Reducing Children’s Exposure to Secondhand Smoke at Home: A Randomized Trial

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KEY WORDS children, nicotine, personalized feedback, randomized controlled trial, secondhand smoke

ABBREVIATIONS

GM—geometric mean
OR—odds ratio
PM—particulate matter
SHS—secondhand smoke

Dr Harutyunyan contributed to the study design, coordinated the data collection, performed data analysis, conceptualized the scope of the paper, and drafted the manuscript; Dr Movsisyan, Dr Stillman, and Dr V. Petrosyan contributed to the study concept and design, accuracy and completeness of data analysis, interpretation of the results, and revision of the manuscript for important intellectual content; and Dr D. Petrosyan contributed to the study design, data collection, and interpretation of the results. All authors approved the final version of the manuscript.

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WHAT’S KNOWN ON THIS SUBJECT: The World Health Organization estimates that ~700 million children breathe tobacco smoke polluted air, particularly at home. Educational strategies either directly or indirectly targeting household decision-makers through other family members are effective in reducing children’s exposure in private homes.

WHAT THIS STUDY ADDS: Intensive intervention was effective in decreasing children’s personal exposure to secondhand smoke (SHS), educating mothers about SHS, and promoting smoking restrictions at home. However, superiority over minimal intervention to decrease children’s personal exposure to SHS was not statistically significant.

OBJECTIVE: To develop and test an intervention to reduce children’s exposure to secondhand smoke (SHS) at homes in Yerevan, Armenia.

METHODS: A single-blind, randomized trial in 250 households with 2- to 6-year-old children tested an intensive intervention (counseling sessions, distribution of tailored educational brochures, demonstration of home air pollution, and 2 follow-up counseling telephone calls) against minimal intervention (distribution of standard leaflets). At baseline and 4-month follow-up, researchers conducted biomonitoring (children’s hair) and surveys. The study used paired t tests, McNemar’s test, and linear and logistic regression analyses.

RESULTS: After adjusting for baseline hair nicotine concentration, child’s age and gender, the follow-up geometric mean (GM) of hair nicotine concentration in the intervention group was 17% lower than in the control group (P = .239). The GM of hair nicotine in the intervention group significantly decreased from 0.50 ng/mg to 0.23 ng/mg (P = .024), unlike in the control group. The follow-up survey revealed an increased proportion of households with smoking restrictions and decreased exposure of children to SHS in both groups. The adjusted odds of children’s less-than-daily exposure to SHS at follow-up was 1.87 times higher in the intervention group than in the control group (P = .077). The GM of mothers’ knowledge scores at follow-up was 10% higher in the intervention group than in the control group (P = .006).

CONCLUSIONS: Intensive intervention is effective in decreasing children’s exposure to SHS through educating mothers and promoting smoking restrictions at home. However, superiority over minimal intervention to decrease children’s exposure was not statistically significant. Pediatrics 2013;132:1071–1080
Secondhand smoke (SHS), a complex mixture of gases and particles that contains many carcinogenic and toxic compounds, results from tobacco smoking indoors. The US Environmental Protection Agency has classified tobacco smoke as a known human carcinogen, with no safe level of exposure. The scientific evidence is clear that SHS exposure causes diseases in adults and children. Children’s exposure is involuntary and primarily occurs through adults smoking in places where children live and play.

Given that >1 billion adults worldwide smoke, the World Health Organization estimates that ~700 million, or almost one-half of the world’s children, breathe air polluted by tobacco smoke, particularly at home. In children, SHS exposure leads to reduced birth weight, lower respiratory tract illnesses, chronic respiratory symptoms, middle ear disease, and reduced lung function. The large number of children exposed to SHS suggests a substantial public health threat worldwide.

Armenia has high rates of tobacco use (63.0% of men; 2.0% of women), with the majority of households (82.2%) having at least 1 smoker. Approximately 70.0% of households do not have any restrictions on smoking.

The World Health Organization recommends legislation and education to protect children from SHS exposure. However, legislation is of limited value in reducing exposure in private homes, and educational strategies, including education about the risks to children from SHS exposure and steps to eliminate exposure, are suggested to be more effective in these settings. Educational programs must strategically target household decision-makers, either directly or indirectly through other family members.

Randomized studies of culturally appropriate tobacco-related interventions, particularly SHS reduction interventions, are rare. Although certain generic approaches may be effective, many agree that an intervention approach that takes into consideration cultural attitudes, norms, expectations, and values would be more likely to increase acceptance and adoption of the program and improve its effectiveness.

The goal of the current study was to test the hypothesis that an intervention which uses motivational interviewing along with immediate feedback and follow-up counseling telephone calls would be effective in educating household members about the health hazards of smoking and SHS exposure and reducing children’s exposure to SHS in households in Armenia.

METHODS

Study Design

The study was a randomized controlled trial with 2 arms (intervention and control groups) conducted from May 2010 to November 2010 (Fig 1). A pilot study of 10 households preceded the clinical trial to test the recruitment strategy, study protocols, and instruments and to finalize intervention strategies.

Study Population

The sample population included households with a nonsmoking mother and at least 1 child 2 to 6 years of age residing with at least 1 daily smoker. The study targeted homes with young children for whom the major source of exposure to tobacco smoke was smoking by parents or other household members.

The study team recruited the households through pediatrician’s offices in Armenia.

<table>
<thead>
<tr>
<th>Clinical Trial</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Intervention</td>
<td>Control</td>
</tr>
<tr>
<td>Hair sampling for assessment of hair nicotine concentration</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counseling and demonstration of PM2.5 measurement</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Educational material</td>
<td>X&lt;sup&gt;a&lt;/sup&gt;</td>
<td>X&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Counseling telephone calls (1- and 2-month follow-up)</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Surveys</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FIGURE 1**

Study design. <sup>a</sup> Educational brochure, “Secondhand Tobacco Smoke and the Health of Your Family.” <sup>b</sup> Leaflet by the US Environmental Protection Agency.
polyclinics (primary health care facilities) by using multistage random sampling. First, the study team randomly selected 10 polyclinics from the list of 19 providing services to the population of Yerevan, the capital city of the Republic of Armenia. At each polyclinic, the study team selected 5 pediatrician offices (those that were open at the time of the study) and randomly selected medical records of children aged 2 to 6 years. The study team recruited 5 eligible households from each pediatrician. Interviewers telephoned each household selected to check for eligibility, provide information about the study and its procedures, and arrange the first home visit upon oral consent. The 250 households recruited were assigned random numbers from 1 to 250; households with odd numbers were included in the intervention group (intensive intervention) and those with even numbers were included in the control group (minimal intervention). Study participants were unaware of their assignment status.

Data Collection
Trained interviewers made 2 baseline visits (1 week apart) and two 4-month follow-up household visits to conduct measurements, surveys, and the intervention (Fig 1). Measurements included hair samples from children to assess changes in nicotine concentration over time; this biomarker is a validated method to quantify personal uptake of nicotine.11,12 Given that each centimeter of hair reflects ~1 month of exposure to SHS, a small sample of hair (~30–50 strands, 2–3 cm) was cut near the hair root from the back of the scalp where there is the most uniform growth pattern between individuals; this method minimizes the variability of the results.12 Surveys were conducted among nonsmoking mothers and 1 of the daily smokers in each household. The first choice was the father; if he was a daily smoker. If the father did not smoke, the counseling was conducted with 1 of the household smokers who spent more time with the child at home. The interviewer-administered questionnaire required ~15 minutes to complete and covered demographic information, knowledge about health hazards of SHS, and household smoking-related practices. The instrument was adapted from the Global Adult Tobacco Survey: Core Questionnaire With Optional Questions.13 The study team translated the questionnaire into Armenian and pretested it during the pilot phase.

Intervention
The intervention included an in-person counseling session with the nonsmoking mother and at least 1 daily smoker in each household, with distribution of a tailored educational brochure and demonstration of measurement of indoor particulate matter (PM$_{2.5}$) (at second baseline visit); it also included 2 follow-up counseling telephone calls 1 and 2 months after the initial session. The intervention was based on the motivational interviewing technique, which is a directive, client-centered counseling technique for eliciting behavior change that has been shown to be effective in smoking cessation and SHS reduction interventions.14–16 The control group received only a brief educational leaflet on the hazards of SHS developed by the US Environmental Protection Agency.17

In-person Counseling Session
The study team provided counseling on eliminating child exposure to tobacco smoke to at least 1 daily smoker and to the mother in the household. The counseling session emphasized the following issues: (1) importance of a healthy environment at home; (2) health dangers of smoking and exposure to SHS; (3) why and how to quit smoking; and (4) how to keep home air smoke-free. At the end of the 40-minute counseling session, each family received a tailored and culturally adjusted educational brochure developed by the study team.

Demonstration of PM$_{2.5}$ Pollution
The study team measured the PM$_{2.5}$ in the air by using the TSI AM 510 Aerosol SidePak$^{18}$ to compare the quality of indoor air with outdoor air and demonstrate the effect of smoking on indoor air quality in the intervention households. After completing the PM$_{2.5}$ measurement, the interventionist immediately downloaded the data to a laptop to visualize the results through graphical presentation of the PM$_{2.5}$ fluctuations for immediate feedback (Fig 2). Feedback, as part of an intervention, has been extensively used in health promotion, particularly for addictive behavior change.19 Demonstration of the indoor PM$_{2.5}$ pollution was a risk-based personalized feedback requiring less effort from participants to make the information personally relevant.

Follow-up Counseling Telephone Calls
Interventionists made 2 follow-up counseling telephone calls to nonsmoking mothers at 1 and 2 months after the in-person counseling session. These calls aimed at: (1) assessing the progress in meeting the goals set earlier; (2) counseling on barriers to change; and (3) encouraging study participants to maintain progress made or to set new goals. These calls also provided an opportunity to ask questions or clarify issues.

Sample Size Calculation
The sample size calculation was based on data from an earlier study.20 Using the formula for comparison of 2 groups of equal size and assuming a type I error of 0.05 to detect a 30% reduction in hair nicotine concentration in the intervention group and a 10% reduction in the control group, 62 households were needed in each group to detect the hair nicotine concentration changes with 80%
power. Adjusting for 10% potential refusal to provide hair samples and 40% potential losses to follow-up, the study estimated the sample size to be equal to 250.

Data Analysis
The data were analyzed by using Stata version 10 (Stata Corp, College Station, TX). The study team compared the baseline and follow-up measurements in both groups by using paired t tests for comparison of continuous measures and McNemar’s test for paired proportions. The primary outcome variable was child’s hair nicotine concentration. Self-reported household smoking restrictions, frequency of smoking in the presence of the child, and participants’ knowledge scores were the secondary outcomes. We assessed the respondents’ knowledge by asking whether smoking or SHS caused a list of health conditions, with 1 point for each correct answer. The knowledge score was calculated as the sum of all scores on the knowledge questions.

Time-weighted average of hair nicotine was assayed at the Exposure Assessment Facility at Johns Hopkins Bloomberg School of Public Health. The skewed hair nicotine concentration data were log-transformed for statistical analysis. In addition, to compare hair nicotine concentrations at baseline and follow-up, we estimated the geometric mean (GM) and 95% confidence intervals of the hair nicotine concentrations.

The study team also compared the change in the outcome variables from baseline to follow-up between the intervention and control groups by using multiple logistic and linear regression models. The follow-up measurements were considered as dependent variables, baseline measurements and other potential confounders as independent variables, and the intervention as the main dichotomous independent variable of interest.

The study used an intention-to-treat approach during statistical analyses to avoid the drop-out effect by imputing all the missing follow-up data with their baseline values.

Ethical Considerations
The institutional review boards of Johns Hopkins Bloomberg School of Public Health and American University of Armenia approved the study.

RESULTS
Participants’ Recruitment and Retention
More than one-half of the contacted households (58.2%) were not eligible for participation, 30.3% refused to participate (most of them refused before the eligibility criteria screening), and 0.7% agreed but were not available for baseline data collection. Overall, 250 households were enrolled in the study, and 250 mothers and 230 smokers participated in the baseline survey. At baseline, 173 households agreed to provide hair samples from their child (83 intervention, 90 control). Of 244 households eligible for the follow-up...
Participants’ Characteristics

The mean ± SD age of nonsmoking mothers was 30.0 ± 5.2 years. Almost one-half (53.6%) were employed, and more than one-third (36.3%) had graduated with a university degree. The mean age of smokers was 38.2 ± 11.4 years, and the overwhelming majority (81%) were the children’s fathers. Approximately 31.3% of smokers had a university degree, and 72.1% were employed over the past 12 months. The mean age of children was 4.0 ± 1.2 years, and 49.1% were girls. Demographic characteristics of participants were similar in the intervention and control groups (Table 1).

Children’s Hair Nicotine Concentration

Table 2 presents the summary of the hair nicotine concentrations at baseline and follow-up. The GM of hair nicotine levels of control group children at baseline and follow-up was 0.29 ng/mg and 0.27 ng/mg, respectively (P = .613). For the intervention group, GM decreased from 0.30 ng/mg to 0.23 ng/mg, and this 23.3% decrease was statistically significant (P = .024).

Multiple linear regression analysis demonstrated that after adjusting for the baseline hair nicotine concentration, child’s age, and child’s gender, the follow-up GM of hair nicotine concentration was 17% lower in the intervention group compared with the control group (P = .239) (Table 3).

Smoking Practices in Households

At baseline, there were 1.5 ± 0.8 smokers in each household smoking a mean of 25.5 ± 11.5 cigarettes per day. Smoking was allowed in all households, with some restrictions in approximately one-half of homes. According to mothers, 5 (4.5%) intervention households and 6 (5.4%) control households completely banned indoor smoking at follow-up. In addition, 5 (4.5%) smokers in the intervention group and 1 (0.9%) in the control group have reportedly stopped smoking at follow-up.

Table 4 presents the proportion of households with smoking restrictions at baseline and follow-up. Based on mothers’ report, the odds of having any smoking restriction at follow-up was statistically significantly higher than at baseline in both the intervention (odds ratio [OR]: 4.67) and control (OR: 3.14) households. According to the smokers, the increase in the proportion of households with smoking restrictions at follow-up was statistically significant only in the intervention group (OR: 2.62). At follow-up, mothers and smokers in both groups reported statistically significantly less exposure of children to SHS (Table 5).

Multiple logistic regression analysis found that, based on mothers’ report, at follow-up the adjusted odds of child’s less-than-daily exposure to SHS was marginally significantly higher in the intervention group compared with the control group (OR: 1.87, P = .077) (Table 6).

Knowledge About Hazards of Smoking and SHS

Paired analysis of knowledge scores revealed that the knowledge of intervention and control group participants increased significantly from baseline to follow-up. The mothers’ mean knowledge score increased from 9.5 to 11.5 in the intervention group and from 9.8 to 10.5 in the control group. Among smokers, it increased from 7.1 to 8.6 and 7.1 to 7.9, respectively. Linear regression analysis suggests that the GM of the mothers’ knowledge score at follow-up was 10% higher in the intervention group compared with control group, after controlling for baseline knowledge score (P = .006).

DISCUSSION

Protecting children from SHS exposure at homes is a complex and sensitive issue and has many social and political implications; hence, it is difficult to monitor and regulate people’s behavior at home. There is a large disparity between male and female smoking rates in Armenia, which poses an additional unique challenge for protecting young children from tobacco smoke in similar societies. This study was the first clinical trial in Armenia designed to develop and test a culturally appropriate intervention to encourage implementation of smoke-free homes and reduce children’s exposure to SHS.

The results of this trial suggest that adjusted follow-up GM of hair nicotine concentration in the intervention group was 17% lower compared with the control group. However, this difference was not statistically significant, which could be due to insufficient power, as fewer numbers of families provided hair samples at follow-up. The comparison of children’s hair nicotine concentration at baseline and follow-up revealed statistically significant decreases only in the intervention group.

A higher proportion of households at follow-up in both groups had smoking restrictions and decreased smoking next to the child. Mothers reported marginally significantly less daily exposure of children to SHS in the intervention group than in the control group. Knowledge score improved in both the intervention and control groups;
However, improvement of the mothers’ knowledge score was statistically significantly higher in the intervention group only.

Some of the observed changes in both groups might have been prompted by participation in the study, focusing on children’s exposure to SHS at homes. Moreover, other researchers have also reported difficulties in detecting the true difference between groups when the control...
The current study evaluated the effectiveness of an intervention package that included PM2.5 measurement at home to demonstrate the effect of smoking on indoor air quality in the intervention households. PM2.5 measurement does not require laboratory analysis as do passive air and hair nicotine measurements, and it allows an immediate and continuous measurement to characterize SHS dangers more real to participants than if they had merely heard or read about it.

A number of studies have investigated methods to reduce children's SHS exposure by targeting parental smoking behavior change or smoking cessation. Some of them demonstrated success through decreased children's SHS exposure measured according to self-reported parental smoking, reduced levels of air nicotine concentrations, or reduced urine cotinine assays. The current study used participants' self-reported and biochemical (hair nicotine) measures for outcome analysis. Hair nicotine concentrations provide better information on long-term SHS exposure than biomarker measures in urine, saliva, or serum because of the shorter half-life of the latter biomarkers. Studies investigating the correlation between self-reported and objective measures demonstrated that self-reported exposure to SHS may be both a valid and reliable measure to characterize SHS exposure.

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### TABLE 1 Baseline Demographic Characteristics of Respondents

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mothers</th>
<th>Household Smokers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intervention Group (n = 125)</td>
<td>Control Group (n = 124)</td>
</tr>
<tr>
<td>Age, mean ± SD, y</td>
<td>30.4 ± 5.2</td>
<td>29.7 ± 5.2</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary/less than secondary school</td>
<td>45 (36.0)</td>
<td>53 (43.1)</td>
</tr>
<tr>
<td>2-year college</td>
<td>30 (24.0)</td>
<td>30 (24.4)</td>
</tr>
<tr>
<td>University/postgraduate degree</td>
<td>50 (38.4)</td>
<td>40 (32.5)</td>
</tr>
<tr>
<td>Employed</td>
<td>66 (52.8)</td>
<td>67 (54.5)</td>
</tr>
<tr>
<td>Male gender, child</td>
<td>61 (49.2)</td>
<td>69 (55.2)</td>
</tr>
<tr>
<td>Relationship to the child</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td>125 (100)</td>
<td>124 (100)</td>
</tr>
<tr>
<td>Father</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Grandfather</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Grandmother</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Uncle</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Unless otherwise noted, values are given as n (%).

a No statistically significant differences between the intervention and control groups (P > .05).

### TABLE 2 Hair Nicotine Concentration (Nanogram/Milligram) According to Intervention and Control Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Intervention Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline (n = 83)</td>
<td>Follow-up (n = 83)</td>
</tr>
<tr>
<td>Mean (95% CI)</td>
<td>0.54 (0.42–0.67)</td>
<td>0.40 (0.30–0.50)</td>
</tr>
<tr>
<td>Median (IQR)</td>
<td>0.30 (0.14–0.87)</td>
<td>0.27 (0.11–0.52)</td>
</tr>
<tr>
<td>GM (95% CI)</td>
<td>0.30 (0.23–0.39)</td>
<td>0.23 (0.18–0.29)</td>
</tr>
</tbody>
</table>

CI, confidence interval; IQR, interquartile range.

a Paired t test using log-transformed data.

### TABLE 3 Multiple Linear Regression Model for Children’s Follow-up Hair Nicotine Concentration

<table>
<thead>
<tr>
<th>Variable</th>
<th>Ratio of GM</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1.00</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Intervention</td>
<td>0.83</td>
<td>0.61–1.14</td>
<td>.238</td>
</tr>
<tr>
<td>Child’s age, y</td>
<td>0.94</td>
<td>0.63–1.08</td>
<td>.366</td>
</tr>
<tr>
<td>Baseline hair nicotine concentration, ng/mg</td>
<td>1.57</td>
<td>1.30–1.77</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Child’s gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.00</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Female</td>
<td>1.04</td>
<td>0.76–1.42</td>
<td>.825</td>
</tr>
</tbody>
</table>

CI, confidence interval.
This study was a single-blind trial: the participants did not know whether they were assigned to the intervention or control group; they were also blinded to the study hypothesis and details of the intervention and control group procedures, which minimized the possibility of differential reporting regarding the outcome variables. Seasonal variations were shown to affect the level of indoor SHS exposure in earlier studies. The current study conducted measurements in late spring and early autumn (with similar weather conditions) to adjust for seasonal fluctuations in indoor smoking behavior; therefore, we had to limit the follow-up period to 4 months. However, this limited time interval does not allow for evaluation of longer-term effects of the intervention. This intervention was not designed to achieve smoking cessation; however, a few smokers did quit. Several studies have shown that strategies which target SHS reduction may indirectly lead to smoking cessation. The meta-analysis of published controlled trials found that interventions targeting children had tangible potential for modification of parental behavior, including parental smoking cessation rate. The findings of this study emphasize the importance of motivational interviewing and providing immediate personalized feedback for addictive behavior change. They could be relevant not only for Armenia but other countries, particularly former Soviet Republics with similar rates of smoking and high exposure to SHS, and for other countries with large disparities in male/female smoking rates. This intervention can be tested in other settings. In Armenia, pediatricians and pediatric nurses are required to make 2 home visits to newborns. Moreover, monthly well-check visits to primary health care clinics are covered by the state for infants aged <1 year. Such a system

### Table 4 Smoking Restrictions Before and After the Intervention

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Group</th>
<th>Follow-up</th>
<th>Baseline, n (%)</th>
<th>ORa (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Any Restriction</td>
<td>No Restriction</td>
</tr>
<tr>
<td>Mother</td>
<td>Intervention</td>
<td>Any restriction</td>
<td>45 (36.0)</td>
<td>28 (22.4)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Any restriction</td>
<td>55 (44.4)</td>
<td>22 (17.7)</td>
</tr>
<tr>
<td>Smoker</td>
<td>Intervention</td>
<td>Any restriction</td>
<td>61 (50.8)</td>
<td>21 (17.8)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Any restriction</td>
<td>8 (6.8)</td>
<td>28 (23.7)</td>
</tr>
</tbody>
</table>

CI, confidence interval.

### Table 5 Children’s Exposure to SHS Before and After the Intervention

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Group</th>
<th>Follow-up</th>
<th>Baseline, n (%)</th>
<th>ORa (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Less Than Daily</td>
<td>Daily</td>
</tr>
<tr>
<td>Mother</td>
<td>Intervention</td>
<td>Less than daily</td>
<td>4 (3.2)</td>
<td>25 (20.0)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Less than daily</td>
<td>0 (0)</td>
<td>96 (76.8)</td>
</tr>
<tr>
<td>Smoker</td>
<td>Intervention</td>
<td>Less than daily</td>
<td>6 (5.1)</td>
<td>17 (14.5)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Less than daily</td>
<td>2 (1.7)</td>
<td>92 (78.6)</td>
</tr>
</tbody>
</table>

CI, confidence interval.

### Table 6 Unadjusted and Adjusted ORs for Comparing Intervention and Control Groups According to Household Smoking Restrictions and Children’s Exposure to SHS

<table>
<thead>
<tr>
<th>Variable</th>
<th>ORa (95% CI)</th>
<th>Adjusted ORb,c (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household smoking restrictions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No restriction</td>
<td>1.00 (Ref)</td>
<td>1.00 (Ref)</td>
</tr>
<tr>
<td>Any restriction</td>
<td>1.06 (0.58–1.94)</td>
<td>1.10 (0.59–2.05)</td>
</tr>
<tr>
<td>Children’s exposure SHS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily</td>
<td>1.00 (Ref)</td>
<td>1.00 (Ref)</td>
</tr>
<tr>
<td>Less than daily</td>
<td>1.73 (0.89–3.42)</td>
<td>1.87 (0.83–3.74)</td>
</tr>
</tbody>
</table>

CI, confidence interval.

* Univariate logistic regression analysis.

* Multiple logistic regression analysis.

* Adjusted for child's age, child's gender, participant's baseline knowledge and attitude scores, baseline household smoking restrictions, and children's exposure to SHS.
would allow for developing and testing a pediatric practice-based modification of our model to reduce children’s exposure to SHS at homes.

CONCLUSIONS

This study demonstrated that in-person counseling, along with provision of immediate personalized feedback and follow-up counseling telephone calls, was effective in decreasing children’s personal exposure to SHS. In addition, it more effectively educated nonsmoking mothers about the health hazards of SHS and promoted smoking restrictions at home than providing an educational leaflet alone. The superiority of intensive intervention over the minimal intervention was not statistically significant; there is a need for a cost-effectiveness evaluation to justify implementation of the intensive intervention or to test its effectiveness in other settings.

ACKNOWLEDGMENTS

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REFERENCES


24. Wilson I, Semple S, Mills LM, et al. REFRESH— reducing families’ exposure to secondhand...
CIRCADIAN RESET WHILE RESTING UNDER THE STARS: The internal clocks that govern our sleep-wake cycle are heavily influenced by artificial light exposure. Increasingly exposed to artificial light deep into the evening hours, many have pushed bedtime back, only to still wake up groggy even after eight hours of sleep. For those of us who wish we could be more in tune with a natural sleep cycle, a week outdoors may be all we need to put us back on track.

As reported by the BBC (Science & Environment: August 1, 2013), researchers investigating the effect of artificial light on sleep-wake cycles found an association between increased natural light exposure and changes in study participants’ circadian rhythms. Eight participants’ self-selected sleeping patterns were observed after one week in their typically electrically-lit environments and then again following one week of camping in Colorado where the only light came from the sun and a campfire. Melatonin, a hormone closely linked to circadian modulation and sleep onset was measured in participant salivary samples. Generally, melatonin rises just before sleep and decreases through the night until awakening. During the camping portion of the study, participants were exposed, on average, to four times the light exposure experienced in their electrically-lit environment.

While in their typical artificially-lighted environment, melatonin elevations rose two hours before going to sleep, usually at midnight or so, and remained elevated even after awakening, suggesting that they were out of sync with their natural rhythm. However, after one week of camping, melatonin levels rose two hours earlier (around 9-10 pm), with elevations occurring nearer to the time of sunset. Melatonin levels fell early in the morning about the time of participants’ natural awakening and close to sunrise. No significant changes in sleep duration or efficiency occurred when the environment was changed.

While this study is small, it indicates that exposure to artificial light potentially acts as a strong, though easily changed, external cue. If future research solidifies the relationship between natural light, sleep-wake cycles, and melatonin, spending more time outside seems like a great way to tune our biologic clock.

Noted by Leah H. Carr, BS, MS-IV
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Arusyak Harutyunyan, Narine Movsisyan, Varduhi Petrosyan, Diana Petrosyan and Frances Stillman
Pediatrics 2013;132;1071
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