A Randomized Trial to Reduce Passive Smoke Exposure in Low-Income Households With Young Children

Karen M. Emmons, PhD; S. Katharine Hammond, PhD; Joseph L. Fava, PhD; Wayne F. Velicer, PhD; Janet L. Evans, MA; and Alicia D. Monroe, MD

ABSTRACT. Objective. Passive smoke exposure among children is widespread in the United States; estimates suggest that almost 40% of children who are younger than 5 years live with a smoker. Few randomized studies of passive smoke exposure reduction among children have been conducted, and the impact of interventions that have been evaluated has been limited. The objective of this study was to determine whether a motivational intervention for smoking parents of young children will lead to reduced household passive smoke exposure.

Methods. Project KISS (Keeping Infants Safe From Smoke), a theory-driven exposure reduction intervention targeting low-income families with young children, was a randomized controlled study in which participants—smoking parents/caregivers (N = 291) who had children who were younger than 3 years and who were recruited through primary care settings—were randomly assigned to either the motivational intervention (MI) or a self-help (SH) comparison condition was used. Follow-up assessments were conducted at 3 and 6 months. The MI condition consisted of a 30- to 45-minute motivational interviewing session at the participant’s home with a trained health educator and 4 follow-up telephone counseling calls. Feedback from baseline household air nicotine assessments and assessment of the participant’s carbon monoxide level was provided as part of the intervention. Participants in the SH group received a copy of the smoking cessation manual, the passive smoke reduction tip sheet, and the resource guide in the mail. Household nicotine levels were measured by a passive diffusion monitor.

Results. The 6-month nicotine levels were significantly lower in MI households. Repeated measures analysis of variance across baseline, 3-month, and 6-month time points showed a significant time-by-treatment interaction, whereby nicotine levels for the MI group decreased significantly and nicotine levels for the SH group increased but were not significantly different from baseline.

Conclusions. This study targeted a large sample of racially and ethnically diverse low-income families, in whom both exposure and disease burden is likely to be significant. This is the first study to our knowledge that has been effective in reducing objective measures of passive smoke exposure in households with healthy children. These findings have important implications for pediatric health care providers, who play an important role in working with parents to protect children’s health. Providers can help parents work toward reducing household passive smoke exposure using motivational strategies and providing a menu of approaches regardless of whether the parents are ready to quit.

ABBREVIATIONS. Project KISS, (Keeping Infants Safe From Smoke); MI, motivational intervention; SH, self-help; ANOVA, analysis of variance; SD, standard deviation.

Regular exposure to passive smoke is associated with detrimental health effects among children. Children whose parents smoke are at greater risk for otitis media, asthma, bronchitis, and pneumonia, compared with those whose parents do not smoke. Children of smokers are more likely to be hospitalized for lower respiratory infections, are more likely to have a tonsillectomy/adenoidectomy, and have more asthma-related emergency department visits compared with children of nonsmokers. Furthermore, children who are exposed to passive smoke have more days of restricted activity and bed confinement and more days of school absence per year, compared with children who are not exposed to passive smoke.

Passive smoke exposure among children is widespread in the United States. Data from the National Health and Nutrition Examination Survey III indicate that almost 40% of children who are younger than 5 years in the United States live with a smoker. A recent Canadian study found that 47% of children in Canada are exposed to passive smoke in the home. It has been estimated that passive smoke exposure among children results in direct annual medical expenditures in the United States of $4.6 billion. Children’s exposure to passive smoke is of particularly great concern because it is involuntary. Few children are able to limit their own exposure, especially younger children, who may be more at risk as a result of chronic exposure and their immature/developing organ systems.

Taken together, the available epidemiologic evidence suggests that passive smoke exposure in children is harmful and that efforts are needed to develop effective interventions for reducing passive smoke exposure among young children. Given the relatively serious health consequences associated
with children’s exposure to passive smoke, there is a surprising lack of randomized studies in the literature targeting passive smoke exposure reduction among children. A recent literature review identified only 4 studies that targeted passive smoke exposure reduction among young children. These interventions were delivered by hospital-based nurses after the infant’s birth via self-help materials provided after delivery or by pediatricians as part of well-child care. One study targeted families of older children who had asthma. None of these studies yielded significant reductions in objective measures of children’s exposure (eg, urinary cotinine levels and/or household nicotine exposure levels); reduction in self-reported exposure was found in 2 of the 4 studies conducted to date. These studies highlight the importance of continued efforts to develop and evaluate effective exposure reduction interventions.

The purpose of this article is to present the outcome evaluation of Project KISS (Keeping Infants Safe From Smoke), a theory-driven passive smoke exposure reduction intervention targeting low-income parents of young children. Project KISS used a motivational interviewing approach in which feedback on household nicotine levels was provided to impact on parents’ awareness of the importance of reducing their children’s passive smoke exposure and to increase their motivation to take action to reduce household exposure levels. A randomized controlled design in which participants were assigned randomly to either the motivational intervention (MI) or a self-help (SH) comparison condition was used. Follow-up assessments were conducted at 3 and 6 months. It was hypothesized that the MI condition would lead to greater reductions in household nicotine levels than the SH comparison intervention.

METHODS

Sample
Eligibility criteria for this study included 1) being either a current smoker or a recent quitter (quit within 3 months of recruitment), 2) having a child or a grandchild younger than 3 years and living in the household, and 3) being able to read and speak English or Spanish. Participants were recruited through the family practice, obstetrics, and pediatric departments of 8 community health centers that serve diverse, low-income populations. When >1 parent/caregiver in a family smoked, the primary caregiver was selected for study participation. Details on recruitment procedures are available elsewhere. The sample was composed of 291 participants who were followed for 6 months, with the use of intention-to-treat principles. Follow-up response rate among participants was 81.2% at 3 months and 85.1% at 6 months (see Fig 1 for sample recruitment and attrition data). The data presented in this article are from the 279 participants who provided a household air sample at baseline.

Intervention Description
The 2 study intervention conditions (SH and MI) are described below.

SH Control Group
Participants in the SH group received in the mail a copy of the smoking cessation manual, the passive smoke reduction tip sheet, and the resource guide. Feedback about household nicotine levels was provided after the final follow-up assessment.

MI Condition
The MI condition consisted of a 30- to 45-minute motivational interviewing session at the participant’s home with a trained health educator and 4 follow-up telephone counseling calls. The intervention was conducted in English or Spanish. In the motivational interview, patient choice, personal responsibility for change, and enhancement of self-efficacy were emphasized. This counseling style focused on building motivation within patients, in part by addressing ambivalence associated with the decision to quit smoking. A key component of the intervention was feedback from baseline household air nicotine assessments and assessment of the participant’s carbon monoxide level. Feedback also was provided about the participant’s experience of smoking-related respiratory symptoms.

After provision of feedback, goal setting was used to help parents identify any next steps that they wanted to take related to reducing passive smoke in their household or their smoking. The intervention was tailored to whether parents were interested in quitting smoking and/or reducing their household passive smoke levels. All participants were provided with a copy of either Quitting Times: A Magazine for Women Who Smoke (women) or Freedom From Smoking for You and Your Family (men) in English; those who preferred Spanish-language materials were given La Mujer: La Familia y el Cigarrillo (women) or Rompa con el Vicio (men). These materials are designed specifically for audiences with lower literacy skills (eg, the reading level of Quitting Times is approximately 5th-6th grade). It was suggested that those who were not considering quitting might hold onto their manual for future use or focus on the motivation-enhancing sections. An action-oriented strategy was used with individuals who were ready to quit; these participants were encouraged to actively use the skills-oriented sections of the manual that emphasized the steps to quitting smoking, and the health educator helped the participant develop a quitting strategy and set a quit date.

All parents—but particularly those who were not ready to quit smoking—were encouraged to consider reduction of household passive smoke exposure; for those participants who were interested in doing so, options were discussed and goals that focused on reducing household smoking were set. Simple tips for passive smoke reduction were provided to all participants, as well as a resource guide that provided details about community-based health and social services resources. All materials were available in English and Spanish. Participants who were not interested in reducing household passive smoke exposure were encouraged to think further about the results of the nicotine assessment and to consider ways in which their family’s health might be affected by this exposure.

Four follow-up counseling calls were provided during the intervention period. The purpose of the follow-up calls was to check in on participants’ progress in meeting the goals that were set at the home visit, to conduct counseling related to barriers to change for participants who had difficulty meeting their goals, and to encourage participants who had achieved their goals to set new ones. The counseling calls were completed by the same therapist who provided the initial home visit session. The average length of the follow-up calls was approximately 10 minutes.

Interventionist Training and Supervision
All study interventionists were trained in motivational interviewing by an experienced motivational interviewing trainer. Extensive training sessions were held in which the principles of MI were discussed, component counseling strategies were demonstrated and practiced (eg, reflective listening, use of open-ended questions, elicitation of self-motivational statements), and feedback was provided. Once interventionists were proficient in the individual components of MI, the study protocol was introduced and extensive training and practice were provided. Ongoing supervision focused on difficulties and successes in the implementation of the intervention and on role-playing interesting and complicated cases. A sample of intervention sessions was audio-taped, and feedback was provided as part of supervision.

Measures
The primary outcome measure was nicotine levels, measured at the household level. Vapor-phase nicotine emissions from tobacco combustion have been established as a valid and reliable marker for self-reported exposure.
for passive smoke in both environmental chamber and field studies. In particular, passive sampling diffusion filters have been found to be an effective and relatively unobtrusive means of assessing household nicotine concentrations. Nicotine levels were measured at the household level by placement of a passive sampling diffusion monitor in each of 2 rooms in participants' homes. The monitors were placed in the kitchen and in a second room in which the child spent the most time, typically the room with the television (referred to as the "TV room" hereafter). The monitors were placed in the homes by a trained research assistant, who removed them 7 days later. Sampling was conducted at baseline and was repeated in the same locations at the 3- and 6-month follow-up assessments. Participants were enrolled during a 2-year period; there were no differences in time of year across the 2 groups. Power analyses were completed before study funding, using data from a nonintervention study investigating household exposure levels in households with children in New York.

Smoking cessation, a secondary outcome, was defined on the basis of a 7-day point prevalence abstinence at each of the follow-up assessments. Smoking history variables included number of cigarettes smoked per day, years smoked, age at which smoking began, partner smoking status, and the number of quit attempts that the parent made in the previous 12 months. Nicotine dependence was assessed with the use of the 1-item version of the Fagerstrom Nicotine Tolerance Questionnaire, which assesses minutes from waking until the first cigarette is smoked. Socio-

Fig 1. Sample recruitment and retention.
economic and demographic variables that were assessed included age, gender, education, marital status, employment status, race/ethnicity, and characteristics of the household. Information about the parents’ pulmonary-related symptoms also was assessed.25

Data Analysis Plan

Preliminary analyses were conducted before the outcome analyses to evaluate any baseline characteristics for differences between the MI and SH groups. Then we performed 3 preliminary sets of analyses to examine whether attrition had any effect on demographic characteristics or key baseline study variables. These preliminary analyses compared 1) baseline demographic characteristics of all participants who remained in the study at the 6-month follow-up versus those who had dropped out or were lost to follow-up, 2) baseline characteristics between treatment groups of participants who remained in the study at the 6-month follow-up, and 3) baseline characteristics between treatment groups of participants who dropped out.

The primary outcome analyses, conducted on an intention-to-treat basis, examined treatment differences in nicotine levels in both the kitchen and the TV room at the 6-month follow-up with the use of analysis of variance (ANOVA) procedures. Repeated measures ANOVA was used to examine for differences in nicotine levels over time between treatment groups. Secondary analyses on smoking cessation rates and cigarette consumption rates also were examined for treatment differences over time.

Assignment

The unit of randomization was the individual family. A computer-generated randomization table was used. Randomization information was kept from study staff until the baseline assessment was completed.

RESULTS

Participant Flow and Follow-Up

Figure 1 presents recruitment and randomization and attrition information.

Demographics

Participants predominantly were women (91.5%); mean age was 28.4 years (standard deviation [SD] = 7.4), and mean educational level was 11.3 years (SD = 2.5). Fifty percent of the sample were single parents, and 75.3% were unemployed; 46% were white, 19% were black, 21% were Hispanic, and 14% were of other race/ethnicity. Participants smoked an average of 14 cigarettes per day (SD = 9.3) and had smoked for 11.8 years (SD = 7.7). More than 30% of the participants had a partner who smoked. Twenty-five percent of the sample was in the earliest stages of readiness to quit smoking, 44.9% were thinking about quitting smoking at some point in the future, and 29.9% had made a quit attempt in the past year about quitting smoking at some point in the future, 44.9% were thinking of readiness to quit smoking, and 5% of the sample was in the earliest stages smoking for 11.8 years (SD = 7.7). More than 30% of the participants had a partner who smoked. Twenty-five percent of the sample was in the earliest stages of readiness to quit smoking, 44.9% were thinking about quitting smoking at some point in the future, and 29.9% had made a quit attempt in the past year.

Preliminary Analyses

We compared treatment groups on a number of socioeconomic and demographic variables (age, gender, race, education, employment status, marital status, household characteristics) and other smoking-related covariates (eg, smoking rate, partner smoking status, number of household smokers, previous quit attempts, pulmonary symptoms, and nicotine dependence) at baseline. Because of the number of comparisons, the corrected α level used for significance testing related to these variables at baseline was 0.003. Among the total baseline sample, there were no significant differences between the MI and SH groups for demographic characteristics. The attrition-related analyses revealed no baseline demographic differences between people who completed the study and those who dropped out, either for the entire sample or between the 2 treatment conditions.

Primary Outcome Analyses

The TV room and kitchen nicotine concentration data were positively skewed, as is typical for most exposure data; thus, a natural log transformation was applied to these data and used in all subsequent analyses. Baseline exposure levels were not significantly different between the 2 conditions (kitchen: 3.7 µg/m³ [SD = 6.7] vs 3.0 µg/m³ [SD = 4.4], MI vs SH, respectively; TV room: 3.1 µg/m³ [SD = 5.1] vs 3.5 µg/m³ [SD = 5.0]). The 6-month exposure levels were significantly lower in the MI group for both kitchen (2.6 µg/m³ vs 6.9 µg/m³; F(1236) = 5.5; P < .05) and TV room (2.3 µg/m³ vs 3.5 µg/m³; F(1235) = 5.04; P < .05), indicating a significant treatment effect.

Secondary Outcome Analyses

Changes Over Time

A repeated measures ANOVA for the kitchen nicotine levels across baseline, 3-month, and 6-month time points showed a significant time-by-treatment interaction (F(2406) = 4.80; P < .01). When simple effects and comparisons were examined, nicotine levels in the MI group decreased significantly (F(2200) = 5.72; P < .01); nicotine levels at 3 and 6 months were significantly lower than baseline nicotine levels. The nicotine levels among the self-help group increased across the study period, although the differences were not significant.

A significant treatment effect also was found for the TV room nicotine levels; the MI group had significantly lower nicotine levels at all follow-up time points (F(1202) = 4.36; P < .05). Figures 2 and 3 show the patterns of nicotine levels by treatment group over time. We also evaluated the impact of household smoking status (eg, whether there were smokers besides the study participant living in the household) on the changes in nicotine levels over time; the results were not affected by inclusion of this variable.

Smoking Cessation and Cigarette Consumption Rates

Smoking cessation rates among the participants in the 2 conditions were examined. Overall cessation rates across both conditions were 7.5% and 10.1% at the 3- and 6-month follow-ups, respectively; there were no significant differences in cessation rates between conditions at any of the follow-ups. There was no change in smoking rate between groups at any of the follow-up assessments.

DISCUSSION

Chronic exposure to passive smoke is a primary cause of morbidity and mortality among low-income children, who are more likely to live with smokers than are children in families from higher socioeconomic status backgrounds. Very few efforts have...
been undertaken to evaluate passive smoke exposure reduction interventions; none of the studies that have been conducted to date have demonstrated reductions in objective measures of exposure, although some have found self-reported changes. This study found that the MI led to significantly reduced levels of household passive smoke exposure among low-income families with very young children. Household nicotine concentrations were found to be significantly lower in the MI group at both the 3- and 6-month follow-up assessments. There were no significant changes in the nicotine concentrations in the self-help group by the 6-month assessment, although the absolute levels were higher.

The concentrations of nicotine found in these homes was higher than has been reported in other studies, which generally have examined middle- and upper-income families. In the motivational intervention condition, these exposures were reduced by 25% to 30%, which is a substantial improvement. However, even in the MI group, the concentrations of nicotine at the 6-month follow-up still were higher than what would be found in a smoke-free home; thus, these children remain at risk for passive smoke-related disease.

These findings demonstrate that motivational interviewing, which is an empathic, client-centered, but directive counseling style, is an effective strategy for reducing household exposure levels. Three key components of the intervention were 1) to provide objective feedback about the impact of the parent’s smoking on the household exposure levels, 2) to allow the participant to decide the best approach to passive smoke reduction in his or her own home, and 3) to provide the participant with responsibility for the change, in the context of a supportive relationship. In this manner, other social contextual factors that frequently impact on parents’ ability to change either their home environments or their own behaviors were addressed (eg, other household members who smoke and are unwilling to change).

This study has important implications for how health care providers work with parents regarding passive smoke reduction and suggests that a supportive, motivation-oriented style may be most effective. Working with parents to identify barriers to
Reducing household passive smoke levels is important, as is adopting a problem-solving approach to addressing the participants’ barriers. It should be noted that the SH condition did involve materials targeted at passive smoke reduction. That absolute exposure levels increased in this group over time, albeit not significantly, suggests that educational materials alone are not sufficient to reduce children’s passive smoke exposure in smoking households.

It is interesting to note that there were no condition differences in smoking cessation outcomes. Although passive smoke reduction was the primary outcome, we anticipated that the intervention might enhance interest in quitting smoking. The emphasis on tailoring the intervention to participants’ readiness and the brevity of the intervention may in part have resulted in our findings of intervention effects for household nicotine concentrations but not smoking cessation. Participants were recruited proactively from health care settings, and thus the intervention was not limited to individuals who were interested in quitting smoking. In fact, the majority of participants were not interested in taking active steps to quit smoking, and thus the intervention targeted passive smoke reduction as the key endpoint. Although support and assistance in developing behavior-oriented smoking cessation plans were offered to participants who were interested in quitting smoking, we were not able to offer pharmacotherapies or more intensive smoking cessation treatment programs.

Passive smoke exposure is responsible for significant chronic disease morbidity in young children and thus should be of concern to pediatricians, family physicians, and other health care providers. For example, household smoking is estimated to be responsible for 529,000 physician visits for asthma and 1.3 to 2.0 million visits for coughs among children per year.3 These findings have important implications for health care providers, who are well-positioned to counsel parents about their smoking and their children’s exposure. There is substantial evidence that health care providers in general and pediatricians in particular can play an important role in encouraging smoking cessation among parents who smoke.16,26 Pediatricians, obstetricians, and adult-focused care providers all can deliver supportive, motivational messages to parents about the importance of reducing their children’s passive smoke exposure and the positive impact that smoking outdoors can have on household passive smoke exposure. Involvement of health care providers in encouraging parents to reduce household passive smoke exposure and to adopt smoke-free households is an important public health approach to reducing passive smoke-related morbidity and mortality. Adjunctive interventions, such as that used in Project KISS, also may be important.

The limitations of this study should be noted. The study sample represents approximately 52% of those contacted about the study. The study population was composed of low-income families, in which smoking rates are higher and children are more likely to be exposed to passive smoke. The difficulties in recruiting and retaining such samples are well-documented. However, once patients were enrolled, the dropout rate and loss to follow-up were relatively low. In addition, comparison of demographic characteristics between those who completed the study and those who dropped out did not reveal any differences. An additional limitation is that the 6-month follow-up period does not allow for evaluation of long-term changes in household exposure. We opted for repeated assessments in a shorter time frame because of concerns about being able to detect differences at long-term follow-ups, particularly given the lack of such findings in the literature. In addition, it was challenging to follow this low-income population over time; despite these difficulties, a high follow-up rate was maintained at the 6-month follow-up; inclusion of a longer follow-up likely would have led to a higher attrition rate. Now that changes have been demonstrated to persist during the 6-month follow-up period, subsequent studies should be conducted to evaluate long-term maintenance of exposure reduction, using strategies to ensure a high rate of cohort maintenance over time. The exposure assessment strategies used in this study require laboratory analysis before feedback can be provided. Passive sampling was the most cost-efficient and feasible assessment strategy available at the time that this study was designed. Additional research to develop alternative sampling approaches that would enable providers to give immediate feedback about household exposure levels is needed. The intervention was focused on the participating parent/caregiver and did not target all smokers in the household. Logistically, it would have been very difficult and costly to design an intervention in which we could have intervened reliably with all of the household smokers in the home visit or telephone follow-up sessions. However, as part of the motivational interview, the health educators did focus on other sources of passive smoke exposure in the household and worked with the participant to develop strategies for addressing them. Future research should focus on developing strategies for targeting all smokers in a household. Finally, it should be noted that although reducing exposure to passive smoke among young children is very important, prenatal exposure has lasting implications for development of the pulmonary system, and thus future efforts to extend these intervention effects to the prenatal period are needed.

This study targeted a relatively large sample of diverse, low-income families, in whom both exposure and disease burden are likely to be greatest. The results of this study suggest that motivational interviewing is an important approach to reducing passive smoke exposure among low-income families. Additional research is needed to determine how to maximize the reduction of exposure and how best to integrate such approaches into the standard of care.

ACKNOWLEDGMENTS
This research was supported in part by HL54351 from the National Institutes of Health and grants from Liberty Mutual Insurance Company, the Boston Foundation, and NYNEX.
REFERENCES


“ANCHORING” EFFECTS

... Anchoring effects and can be demonstrated by anyone willing to ask a few questions. It is illustrated by studies in which people were asked to estimate the population of Turkey. Before answering, they were presented with a figure and asked whether the actual number was higher or lower. Of those who were first presented with the figure of 5 million, the average estimate was 17 million; of those first presented with a figure of 65 million, the average estimate was 35 million. As Tversky, Kahneman, and others have established, people are “anchored” to the original figure presented to them and, although they move in the right direction away from it, they are reluctant to move too far. (The population of Turkey was approximately 50 million when the experiment was performed.)