

## **Reducing Exposure of Pre-School Children to Environmental Tobacco Smoke: Feasibility of a Program for Parents and other Caregivers\***

*Reducción de la Exposición de Niños Pre-Escolares al Humo del Tabaco:  
Viabilidad de un Programa para Padres y Cuidadores*

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### Abstract

The aim of this study was to assess the viability and potential efficacy of an environmental tobacco smoke (ETS) exposure reduction intervention for at-risk children. The study consisted of a 12-week behavioral intervention and a 6-month follow-up, conducted on a convenience sample (N=43) of low-income, self-identified, adult smokers who were caregivers of 3-5 year old children. The intervention included a manualized program, plus nicotine replacement therapy, and monetary reinforcement of abstinence. Outcome measures included *breath carbon monoxide (CO)*, *self-reported smoking practices*, *level of nicotine dependence*, and *depression symptoms*. Significant reductions were observed in CO concentration, frequency of smoking around chil-

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dren, and nicotine dependence and depression scores. Sixty-one percent of the participants attended 8 or more weekly sessions, and one third remained smoke-free at follow-up. Those who did not quit reported not changing their smoking behavior patterns in vehicles or indoors. The cessation intervention compared well with other interventions for treatment-seeking smokers, suggesting that implementing evidence-based cessation and education programs for caregivers at school sites may be effective in reducing daily exposure to ETS of pre-school children.

**Keywords:** *ETS, tobacco smoke, smoking cessation, pre-school children, caregivers*

### Resumen

El objetivo de este estudio fue evaluar la viabilidad y eficacia potencial de una intervención para reducir la exposición de niños al humo ambiental de tabaco (HAT). El estudio consistió en una intervención conductual de 12 semanas con seguimiento a los 6 meses, con una muestra no aleatoria (N=43) de fumadores adultos de bajos ingresos, parientes de niños entre 3 y 5 años de edad. La intervención incluyó un programa manualizado para dejar de fumar más terapia de reemplazo de nicotina, y reforzamiento monetario de abstinencia. Las medidas fueron *concentración de monóxido de carbono (CO) en aliento, auto-reporte de prácticas de fumar, nivel de dependencia a la nicotina, y síntomas de depresión*. Se observaron reducciones significativas en la concentración de CO, la frecuencia de reportes de fumar en presencia de los niños, y los puntajes de dependencia a la nicotina y depresión. Sesenta y uno por ciento de los participantes asistieron a 8 o más sesiones semanales, y un tercio reportó no fumar a los seis meses. Los individuos que continuaron fumando reportaron no haber cambiado sus patrones de fumar ni en el hogar ni en el automóvil. Este tratamiento se compara favorablemente con otras intervenciones para fumadores que solicitan tratamiento, lo que sugiere que es posible reducir la exposición diaria de niños al HAT mediante la implementación, en escuelas, de programas eficaces de tratamiento y educación para padres fumadores.

**Palabras clave:** *humo ambiental de tabaco, dejar de fumar, niños preescolares, cuidadores.*

In addition to the negative health consequences for the smoker, tobacco smoke has adverse health consequences for everyone exposed. Specifically, exposure of children to environmental tobacco smoke (ETS) has been as-

sociated with multiple health problems. These problems, including asthma, are particularly critical for children younger than 5 years (Chilmonczyk et al., 1993; Corbo et al., 1989; Cunningham et al., 1996; DiFranza & Lew, 1996). This is of great concern because a large proportion of children live with adults who smoke. It has been estimated that at least 15 million children in the USA alone are regularly exposed to ETS at home and on vehicles (Schuster et al., 2002). The magnitude of this problem suggests the need to better understand potential tobacco harm reduction methods aimed at lowering exposure to ETS in unregulated environments such as homes and automobiles. The purpose of this study was to evaluate the feasibility and potential efficacy of an evidence-based smoking cessation treatment package for parents and relatives caring for young children attending pre-school, as a way to reduce their exposure to ETS.

Head Start (HS) is a public early childhood intervention program in the USA with a nationwide enrollment of over 822,000 children of economically underprivileged families; the program's main focus is on improving the children's health and school readiness. A recent asthma case-finding study involving caregivers of 2,533 HS children, revealed a 33% prevalence of asthma-like symptoms (Vargas et al., 2004). Three hundred and sixty-eight of the surveyed families of children at risk for asthma were further studied and the children were found to be highly symptomatic: 71% of the children had asthma symptoms at night more than twice a month, 50% experienced asthma-related activity limitations, and more than one third of the parents reported having lost work-days because of their children's respiratory symptoms. Regular exposure of the children to ETS was reported by 49% of the caregivers: 37% at home, and 12% at places other than the family home (e.g., grandmother's). The children's mean urinary cotinine (COT) concentration, a reliable measure of ETS exposure (Berman et al., 2003a; Greenberg, et al., 1984; Hald et al., 2003; Jordaan, 1999) was 15 ng/mL with a range 0 – 188 ng/mL. Specially important to note is that 27% of these children's COT exceeded 20 ng/mL, twice the average concentration found in light smokers (Chilmonczyk et al., 1993; Cornelius et al., 2003; Vardavas, et al., 2006; Winkelstein et al., 1997). Simultaneously, and consistent with other reports (Perez-Stable et al., 2001), most parents in the sample (90.7%) reported having been warned by the child's doctor regarding the adverse effects of ETS on their children's respiratory health. Perez-Stable (2001) found that pediatricians are likely to counsel parents about the health risks of ETS to the child (79%) and to recommend quitting (77%). On the other hand, less than 30% of those who smoke receive cessation support.

Smoking reduction strategies aimed at lowering ETS exposure among children, particularly children with asthma, have shown various degrees of success (Blackburn et al., 2003; Chilmonczyk et al., 1992; Curry et al., 2003;

Eriksen et al., 1996; Hovell et al., 2000a; Woodward et al., 1987; Hovell et al., 1994; McIntosh et al., 1994; Wakefield et al., 2002; Wilson et al., 2001). While one-time minimal interventions appear to be ineffective, more intense interventions have shown success in reducing ETS exposure in children. For example, Hovell (2000b) found that providing asthma education and coaching for ETS reduction to smoking mothers during home visits was effective in motivating parents to reduce ETS exposure among low-income families. In one study, although the primary goal of the study was to reduce ETS exposure and parents were not urged to quit, 10% of the parents in the intervention group reported quitting (Hovell et al., 1994). These results are encouraging, and suggest the need to directly treat caregiver smoking while containing the cost associated with home visits. Furthermore, Blackburn (2003) found while evaluating the effect of harm reduction strategies used by parents, that only banning smoking in the house was associated with a significant reduction in their children's urinary cotinine, compared to less strict strategies such as not smoking in the child's bedroom, or airing the room when smoking. To date, the general consensus regarding interventions to reduce ETS exposure is that a total smoking ban in the household (Blackburn et al., 2003; Hovell et al., 2000b; Hovell et al., 1994; McIntosh et al., 1994) and parental smoking cessation (Curry et al., 2003) may be the only effective ways to significantly reduce children's exposure to ETS.

Certainly, in addition to the positive effects on reducing ETS exposure in children, smoking cessation has the added benefit of improving the health of the adult smoker. Compared with other medical interventions such as mammography or hypertension screening, state of the art smoking cessation is considered to be a cost effective intervention for smokers (CDC, 2003; Fiore et al., 2008). The Centers for Disease Control and Prevention (CDC) recommend that treatment for tobacco dependence be available to anyone who wishes to quit (Fiore et al., 2008; Stitzer, 1999; Wetter et al., 1998). Although most health insurance plans cover tobacco cessation treatment, uninsured adults are unlikely to get medical assistance to quit smoking. Extrapolating from populations with similar demographic characteristics, we estimate that, nationally, over 40% of the parents of children in the HS program are uninsured and lack a primary care provider (Dubay et al., 2000).

Finally, mental health problems have been linked to high prevalence of smoking (Heiligenstein and Smith, 2006; Hu et al., 2007; Weg et al., 2004). For example, a strong positive relationship has been observed between depression symptoms and smoking (Bonnet et al., 2005; Wagena et al., 2004; Weg et al., 2004). This is especially relevant because a caregiver's well-being --particularly mental health and substance use-- is likely to affect the children's health and quality of life (Berman, 2003b). On one hand, depression symptoms may interfere with a caregiver's general ability to care for his/

her children. On the other, a depressed caregiver is more likely to smoke and have difficulty quitting.

Given the significance of caregiver smoking on asthma-like symptoms in the HS pre-school population, the lack of smoking cessation resources available to low-income and uninsured parents, and the difficulty experienced by adults trying to give up cigarettes, this study was designed to evaluate the feasibility and potential efficacy of an evidence-based smoking cessation treatment package for parents and relatives caring for HS children, as a way to reduce their exposure to ETS.

## METHODS

### *Sample and Setting*

Our sample comes from a population of more than 1,000 children enrolling each year in the 32 HS centers in Pulaski County, Arkansas. The county is composed by a mixture of urban and rural regions. To be eligible for HS families must be at or below USA federal poverty level, with enrollment preference given to children with the most severe economic problems and developmental disabilities. This population is highly mobile and difficult to follow. In 2001 approximately 10% of the enrollees in the HS asthma program had no telephone, 30% had their telephone service disconnected at least once, and 15% moved at least once within a 6-month period.

### *Recruitment and Enrollment*

A free smoking cessation program was offered to all caregivers of children in the HS program over a period of two months. *Caregiver* was broadly defined as any member of the family network responsible for tending to the child's needs either full or part time. Any caregiver of a child in HS was eligible to participate. Signs were posted at all the centers, and the HS staff was asked to encourage families to contact the Smoking Cessation Study for inquiries. Forty-three smoking caregivers from ten HS centers enrolled in the cessation study. Five smoking cessation counseling groups were organized; the counseling sessions were conducted at three centrally located HS centers. All study participants signed a written consent form approved by the local Institutional Review Board.

### *Characteristics of the sample*

Participants (N=43) were predominantly African-American (65%) women (84%) with a median age of 39 years (range 18-66). Table 1 shows sample characteristics at baseline.

Table 1  
*Characteristics of the study participants at baseline (N=43)*

<i>Characteristic</i>	<i>Percentage</i>
Female	83.7% (n=36)
Parents	58.1% (n=25)
African American	65.1% (n=28)
Education ≤ HS	60.5% (n=26)
Age	Median 39 years (18-66 years)
Years Smoking	Median 18 years (1-50 years)
Cigarettes per day	Median 20 (2-40)
FTQ score	Median 4 (0-9)
≥Medium dependence	55.8% (n=24)
Caregivers of children with asthma	18.6% (n=8)
Advised about ETS effects on child's health	90.7% (n=39), 65% >10 times
No previous attempts to quit	27.9% (n=12)
Smoked around child	51.2% (n=22)
Smoked in car	60.5% (n=26)
Smoking inside at home	81.4% (n=35)

### *Assessments*

At baseline and at the 6-month follow-up, all participants were asked to complete a smoking behavior questionnaire (Wilson et al., 2001) containing items regarding smoking practices and children exposure to ETS. Participants were also given the Fagerström Tolerance Questionnaire (FTQ; Fagerstrom & Schneide, 1989), and the short version of the Center for Epidemiological Studies depression scale (CES-D; Miller & Markides, 1997; Radloff, 1977; Roberts et al., 1990). The FTQ is widely used to classify smokers according to their degree of nicotine dependence using *number of cigarettes smoked; difficulty refraining from smoking where it is forbidden; smoking more in the morning; smoking when bedridden because of illness; and time after awakening before smoking the first cigarette*. To assess the prevalence of depression symptoms in our sample, we used the short version of the CES-D. This is a 11-item questionnaire originally used to screen for clinical depression in the general population (Radloff, 1977). The questionnaire is easy to complete, and it has been shown valid in screening for depression among women attending public community clinics (Thomas et al., 2001), and in cross-cultural studies (Radloff, 1977; Thomas et al., 2001). Carbon monoxide concentration in exhaled breath (CO) was collected at baseline and weekly during the treatment sessions. Breath CO concentration is an objective measure of exposure to smoke that correlates highly with measurements of urinary cotinine, the primary metabolite of nicotine (Mustonen et al., 2005; Jarvik et al., 2000).

### *Outcomes*

Participants provided breath samples for CO testing at the start of every weekly meeting. During breath sample collection, participants were instructed to take a deep breath and exhale slowly into the CO monitor for 20 seconds. The cut off point used for CO-negative samples was the manufacturer's recommended  $\leq 10$  parts per million (ppm). CO measurements were used to 1) provide participants with objective feedback, and 2) to serve as objective criterion for awarding prizes contingent on smoking reduction. Other outcomes were frequency of self-reports of smoking around the child, smoking indoors at home, and smoking in the car, number of tobacco abstinent participants, and FTQ and CES-D scores.

### *Intervention*

In general, the intervention package followed the guidelines recommended by the Agency for Health Care Research and Quality panel of experts on smoking cessation (AHRQ, 2000). According to these guidelines nicotine replacement therapy (NRT), intra-treatment social support, and problem-solving skills training should be incorporated as components of smoking cessation interventions. The intervention consisted of 12 1-hour sessions during which the American Lung Association's (ALA) Freedom From Smoking<sup>®</sup> program was conducted by research staff trained and certified by the ALA. Freedom From Smoking<sup>®</sup> is a manualized eight group-session program that provides education about the ill effects of smoking, social support, and problem-solving skills. The program uses a positive behavior-change approach and focuses on developing a quitting strategy, understanding nicotine addiction and using nicotine replacement products, dealing with recovery symptoms, controlling weight, managing stress through relaxation, and learning relapse prevention strategies for staying off cigarettes. In this program, session four is the designated Quit Day, occurring once participants have prepared a quitting strategy and learned problem-solving skills. In an attempt to maximize the efficacy of the intervention, nicotine replacement (NRT) and monetary reinforcement for low CO concentration, two highly effective treatments in reducing tobacco use, were added to the ALA package. NRT has been shown most effective in initiating and sustaining abstinence from tobacco when given in conjunction with behavioral treatments (for a comprehensive review, see Fiore et al. 2008). Therefore, all medically-eligible participants were offered a free 1-week supply of their choice of NicoDerm CQ<sup>®</sup> patches (21, 14 or 7 mg step-down system) at every session. Participants were ineligible to receive nicotine patches if they were pregnant, had uncontrolled hypertension, or were taking prescription medication for depression. In turn, monetary reinforcement has been shown highly effective in initiating and sustaining of abstinence from tobacco (Dallery et al., 2007; Heil et al., 2003; Higgins et al., 2004; Higgins

et al., 2005; Olmstead et al., 2007; Robles et al., 2005; Roll & Higgins, 2000; Stitzer & Bigelow, 1983; 1984; Tidey et al., 2002;). In this study, weekly after Quit Day, CO-negative participants were eligible to receive monetary prizes. CO levels were measured at the beginning of each session, and participants with CO levels of  $\leq 10$  ppm were included in the week's raffle of a \$20 gift card. The raffle was conducted and the prize awarded immediately after the CO measures were taken. Finally, all participants were asked to sign the Environmental Protection Agency's (EPA) *Smoke-Free Home* pledge, watch an EPA video on second hand smoke, and attend a 30 minute asthma education session. The session's objective was to insure all participants had received essential information regarding pediatric asthma, and were aware of the negative effects of ETS on their children's health. Participants were paid \$25 per completed questionnaire, plus a \$50 bonus for completing both questionnaires and attending at least 8 of the 12 scheduled counseling sessions.

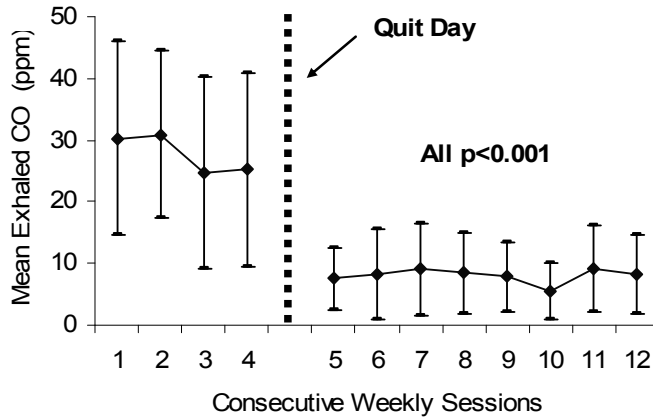
### *Statistical Analysis*

Missing CO samples were counted as positive, and participants lost to follow up were counted as smokers throughout. Baseline characteristics predictive of abstinence at the follow-up were identified using logistic regression. Mean baseline CO concentration was compared to mean weekly concentration during the intervention using Friedman Repeated Measures Analysis of Variance on Ranks. Post hoc comparisons were performed using Tukey's HSD test. Baseline and follow-up outcome variables were compared with paired *t*-tests. Comparisons between participants who quit and those who did not were made with dependent samples *t*-test. SPSS (2004) was used in all analyses.

## RESULTS

Eighty-six percent ( $n = 37$ ) of the participants completed the 6-month follow-up assessments; one participant died before the follow-up. The only significant difference ( $t = 2.3$ ;  $df = 34$ ,  $p = 0.03$ ) between participants who were lost to follow-up and those who completed the 6-month follow-up was the number of years smoking; median = 18 vs. 16 years respectively. Baseline depression scores were higher in the group lost to follow-up but the difference was not statistically significant (24.5 vs. 20).





*Figure 1.* Mean exhaled CO concentration ( $\pm$ SD) during the 12 consecutive counseling sessions for all attendees. CO levels dropped significantly ( $\chi^2= 56.94$ ,  $df= 8$ ,  $p < 0.001$ ) after session 4 (Quit Day). Significantly lower CO levels were observed at all intervention sessions compared to baseline (all  $p < .05$ ).

**Carbon Monoxide.** Figure 1 shows mean breath CO concentration  $\pm$  standard deviation for every session. CO levels dropped significantly ( $\chi^2= 56.94$ ,  $df= 8$ ,  $p < 0.001$ ) after Quit Day. All pairwise comparisons (Tukey's HSD) between baseline and the 8 remaining sessions showed significant reduction in CO level ( $p < .05$ ). During baseline, between 7% and 14% of the CO samples were negative ( $\leq 10$  ppm). Median percentage of CO-negative samples during the 8 post quit-day sessions was 75% (range = 64-100%).

**Attendance.** Median attendance was 8 out of 12 sessions (range = 1-12) with 26 participants (60.5%) attending 8 or more sessions. Using 3 consecutive missed sessions as drop-out criterion, survival was 66% at the end of the intervention.

**Nicotine Replacement Therapy.** Most caregivers (90.7%) accepted at least one box of nicotine patches (median 3, range = 0-7). Two participants were ineligible for NRT; one was pregnant and one had uncontrolled hypertension. Only one participant received the 7 available boxes of nicotine patches.

**Self-Reported Smoking.** Of the initial sample, 32.6 % ( $n = 14$ ) were smoke-free at 6 months (i.e., reported not using any tobacco products in the previous six months, or using NRT only). Seven of the non-smokers reported using NRT to stay smoke-free. One non-smoker reported several lapses. Se-

Table 2

*Smoking behavior, mean nicotine dependence, and depression scores at baseline and the 6-month follow-up. Note that only data for participants in the follow-up session are reported*

<i>Outcome measures (n=32)</i>	<i>Baseline</i>	<i>Follow-up</i>
FTQ Score	4.4	1.4*
Time to first cigarette	2.0	0.6*
Number of cigarettes	0.9	0.2*
CES-D mean score	22	19†
<i>Self-reported smokers (n=23)</i>		
Smoking around child	68%	29%†
Smoking in car	64%	41%§
Smoking inside at home	78%	65%‡

\* $p < 0.001$ ; † $p < 0.01$ ; § $p = 0.10$ ; ‡ $p = 0.63$

ven smokers did not answer all questions at the follow-up and were excluded from the corresponding analyses.

*Children ETS Exposure.* Among those who continued smoking, there was a significant reduction in the number of reports of smoking around their child (68% to 29%;  $t = -3.05$ ,  $df = 15$ ,  $p = .008$ ). However, the observed reductions in reports of smoking indoors, or smoking in the car were not statistically significant (see Table 2). These frequencies were obtained by collapsing responses to “All the time” and “A fair amount of the time” as “Yes” and “Rarely” and “Never” as “No.”

*FTQ Scores.* As shown in Table 2, there was an overall reduction in FTQ scores between baseline and follow-up ( $t = 5.42$ ,  $df = 26$ ,  $p < 0.001$ ), and there were significant reductions in the two critical items of the scale: *time to first cigarette* and *number of cigarettes smoked daily*.

*CES-D Scores.* There was a significant reduction ( $t = 2.65$ ,  $df = 34$ ,  $p = 0.012$ ) in depression scores between baseline and follow-up. Compared to baseline, at follow-up there was an 8% reduction in prevalence of scores suggestive of depression, and nearly a 3-fold reduction in scores suggestive of severe depression. Multivariate logistic regression analysis shows that controlling for the effect of sex, number of years smoking, and level of nicotine dependence, participants with higher CES-D scores at baseline, were more likely to continue smoking (Odds Ratio = 1.145, Confidence Interval: 1.001-1.310).

## DISCUSSION

Worldwide, a large proportion of children are regularly exposed to ETS by caregivers who regularly smoke in their homes and vehicles. In this study, an evidence-based cessation intervention offered to caregivers in the HS preschool program significantly reduced CO readings during the 8-week post quit sessions, and was associated with a reduction in the number reports of smoking around their children, and a 32% abstinence from smoking at the 6-month follow-up. These changes were paralleled by consistent reductions in nicotine dependence and depression symptoms between baseline and the 6-month follow-up.

Controlling for the effect of sex, number of years smoking, and level of nicotine dependence, a higher depression score at baseline was a significant predictor of smoking at the 6-month follow-up. The observed relationship between tobacco abstinence and reduction in depression scores is important and consistent with previous reports, since a caregiver's well-being is likely to affect the child's health and quality of life. For example, a reduction in a caregiver's depression symptoms is likely to have a positive impact on the general level of care that his/her children receive. Although the mechanism relating smoking and depression symptoms is not entirely clear, it is possible that individuals with milder depression symptoms at baseline had been better able to deal with the stress associated with quitting, and that overcoming tobacco dependence might have had positive effects on the person's general mood. Therefore, the overall efficacy of behavioral smoking cessation interventions such as the one evaluated here might be enhanced by simultaneously treating depression symptoms with medication. The results on the effects of selective serotonin reuptake inhibitors on smoking are indefinite at this point, but bupropion hydrochloride (Wellbutrin®/Zyban®), has been shown effective in reducing both cigarette smoking and depression symptoms (Dale et al., 2001; Hayford et al., 1999; Hays et al., 2001, Robles et al., 2005; Hurt et al., 1997).

The study also showed that among those participants who did not quit, signing a smoke-free home pledge, watching the EPA's video-tape on second hand smoke, and attending a lecture on pediatric asthma and ETS did not suffice to reduce smoking at homes and on vehicles. These results suggest that a more direct intervention addressing behavior change in these settings may be needed to reduce ETS exposure among children of nonresponders (Sweanor et al., 2007).

The study has several limitations. For example, the main purpose of having the 6-month assessment was to document the long-term effects of the cessation program; however, although self-reported smoking was surveyed, for reasons unrelated to the study, it was not possible to collect CO sample

at follow-up. In addition, although the ultimate goal of the intervention tested in this study was the reduction of children's exposure to ETS mediated by reduction in caregiver's smoking, based on previous experience, no biomedical measures of ETS exposure were collected out of concern that direct monitoring of children's COT levels might result in low participant recruitment or higher attrition.

In terms of efficacy, the intervention package used compares well with other interventions offered to treatment-seeking volunteers. For example, the CDC report that intensive cessation intervention programs (that include stress management, self-esteem enhancement, group support, and other activities that improve quality of life) targeting women of low SES have had successful cessation rates of 20% to 25% (Fiore et al., 2008), compared to the 32% observed in this study. Our results show that it is possible to successfully engage caregivers of preschool children in a smoking cessation program at HS preschool sites. The intervention targeted adult smoking in the context of both the adults and their children's health, which may have had an additive effect on their motivation to quit (see Hovell et al., 2000b). Future research should focus on enhancing recruitment/referral techniques by working in partnership with community pediatricians, enhancing abstinence in the presence of children, sustaining tobacco abstinence beyond 6 months, and assessing the costs and benefits of implementing the program in day care and/or school settings.

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