up periods were 6 and 12 months.
- Researchers delivered 1 asthma education session to both intervention and control groups, as well as weekly cotinine feedback and stage of change based counseling in 3 weekly in person sessions over 6 weeks to the intervention group.
- No NRT was provided.
- Reducing ETS and health care usage were primary outcomes measured by cotinine/creatinine ratio, use of health care services, home smoking, smoking status of people in the home.
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 1

Winickoff 2010

- USA, RCT
- 101 current smokers and recent quitters who just had a baby at a hospital birth centre in Massachusetts; 72% retention at final follow-up. Follow up time period was 3 months after hospital discharge.
- Researchers utilized 5A's strategy, based on social learning theory, transtheoretical stages of change, and the health belief model based intervention.
- No NRT as provided.
- Cessation was the primary outcome, measured by self-reported and biochemically verified 7 day point prevalence.
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Yilmaz 2006

- Turkey, RCT
- 375 mothers who were current smokers with children attending a well-child clinic; 98.6% retention at final follow-up. Follow-up period was 6 months.
- Hospital nurse delivered a cessation intervention aimed at child health or a cessation intervention aimed at mothers health or a no advice control condition.
- No NRT was provided.
- ETS reduction and cessation were primary goals, measured by self-reported maternal smoking status, smoking location change, post-intervention knowledge change
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 0

Yucel 2014

- Turkey, RCT
- 80 mothers of children aged 1-5 who lived in the Cengizhan district of Izmir in Turkey, who smoked and/or their spouse smoked.; 97.5% retention at final follow-up. Follow-up time points was 6 weeks.
- Researchers provided materials on harms of SHS and tips for quitting and reducing exposure to mothers and asked them to share them with their partners who smoked.
- No NRT was provided.
- Reducing ETS was the primary outcome, measured bychange in cotinine, implementation of home bans, number of cigarettes smoked by caregiver, and number of cigarettes smoke in the home.
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 1

Zakarian 2004
- USA, RCT
- 150 mothers who smoked with children aged 4 or under; 85.3% retention at final follow-up. Follow up times were 3, 6, and 12 months.
- Researchers delivered 7 behavioural counselling sessions: 3 in person and 4 over the telephone, over 6 months which included reshaping and self-monitoring based on social learning theory and the behavioural ecological model. A Quit Kit provided if requested.
- No NRT was provided.
- ETS exposure reduction and cessation were primary outcomes, measured by mother report of smoking status and child ETS exposure, child cotinine, and air nicotine monitor reading.
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 1

Zhang 1993
- China, CT
- 20382 children in 44 Chinese primary schools; 100% retention at final follow-up. Follow up time was 8 months.
- Tobacco prevention curriculum was delivered to students which included child written letters to their smoking fathers and stage based cessation materials
- No NRT was provided.
- Cessation was the primary outcome, measured by self-reported smoking cessation by fathers at interview with health educator and their children's diary entries.
- Jadad randomization score: 0
- Jadad blinding score: 0
- Jadad account of participants score: 0

Studies included in the narrative review only

Borelli 2010
- USA, RCT
- 133 Latino caregivers who smoked and had a child with asthma; 65.7% retention at final follow-up. Follow-up time point was 3 months.
- Researchers delivered one of two interventions; either the BAM modeled on clinical guidelines, including increasing self-efficacy, problem solving and coping skills; or the PAM which gave feedback on CO levels and SHSe, using motivational interviewing techniques.
- NRT was available for free to those interested.
- Reducing ETS was the primary outcome, measured by passive nicotine monitor reading, asthma morbidity and functioning g level, caregiver self-reported cessation and expired CO
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 1

Carlsson 2013

- Sweden, Process evaluation
- 72 families with small children (5 or under) with at least one smoking parent who attended a community health care centre; 58% retention at final follow-up. Follow-up period was 12 months.
- Hospital nurses delivered a motivational interviewing based intervention.
- No NRT was provided.
- Cessation and reducing ETS were main outcomes measured by home bans, self-reported quit rate, ban implementation, and child cotinine.
- Jadad randomization score: 0
- Jadad blinding score: 0
- Jadad account of participants score: 0

Chan 2003

- China, RCT
- 1273 nonsmoking mothers who attended hospital with a sick child and had a smoking partner who they and the child reside with; 85.5% retention rate at final follow-up. Follow up period was 12 months.
- Hospital nurses delivered standardized health advice, 2 purpose designed booklets and a sticker, a telephone reminder
- No NRT was provided.
- Reducing ETS and cessation were primary outcomes, measured by reported time the child is exposed, the reported number of smokers in the home, and negative health symptoms.experienced by the child.
- Jadad randomization score: 1
- Jadad blinding score: 0
- Jadad account of participants score: 1

Chan 2006

- China, RCT
- 1483 mothers of children admitted to the outpatient department from participating hospital peadatric ward/ outpatient clinics in Hong Kong in 1997 & 1998; 86% retention at final follow-up. Follow up points were 3, 6, and 12 months.
- Hospital nurses delivered intervention on preventing exposure with advice and materials, provided home no smoking signs
- No NRT was provided
- ETS reduction was the primary outcome, measured by mother self-reported actions taken to reduce the child's passive smoke exposure
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Chilmonczyk 1992

- USA, RCT
- 103 mothers who were current smokers and attended a well-baby visit; 52.6% retention at final follow-up. Follow-up time was at 2 months.
- General practitioners delivered intervention recommending ETS reduction and tips to achieve it, a follow up telephone call, and a letter with cotinine feedback.
- No NRT was provided.
- Reducing ETS was the primary outcome, measured by infant cotinine, controlled for breastfeeding and mother report
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Conway 2004

- USA, RCT
- 143 Latino parents of children aged 1-9 who reported smoking at least 6 cigarettes a week; 81% retention at final follow-up. Follow-up time points were 3 and 12 months.
- Community nurses delivered 6 home and telephone sessions which focused on problem solving to lower child's ETS exposure as well as contracting, shaping, positive reinforcement, & social support, based on operant and social learning theory
- No NRT was provided
- Reducing ETS was the main outcome, measured by cotinine and parental report of past month exposure from all sources
- Jadad randomization score: 1
- Jadad blinding score: 0
- Jadad account of participants score: 1

Crone 2003

- Netherlands, Pre-post
- 40 parents with a baby aged 1 to 10 months who visited the well-baby clinic and had reported ETS exposure.
- Hospital nurses delivered an educational program implemented at same time as a nationwide program using radio, television, and other promotional materials
- No NRT was provided
- Reducing ETS was the primary outcome, measured by parent reported smoking in the presence of their infant.
- Jadad randomization score: 0
- Jadad blinding score: 0
- Jadad account of participants score: 1

Culp 2007

- USA, Quasi-experimental
- 263 pregnant, first time mothers in rural US counties who reported smoking within 2 years of their prenatal interview; 74% retention at final follow-up. Follow up points were when the child was 6 and 12 months old.
- Researchers conducted home visits with 3 goals: maternal and child health and safety, and family functioning, including smoking education.
- No NRT was provided.
- Outcomes included a range of things covering maternal and child health and safety, including mother's smoking measured by self reported number of cigarettes per day and family healthcare usage.
- Jadad randomization score: 0
- Jadad blinding score: 0
- Jadad account of participants score: 0

Curry 2003

- Portugal, RCT
- 303 self-identified women smokers whose children received care at participating clinics; 80% retention at final follow-up. Follow-up time was 12 months.
- Community nurses delivered motivational messages, a quit smoking guide, a 10 minute interview and 3 outreach phone calls over 3 months.
- No NRT was provided.
- Cessation was the primary outcome, measured by maternal CO and self-reported 7-day abstinence
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Fossum 2004

- Sweden, CT
- 41 mothers of newborn infants attending child health centres in Sweden for a well-baby visit; 85% retention at final follow-up. Follow up time point was 3 months.
- Community nurses provided "smoke free children counseling" based on motivation, self-help and self-efficacy, behavioral counseling, and social learning theory.
- No NRT was provided.
- Reducing ETS, and cessation were primary outcomes, measured by maternal cotinine and self-reported smoking habits
- Jadad randomization score: 0
- Jadad blinding score: 1
- Jadad account of participants score: 1

Greenberg 1994

- USA, RCT
- 583 infants recruited at 18days old, new mothers who were a smoker or a non-smoker (141 who smoked); 96% retention at final follow-up. Follow-up periods were 7 and 12 months.
- Researchers delivered 4 45min home counseling sessions over first 6 months based on social learning theory
- No NRT was provided
- Reducing ETS was the primary outcome, measured by number of cigarettes smoked in same room as child, child's lower respiratory symptoms, and child cotinine (controlled for breastfeeding)
- Jadad randomization score: 2
- Jadad blinding score: 1
- Jadad account of participants score: 1

Harutyunyan 2013

- Armenia, RCT
- 250 households with children aged 2 – 6 years whose mother was a nonsmoker but they both resided with a daily smoker; 56% retention rate at final follow-up. Follow-up periods were 1 and 2 months.
- Researchers delivered motivational interviewing intervention
- No NRT was provided.
- Reducing ETS was the primary outcome, measured by hair nicotine, knowledge about smoking and SHS hazards, household smoking practices
- Jadad randomization score: 1
- Jadad blinding score: 1
- Jadad account of participants score: 1

Herbert 2011

- Canada, RCT
- 60 families recruited from nursing offices, daycares, and family resource centres in PEI who were largely low-income and included a current smoker; 100% retention at final follow-up. Follow-up time point was 6 months.
- Researchers delivered 3 weekly empowerment based group sessions followed by 3 weekly follow-up telephone calls over 6 consecutive weeks. Parents shared experiences, developed action plans, identified resources & barriers.
- No NRT was provided
- Reducing ETS, home and car smoking, and cessation were outcomes of interest measured by parent report of average number of cigarettes smoked in house daily, number of smokers in the home, number of quit attempts, Fagerstrom test of nicotine dependence scores.
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Hovell 2000

- USA, RCT
- 108 low socio-economic status mothers of children under 4 who currently smoked; 87% retention at final follow-up. Follow-up periods were 3, 6, and 12 months.
- Researchers delivered 7 sessions over 3 months that utilized operant theory such as shaping, goals, contracts, rewards, stimulus control either in person or over the phone.
- No NRT was provided.
- Reducing ETS was the primary outcome, measured by cotinine
- Jadad randomization score: 2
- Jadad blinding score: 2
- Jadad account of participants score: 1

McIntosh 1994

- USA, RCT
- 92 families of asthmatic children from 6 months -17 years old; 80% retention at final follow-up. Follow-up periods were 4 and 6 months
- Pediatricians delivered either minimal contact advice and pamphlet or individualized cotinine feedback, self-help manual based on behaviour modification theory and cognitive theory (stimulus control, goal setting, self-monitoring, self-efficacy, relaxation)
- No NRT was provided
- Reducing ETS and cessation were primary goals, measured by reported indoor smoking, self-report smoking location, quit attempts, and child biological measures
- Jadad randomization score: 2
- Jadad blinding score: 0
- Jadad account of participants score: 1

Meltzer 1993

- USA, Quasi-experimental
- 5 families with asthmatic children and a smoker in San Diego; 71.4% retention at final follow-up. Follow up period was 1 month.
- Researchers delivered 5 30min counseling sessions over 4 weeks using behaviour modification, shaping, ETS info
- No NRT was provided
- Reducing ETS was the primary outcome, measured by daily proportion of cigarettes exposed
- Jadad randomization score: 0
- Jadad blinding score: 0
- Jadad account of participants score: 0

Peck 2015

- USA, RCT
- 71 parents or guardians of children with cancer who reported SHSe exposure for their child; 90% retention at final follow-up. Follow-up periods were 3, 6, 9, and 12 months.
- Researchers delivered an intervention developed based on the health belief model and social learning theory where counselors provided feedback, encouragement, and facilitated problem solving towards goals.
- No NRT was provided
- Reducing ETS was the primary outcome, measured by reported number of cigarettes exposed.
- Jadad randomization score: 1
- Jadad blinding score: 0
- Jadad account of participants score: 0

Stotts 2013

- USA, RCT
- 144 Caregivers of NICU infants who smoke or live with at least one smoker; 69.4% retention at final follow-up. Follow-up periods were 1, 3, and 6 months.
- Researchers delivered motivational interviewing and personalized written feedback;
- No NRT was provided
- Reducing ETS was the primary outcome, measured by nicotine wipes, passive sampling diffusion filters, saliva cotinine, home and car smoking rules, healthcare utilization, household smoking, and nicotine dependence scores
- Jadad randomization score: 1
- Jadad blinding score: 0
- Jadad account of participants score: 1

Winickoff 2003a

- USA, Observational
- 100 parents who attended Boston Children's Hospital outpatient clinic with their child who had an illness exacerbated by smoking; 81% retention at final follow-up. Follow-up period was 2 months.
- Researchers delivered 3 brief counselling sessions(15min), written info, proactive quit line referral, fax referral to primary care provider; used stage based materials and motivational interviewing
- NRT was provided.
- Cessation and reducing ETS were primary outcomes, measured by self-reported quit attempts, cessation, NRT use, quit line use, household smoking
- Jadad randomization score: 0
- Jadad blinding score: 0
- Jadad account of participants score: 1

Winickoff 2003b

- USA, Observational
- 71 parents who attended Boston Children's Hospital outpatient clinic with their child who had an illness exacerbated by smoking; 88.7% retention at final follow-up. Follow-up period was 2 months.
- Researchers delivered counseling sessions using stage based approach and motivational interviewing, written info, proactive quit line referral, and fax referral to primary care provider
- NRT was provided.
- Cessation and reducing ETS were primary outcomes, measured by completion of counseling sessions, self-reported 24hr abstinence, readiness to change, attitudes, home and car smoking rules
- Jadad randomization score: 0
- Jadad blinding score: 0
- Jadad account of participants score: 1

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Abdullah 2005	Yes	China	RCT	952 parents who were current or recent quitters who smoked last 6 months (84% fathers)	Community nurses delivered 20-30 minutes of telephone counseling and stage-based self-help materials. Control group received the same materials, but no counseling. Counseling was based on the stages of change theory (Prochaska's Transtheoretical Model), and 5R approach.	No	Cessation was the primary outcome, measured by self-reported 7 day and 24hr prevalence quit rate. Other outcomes were self-reported continuous abstinence rate, CO & cotinine, reported total or partial smoking ban at home	1, 3, 6 mos	88%
Abdullah 2015	Yes	China	RCT	318 parents or caregivers who smoked who had a child aged 5 years or younger at home, and were current smokers within the last month; 56.6% retention at final follow up.	Chinese community health centres used for recruitment; community nurses delivered an intervention based on smoking hygiene and motivation theory by Rogers	No	Reducing ETS was the primary outcome, measured by self-reported environmental bans and number of cigarettes per week smoked in the home	2 & 6 mo	57%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Med used	Outcome	Follow-up periods	Retent-ion at final follow-up
Baheiraei 2011	Yes	Iran	RCT	130 children under 1 year of age, from a low income family unit which includes a smoker; 93% retention at final follow-up. Follow up period was 3 months	Health care centres and phone was for recruitment and delivery; researchers delivered 3 counseling sessions, motivational interviewing, pamphlets and smoke free home stickers, with the aim of increasing self-efficacy, and resolving barriers and ambivalence; usual care control group	No	Reducing ETS was the primary outcome, measured by implementation of home and car smoking bans, child cotinine, and reported cigarette consumption in the presence of the child.	3 mos	93%
Blaakman 2015	Yes	USA	RCT	165 caregivers and their infants equal to or under 32 weeks gestational age enrolled after discharge from a NICU unit in Rochester, New York (included nonsmoking parents);	Hospital nurses delivered motivational interviewing intervention.	No	Improving respiratory outcomes was the primary outcome. Other outcomes were home smoking bans, reduced infant contact with smokers, salivary cotinine	5 months after NICU discharge	87%
Borelli 2010	No	USA	RCT	133 Latino caregivers who smoked and had a child with asthma	Researchers delivered one of two interventions; either the BAM modeled on clinical guidelines, including increasing self-efficacy, problem solving and coping skills; or the PAM which gave feedback on CO levels and SHSe, using motivational interviewing techniques.	Yes	Reducing ETS was the primary outcome, measured by passive nicotine monitor reading, asthma morbidity and functioning g level, caregiver self-reported cessation and expired CO	3mos	66%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Butz 2011	Yes	USA	RCT	126 inner city (Baltimore) families with a child aged 6-12 with asthma residing with a smoker who smoked more than 5 cigarettes a day and resided in the home at least 4 days a week	Community nurses delivered 4 30-45 minute behavioural interventions focused on asthma education as well as providing air cleaners	No	Reduced ETS was the primary outcome, measured by child urinary cotinine, asthma symptom free days, acute asthma health care events, air quality changes, caregiver smoking frequency and location.	6mos	91%
Carlsson 2013	No	Sweden	Process evaluati-on	72 families with small children (5 or under) with at least one smoking parent who attended a community health care centre	Hospital nurses delivered a motivational interviewing based intervention.	No	Cessation and reducing ETS were main outcomes measured by home bans, self-reported quit rate, ban implementation, and child cotinine.	12mos	58%
Chan 2003	No	China	RCT	1273 nonsmoking mothers who attended hospital with a sick child and had a smoking partner who they and the child reside with	Hospital nurses delivered standardized health advice, 2 purpose designed booklets and a sticker, a telephone reminder	No	Reducing ETS and cessation were primary outcomes, measured by reported time the child is exposed, the reported number of smokers in the home, and negative health symptoms.experien-ced by the child.	12mos	86%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Chan 2005	Yes	China	RCT	80 parents of sick children whose family unit included a smoker who had smoked in the past week, presenting to a clinic or admitted to children's hospital or pediatric ward in Hong Kong	Hospital nurses delivered an individualized, stage-matched motivational interview for 30min; the control group received healthy diet counseling for sick children	No	Cessation was the primary outcome measured by parental report of past 30 day cigarette consumption	1 mo	96%
Chan 2006	No	China	RCT	1483 mothers of children admitted to the outpatient department from participating trial centers in hospital peadatric wards/ outpatient clinics in Hong Kong in 1997 & 1998;	Hospital nurses delivered intervention on preventing exposure with advice and materials, provided home no smoking signs	No	ETS reduction was the primary outcome, measured by mother self-reported actions taken to reduce the child's passive smoke exposure	3, 6 & 12mos	86%
Chilmonczyk 1992	No	USA	RCT	103 mothers who were current smokers and attended a well-baby visit	General practitioners delivered intervention recommending ETS reduction and tips to achieve it, a follow up telephone call, and a letter with cotinine feedback.	No	Reducing ETS was the primary outcome, measured by infant cotinine, controlled for breastfeeding and mother report	2mos	53%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Collins 2015	Yes	USA	RCT	300 randomized maternal smokers with a child under 4 years old exposed to 2 or more maternal cigarettes a day home, in North and West Philadelphia low income neighborhoods	Researchers delivered "evidence based strategies" including problem solving and goal monitoring	No	Reducing ETS was the primary outcome, measured by child cotinine, reported tobacco smoke exposure vie maternal cigarettes per day, 7 day point prevalence, self reported cigarettes smoked per day and bioverified quit status	"end of treatment" approxim-ately 16weeks	73%
Conway 2004	No	USA	RCT	143 Latino parents of children aged 1-9 who reported smoking at least 6 cigarettes a week	Community nurses delivered 6 home and telephone sessions which focused on problem solving to lower child's ETS exposure as well as contracting, shaping, positive reinforcement, & social support, based on operant and social learning theory	No	Reducing ETS was the main outcome, measured by cotinine and parental report of past month exposure from all sources	3 & 12mos	81%
Crone 2003	No	Netherlands	Pre-post	40 parents with a baby aged 1 to 10 months who visited the well-baby clinic and had reported ETS exposure.	Hospital nurses delivered an educational program implemented at same time as a nationwide program using radio, television, and other promotional materials	No	Reducing ETS was the primary outcome, measured by parent reported smoking in the presence of their infant.	pre-post	pre-post

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Culp 2007	No	USA	Quasi-experim-ental	263 pregnant, first time mothers in rural US counties who reported smoking within 2 years of their prenatal interview	Researchers conducted home visits with 3 goals: maternal and child health and safety, and family functioning, including smoking education.	No	Outcomes included a range of things covering maternal and child health and safety, including mother's smoking measured by self reported number of cigarettes per day and family healthcare usage.	Child = 12mos	74%
Curry 2003	No	Portugal	RCT	303 self-identified women smokers whose children received care at participating clinics	Community nurses delivered motivational messages, a quit smoking guide, a 10 minute interview and 3 outreach phone calls over 3 months	No	Cessation was the primary outcome, measured by maternal CO and self-reported 7-day abstinence	12mos	80%
Eakin 2014	Yes	USA	RCT	350 children aged 6 months to 6 years enrolled in Baltimore City Head Start whose caregivers reported a smoker living in the home	Researchers delivered a motivational interviewing and education intervention to the intervention group or an education alone intervention to the control group	No	Reducing ETS was the primary outcome, measured by household air nicotine levels measured by passive dosimeters, child salivary cotinine, reported home smoking ban, self-reported smoking status	3, 6, and 12mos	76%
Ekerbicer 2007	Yes	Turkey	RCT	347 parents of children exposed to ETS aged 9-11 attending a private primary school	Parents were interviewed by a smoking addiction professional; control group parents were given child's cotinine feedback	No	Reducing ETS was the primary outcome, measured by child cotinine.	9mos	100%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Eriksen 1996	Yes	Norway	RCT	363 healthy children at 6 weeks, 2 or 4 years of age; (88% female) whose family unit included a smoker who had smoked in the past week	Researchers delivered a 5 minute contact at well-baby visits, 3 brochures on ETS health effects, what parents can do to reduce, cessation course referrals, and a self-help manual for cessation	No	Cessation and reducing ETS were both primary outcomes, measured by self-reported cigarettes per day, home smoking rules including when and where people smoke, airing rooms & other strategies.	1mo	82%
Fossum 2004	No	Sweden	CT	41 mothers of newborn infants attending child health centres in Sweden for a well-baby visit	Community nurses provided "smoke free children counseling" based on motivation, self-help and self-efficacy, behavioral counseling, and social learning theory.	No	Reducing ETS, and cessation were primary outcomes, measured by maternal cotinine and self-reported smoking habits	3mos	85%
Greenberg 1994	No	USA	RCT	583 infants recruited at 18days old, new mothers who were a smoker or a non-smoker (141 who smoked)	Researchers delivered 4 45min home counseling sessions over first 6 months based on social learning theory	No	Reducing ETS was the primary outcome, measured by number of cigarettes smoked in same room as child, child's lower respiratory symptoms, and child cotinine (controlled for breastfeeding)	7mo & 12mo	96%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Groner 2000	Yes	USA	RCT	479 mothers who smoked and were accompanying a child under 12 to the hospital	Community nurses delivered 2 10-15min sessions at 2 weeks and 4 months, based on the Health Belief Model and behaviour modification, including stimulus control, goals, rewards	No	Cessation was the primary outcome, measured by cigarettes per day, quit rate, location of smoking, and ETS knowledge	6mo	48%
Harutyunyan 2013	No	Armenia	RCT	250 households with children aged 2 – 6 years whose mother was a nonsmoker but they both resided with a daily smoker	Researchers delivered motivational interviewing intervention	No	Reducing ETS was the primary outcome, measured by hair nicotine, knowledge about smoking and SHS hazards, household smoking practices	1 & 2 mos	56%
Herbert 2011	No	Canada	RCT	60 families recruited from nursing offices, daycares, and family resource centres in PEI who were largely low-income and included a current smoker	Researchers delivered 3 weekly empowerment based group sessions followed by 3 weekly follow-up telephone calls over 6 consecutive weeks. Parents shared experiences, developed action plans, identified resources & barriers	No	Reducing ETS, home and car smoking, and Cessation were outcomes of interest measured by parent report of average number of cigarettes smoked in house daily, number of smokers in the home, number of quit attempts, Fagerstrom test of nicotine dependence scores.	6 mos	100%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Hovell 1994	Yes	USA	RCT	79 asthmatic children aged 6-17 years whose family unit includes a smoker	Researchers delivered 6 30min counseling sessions using behaviour modification (self-monitoring, shaping, stimulus control, contingency); monitoring control group monitored only, usual treatment control group completed final assessments only	No	Reducing ETS was the primary outcome, measured by number of cigarettes per day exposed, air filter monitor readings and child report	2, 6, 9, & 12mo	87%
Hovell 2000	No	USA	RCT	108 low socio-economic status mothers of children under 4 who currently smoked	Researchers delivered 7 sessions over 3 months that utilized operant theory such as shaping, goals, contracts, rewards, stimulus control either in person or over the phone.	No	Reducing ETS was the primary outcome, measured by cotinine	6 & 12mo	87%
Hovell 2002	Yes	USA	RCT	204 Latino families with asthmatic children 3-17 years old who lived with at least 1 smoker or were exposed to 6 cigarettes in the last week	Researchers delivered 7 30-45min asthma management education sessions at participants' homes, including ETS reduction advice	No	Reducing ETS and cessation were primary outcomes, measured by parent report of ETS exposure, child cotinine, air nicotine levels, parental cotinine.	4, 7, 10, 13 mos	95%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Hovell 2009	Yes	USA	CT	150 mothers of children aged 4 or under who were exposed to 10 or more cigarettes per week	Researchers delivered10 in person at home and 4 telephone counseling session over 6 months biweekly, including pre- and post-quit telephone sessions, behavioural contracting, self-monitoring and problem solving. A usual care control group was used.	No	Reducing ETS and cessation were primary outcomes measured by air nicotine, child cotinine, reported quit rate and attempts, reported SHSe, mothers' smoking and indoor smoking	3, 6, 12, 18 mos	87%
Irvine 1999	Yes	UK	RCT	501 parents of asthmatic children aged 2-12 whose family unit includes a smoker	Community nurses delivered 2 "brief" sessions and 3 self-help pamphlets as well as a referral for cessation assistance. Control participants received leaflets on smoking with no ETS info or quit advice	No	Reducing ETS and cessation were primary outcomes, measured by reported ETS exposure, smoking habits, and cotinine.	1yr	87%
Mahabee-Gittens 2009	Yes	USA	RT	359 parents who smoked within the last week who attended an emergency department with their child as a patient at Cincinnati Children's Hospital	Researchers delivered a brief intervention based on the first two A's of the Five A's approach	No	Cessation was the primary outcome, measured by self-reported point prevalence, quit attempts, and readiness to quit.	1mo	52%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
McIntosh 1994	No	USA	RCT	92 families of asthmatic children from 6 months -17 years old;	Pediatricians delivered either minimal contact advice and pamphlet or individualized cotinine feedback, self-help manual based on behaviour modification theory and cognitive theory (stimulus control, goal setting, self-monitoring, self-efficacy, relaxation)	No	Reducing ETS and cessation were primary goals, measured by reported indoor smoking, self-report smoking location, quit attempts, and child biological measures	4-6mos	80%
Meltzer 1993	No	USA	Quasi-experim-ental	5 families with asthmatic children and a smoker in San Diego	Researchers delivered 5 30min counseling sessions over 4 weeks using behaviour modification, shaping, ETS info	No	Reducing ETS was the primary outcome, measured by daily proportion of cigarettes exposed	final visit (4 weeks)	71%
Nicholson 2015	Yes	USA	RCT	120 families with at least 1 smoker who reported SHSe for their children who attended a large pediatric oncology hospital	Researchers delivered 3 1 hour long counseling sessions and 3 25 minute long counseling sessions.	No	Reducing ETS was the primary outcome measured by implementation of home bans, household and car smoking behaviour, health care utilization	6, 9, & 12mos	88%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Ortega 2015	Yes	Spain	Random-ized field trial	1123 parents of infants under 18 months of age in a primary care setting in Catalonia who were smokers	General practitioners delivered a brief intervention based on cognitive theory and motivational interviewing using the 5 A's approach.	No	Reducing ETS was the primary outcome, measured by ETS exposure questionnaire and hair nicotine of infants	6mos	83%
Peck 2015	No	USA	RCT	71 parents or guardians of children with cancer who reported SHSe exposure for their child	Researchers delivered motivational interviewing and personalized written feedback	No	Reducing ETS was the primary outcome, measured by nicotine wipes, passive sampling diffusion filters, saliva cotinine, home and car smoking rules, healthcare utilization, household smoking, and nicotine dependence scores	3, 6, 9, 12mos	90%
Prokhorov 2013	Yes	USA	RT	91 Mexican-American households with a child under 18 and at least one smoker	Community researchers delivered a culturally specific comic for children and fotonovella for parents	No	Reducing ETS was the primary outcome, measured by informant and self-reported exposure, air nicotine monitor readings, and smoke/ETS harm attitudes	6 & 12mo	78%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Ralston 2008	Yes	USA	RCT	42 caregivers of children hospitalized for respiratory illness at the University of New Mexico Hospital who were smokers	General practitioners delivered a brief message and quit line referral to the control group or an extensive message and quit line referral to the intervention group.	Yes	Cessation was the primary outcome, measured by self-reported quit date set, quit attempts, abstinence	3 & 6 mo	67%
Ralston 2013	Yes	USA	RCT	41 tobacco smoking caregivers with a hospitalized child	Researchers delivered a brief recommendation of cessation, state quitline referral, and cessation brochure from the American Cancer Society while using the stages of change theory to tailor approach. Both groups received age-appropriate injury prevention brochures.	No	Cessation was the primary outcome, measured by self-reported quit status , cigarettes smoked per day, perceived importance of quitting, and quitline contact	2mo	68%
Schuck 2014	Yes	Netherlands	RCT	512 parents who smoked were recruited through their children's primary school;	Researchers delivered behaviour change techniques and self-help brochures.	Yes	Cessation and home ban implementation were primary outcomes measured by self-reported 7 day point prevalence, use of NRT, implementation of home smoking ban.	12mos	86%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Stepans 2006	Yes	USA	RT	27 breastfeeding infant-mother dyads recruited out of postpartum units in New Mexico and Ohio hospitals	Researchers delivered a smoking hygiene intervention.	No	Reducing ETS was the primary outcome measured by improved smoking hygiene,smoking habits questionnaire, smoking hygiene questionnaire, cotinine in breast milk and infant urine	2, 3, and 5 weeks	77%
Stotts 2013	No	USA	RCT	144 Caregivers of NICU infants who smoke or live with at least one smoker	Researchers delivered motivational interviewing and personalized written feedback	No	Reducing ETS was the primary outcome, measured by nicotine wipes, passive sampling diffusion filters, saliva cotinine, home and car smoking rules, healthcare utilization, household smoking, and nicotine dependence scores	1, 3, 6mo	69%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Streja 2014	Yes	USA	RCT	242 adult/child dyads that included a child 2-14years old with asthma from low income minority households in Los Angeles, California and in which there had been smoking at home in the past month	Researchers delivered intervention developed according to Health Behaviour Framework and procedures were conducted by trained bicultural/bilingual Spanish/English staff members	No	Reducing ETS was the primary outcome measured by child cotinine and household nicotine levels	6 & 12mo	74%
Tyc 2013	Yes	USA	RCT	135 parents of children receiving cancer treatment who lived with at least one adult smoker and were exposed to SHS in home or car	Researchers delivered 3 individual, in person, bi-weekly counseling sessions and 3 telephone sessions that included health risk education and stress management strategies	No	Reducing ETS was the primary outcome measured by parent reported SHS exposure and smoking behaviours and child urinary cotinine.	3, 6, 9, 12 months	93%
Ulbricht 2014	Yes	Germany	RCT	917 households with a child aged 4 or younger with at least one parent who was a daily smoker who lived with them	Researchers used motivational interviewing principles for the intervention.	No	Reducing ETS was the primary outcome measured by child cotinine.	12mos	93%
Vineis 1993	Yes	Italy	CT	1015 families who attended well-baby visits and whose family unit included a smoker	Community nurses delivered brief counseling at visits as well as ETS reduction booklets.	No	Cessation was the primary outcome measured by self-reported quit rate.	2 & 4 year	74%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Wahlgren 1997	Yes	USA	RCT	91 asthmatic children attending pediatric allergy medical clinics;	Researchers delivered 6 30min counseling sessions using behaviour modification techniques such as self-monitoring, shaping, stimulus control, contingency.	No	Reducing ETS was the primary outcome measured by cotinine, reported cigarettes exposed, and air monitor results.	2 yr	80%
Wakefield 2002	Yes	Australia	CT	292 low-income asthmatic children aged 1-11 whose family unit included a smoker	Researchers delivered a letter with cotinine feedback, asthma and ETS reduction booklets, phone calls, and encouraged home smoking bans.	No	Reducing ETS was the primary outcome measured by indoor smoking bans, mean cigarette consumption, and cotinine.	6 mo	90%
Walker 2015	Yes	Australia	RCT	293 mother/infant dyads in which the mother either currently smoked or smoked during pregnancy, the infant was 0-5 weeks, and the mother was self-identified as Maori or Australian Aboriginal/Torres Strait Islander	Community nurses delivered motivational interviewing intervention.	Yes	Primary outcome of interest was to reduce respiratory complaints which was measured by reports of healthcare usage for respiratory complaints, reports of SHS exposure, environmental smoking bans, mothers current status as a smoker (7 day point prevalence)	when child was 4 and 12mos of age	99%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Wall 1995	Yes	USA	CT	2901 children aged 2 weeks, 2, 4, and 6mos who attended a pediatric office in Oregon with their mother who smoked within a month of pregnancy and the family unit currently included a smoker	General practitioners delivered 2min advice at 2week, 2, 4, and 6 month well-baby visits as well as written advice	No	Cessation was the primary outcome, measured by self-reported quit and relapse rates, stage of change, knowledge of ETS, and home smoking rules.	2 weeks, 2, 4 & 6mo	81%
Wang 2015	Yes	China	RCT	65 children aged 5-6 and their caregivers who were smokers were recruited through child's preschool in Changsha, China	Researchers used motivational interviewing and protective motivation theory, trans-theoretical model of behavior change, and provided materials that were stage matched.	No	Cessation and reducing ETS were primary outcomes, measured by self-reported 7-day and 24-hr point prevalence	6mo	100%
Wiggins 2005	Yes	UK	RCT	731 mothers who lived in deprived London districts	Health Visitors conducted monthly supportive listening visits to mother’s home, beginning at baby’s age 10 weeks.	No	ETS reduction and cessation were outcomes included in the study, but so were childhood injury, maternal depression, maternal smoking, uptake and cost of health services, household resources, maternal and child health, mother reported experiences	12 & 18 mos	82%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Wilson 2001	Yes	USA	RCT	87 low socio-economic status, minority asthmatic children aged 3-12 years who accessed pediatric pulmonary services	Hospital nurses delivered 3 sessions which included behaviour change, contingency contracts, modeling, role play, asthma education & cotinine feedback	No	Reducing ETS was the primary outcome, measured by asthma related medical visits, asthma hospitalization, cotinine, and reported indoor smoking	6 & 12mo	69%
Wilson 2011	Yes	USA	RCT	Caregivers of 519 children aged 3-12yrs with asthma and smoke exposure who attended a Kaiser Permanente Northern California facility	Researchers delivered 1 asthma education session to both intervention and control groups, as well as weekly cotinine feedback and stage of change based counseling in 3 weekly in person sessions over 6 weeks to the intervention group.	No	Reducing ETS and health care usage were primary outcomes measured by cotinine/creatinine ratio, use of health care services, home smoking, smoking status of people in the home.	6 & 12mo	95%
Winickoff 2003a	No	USA	Observa-tional	100 parents who attended Boston Children's Hospital outpatient clinic with their child who had an illness exacerbated by smoking	Researchers delivered 3 brief counseling sessions(15min), written info, proactive quit line referral, fax referral to primary care provider; used stage based materials and motivational interviewing	Yes	Cessation and reducing ETS were primary outcomes, measured by self-reported quit attempts, cessation, NRT use, quit line use, household smoking	2mo	81%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Winickoff 2003b	No	USA	Observa-tional	71 parents who attended Boston Children's Hospital outpatient clinic with their child who had an illness exacerbated by smoking	Researchers delivered counseling sessions using stage based approach and motivational interviewing, written info, proactive quit line referral, and fax referral to primary care provider	Yes	Cessation and reducing ETS were primary outcomes, measured by completion of counseling sessions, self-reported 24hr abstinence, readiness to change, attitudes, home and car smoking rules	2mo	89%
Winickoff 2010	Yes	USA	RCT	101 current smokers and recent quitters who just had a baby at a hospital birth centre in Massachusetts	Researchers utilized 5A's strategy, based on social learning theory, transtheoretical stages of change, and the health belief model based intervention.	No	Cessation was the primary outcome, measured by self-reported and biochemically verified 7 day point prevalence.	3mo after hospital discharge	72%
Yilmaz 2006	Yes	Turkey	RCT	375 mothers who were current smokers with children attending a well-child clinic	Hospital nurses delivered a cessation intervention aimed at child health or a cessation intervention aimed at mothers health or a no advice control condition.	No	ETS reduction and cessation were primary goals, measured by self-reported maternal smoking status, smoking location change, post-intervention knowledge change	6mo	97%

Study	In meta-analy-sis	Country	Study type	Subjects	Intervention	Meds Used	Outcomes	Follow-up periods	Retent-ion at final follow-up
Yucel 2014	Yes	Turkey	RCT	80 mothers of children aged 1-5 who lived in the Cengizhan district of Izmir in Turkey, who smoked and/or their spouse smoked	Researchers provided materials on harms of SHS and tips for quitting and reducing exposure to mothers and asked them to share them with their partners who smoked	No	Reducing ETS was the primary outcome, measured by change in cotinine, implementation of home bans, number of cigarettes smoked by caregiver, and number of cigarettes smoke in the home.	6 weeks	98%
Zakarian 2004	Yes	USA	RCT	150 mothers who smoked with children aged 4 or under	Researchers delivered 7 behavioural counseling sessions: 3 in person and 4 over the telephone, over 6 months which included reshaping and self-monitoring based on social learning theory and the behavioural ecological model. A Quit Kit was provided if requested.	No	ETS exposure reduction and cessation were primary outcomes, measured by mother report of smoking status and child ETS exposure, child cotinine, and air nicotine monitor reading.	3, 6 & 12mos	85%
Zhang 1993	Yes	China	CT	20382 children in 44 Chinese primary schools	Tobacco prevention curriculum was delivered to students which included child written letters to their smoking fathers and stage based cessation materials	No	Cessation was the primary outcome, measured by self-reported smoking cessation by fathers at interview with health educator and their children's diary entries.	8mos	100%