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Telephone-assisted placement of air nicotine monitors to validate self-reported smoke-free home policies

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SUMMARY

Objectives—To examine the feasibility of telephone-assisted placement of air nicotine monitors among low socio-economic intervention participants, and examine the use of this strategy in differentiating air nicotine concentrations in rooms where smoking is allowed from rooms where smoking is not allowed.

Methods—Forty participants were recruited from a county health department clinic and were enrolled in a brief smoke-free home policy intervention study. Twenty participants were selected at random for air nicotine monitor placement, and were instructed to telephone study staff who assisted them in monitor placement in their homes at the end of the intervention. Assessments were conducted at Weeks 0 and 8, with air nicotine assessment performed post-test.

Results—Of the 20 participants, 17 placed and returned the air nicotine monitors, and 16 also completed the follow-up survey. Follow-up survey data were not obtained on one monitor, and one participant who did not return the monitor completed the follow-up survey. Among those who reported a smoke-free policy ($n=7$), the average nicotine concentration was $0.62 \mu\text{g}/\text{m}^3$ [standard deviation (SD) 0.48]. Among those without a smoke-free policy ($n=9$), the average nicotine concentration was $2.30 \mu\text{g}/\text{m}^3$ (SD 2.04). Thus, the air nicotine concentration was significantly higher in those rooms where smoking was allowed [$t(9, 11)=-2.39, P=0.04$].

Conclusions—The use of a telephone-assisted protocol for placement of air nicotine monitors was feasible. Despite the variability of air nicotine concentrations in rooms where smoking is allowed compared with rooms where smoking is not allowed, average concentrations were lower in smoke-free rooms.

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Ethical approval

The current study was approved by the Emory University Institutional Review Board.

Competing interests

None declared.

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Keywords

Secondhand smoke; Interventions; Smoke-free policy; Tobacco control

Secondhand smoke (SHS) exposure increases the risk of lung cancer, stroke, coronary heart disease and respiratory problems.¹ Among children, SHS exposure is associated with increased risk of respiratory infections (including asthma, bronchitis and pneumonia), severity of asthma symptoms, middle ear infections and sudden infant death syndrome.¹ With increased policies restricting smoking in public places in the USA, homes are the primary source of SHS exposure.¹ However, having a smoke-free home reduces SHS exposure.^{2,3} As a result, interventions promoting smoke-free homes have been delivered through clinic-based programmes;⁴ mass media campaigns; and remotely via mail, telephone or other technology-based approaches.⁵

Research examining SHS exposure uses air nicotine monitors as the gold standard for assessing air nicotine concentrations, as they assess the level of nicotine-specific particles in the air.⁶ Typically, trained research staff are responsible for the placement and removal of air nicotine monitors. However, with technology-based and other remotely administered interventions becoming more common, it may not be feasible to have trained staff place and remove the monitors, as this approach may be costly or may have a negative impact on recruitment if participants are not comfortable with staff entering their homes. Despite this challenge to research staff monitor placement, no published research has documented a process for distance placement of air nicotine monitors or the feasibility of such a process. Thus, this study examined: (1) the feasibility of telephone-assisted placement of air nicotine monitors among low socio-economic (SES) intervention participants; and (2) the use of this strategy in differentiating air nicotine concentrations in rooms where smoking is allowed from rooms where smoking is not allowed. This information may support the development of telephone-assisted placement protocols for collecting validation assessments of future smoke-free policy interventions.

The current study, approved by Emory University Institutional Review Board, draws from data collected as part of a pilot test of a brief smoke-free homes intervention⁵ targeting 20 smokers living with at least one other person in the household and 20 non-smokers living with a smoker, recruited via fliers from a county health department clinic in Atlanta. Twenty participants were selected at random to receive a 16-g air nicotine monitor, purchased from and analysed by the Johns Hopkins Bloomberg School of Public Health. Ten days prior to the final follow-up interview, selected participants were mailed a monitor to measure household air nicotine concentrations. The monitor contains a filter treated with sodium bisulphate attached to a polystyrene cassette with a nucleopore windscreen, allowing air passage at a flow rate of 0.024 dm³/min. Monitors were shipped in a padded envelope along with materials necessary for placement and return (e.g. latex-free gloves, self-addressed and stamped padded envelope).

Upon receipt of the monitor, participants were instructed to call the research office for telephone-guided placement assistance. During the call, research staff informed participants of the monitor's purpose and methods, and instructed participants to put on the gloves,

remove the monitor from the sealed bag and protective cup, and select a room where household members spent most of their time for placement of the monitor. Participants were asked to place the monitor 2–4 feet (0.61–1.22 m) above the floor and 2–4 feet (0.61–1.22 m) away from windows or mechanical ventilation. They recorded the date and time of placement. Two participants were sent duplicate monitors and asked to follow the same procedures at the same time for both monitors. Monitors were in place for 7 days. For the blank monitor, staff removed the cover for 5 s, replaced the cap, placed it in the sealed bag and cup, and housed it at the research office until all monitors were shipped for analysis. Blank monitor data were used to correct for nicotine levels indicated in the experimental monitor data.

A 30-min telephone-administered baseline survey and an 8-week follow-up survey assessed sociodemographics, smoking status and smoke-free policy status. Research staff attempted to call participants up to 12 times before discontinuing attempts. Participants were compensated with a \$25 gift card for completing each assessment. Those selected for air nicotine monitors received an additional \$25 gift card for returning the monitor. The authors assessed whether smoking was allowed in the room where the monitor was placed in order to account for air nicotine exposure in that location. During the placement call, the participant was asked ‘Which room do you and your household members spend most of your time?’ Participants were instructed to place the monitor in that room. During the follow-up survey, the participant was asked ‘In what room or rooms is smoking allowed? Family/living room? Kitchen? Bathroom(s)? Participant’s bedroom? Other adults’ bedroom(s)? Children’s bedroom(s)? Other?’ These responses were matched to determine if smoking was allowed in the room where the monitor was placed. Also during the placement call, participants reported the number of doors and windows leading outside and room size. If participants did not know the room size, they were guided to measure the room’s width and length in steps.

Room sizes were computed using measurements (m) provided or, in the case of steps, using average stride lengths for men (79 cm) and women (66 cm).^{7,8} Data from duplicate monitors were averaged, and the differences between the duplicate monitors were divided by the larger quantity of the two to yield the percentage difference in air nicotine concentration. An independent samples *t*-test examined air nicotine concentrations in rooms where smoking was allowed and rooms where smoking was not allowed. Statistical Package for the Social Sciences Version 19.0 (SPSS Inc., Chicago, IL, USA) was used for analyses. Significance was set at $\alpha=0.05$.

Table 1 presents the participants’ characteristics. Of the 20 participants selected at random to receive and place the monitors, 17 placed and returned them, and 16 also completed the follow-up survey (i.e. had complete monitor data and survey data). Followup survey data were not obtained on one monitor (air nicotine concentration of $0.27 \mu\text{g}/\text{m}^3$) due to an inability to reach the participant within the 12 call attempts. One participant who did not return the monitor completed the follow-up survey.

Telephone-guided monitor placement took approximately 10 min, with approximately three calls needed to reach participants. Among those who engaged in the placement call and

returned the monitors ($n=17$), the average room size was 60.4 m² (range 13.4–163.4 m²). Most participants ($n=15$) indicated the living/family room as the room where household members spent the most time, followed by the bedroom ($n=2$). Thus, these rooms were selected for monitor placement. The majority of participants' questions were related to placement and return procedures, and clarification on the monitor's purpose (e.g. type of smoke detected).

Among those with complete data ($n=16$), three participants reported a total smokefree home policy. Among these, the average nicotine concentration was 0.69 µg/m³ [standard deviation (SD) 0.63]. Those who reported not allowing smoking in the room where the monitor was placed ($n=7$) had lower average nicotine concentrations per min of 0.62 µg/m³ (SD 0.48, range 0.00–1.36) compared with 2.30 µg/m³ (SD 2.04, range 0.00– 5.89) among those who allowed smoking in the room where the monitor was placed [$n=9$; $t(9, 11)=-2.39$, $P=0.04$]. Considering room size yielded similar results. Differences between duplicate monitors were 4.8% and 9.0%.

To the authors' knowledge, this is the first study to report on the process and feasibility of telephone-assisted air nicotine monitor placement among a low-SES population enrolled in a brief smoke-free home intervention study. The majority of participants were willing and able to place and return the air nicotine monitors. Moreover, the results of the monitor analyses were aligned with expected air nicotine concentrations, according to a recent review,⁹ although there is a great amount of variability in concentrations depending on setting and study population.⁹

Air nicotine concentrations were lower among participants who reported that smoking was not allowed in the room where the monitor was placed compared with those where the monitor was placed in a rooms where smoking was allowed. Despite the fact that only three participants reported complete smoke-free policies, the seven participants who reported that smoking was not allowed in the room where the monitor was placed had lower air nicotine concentrations compared with the rooms where smoking was allowed. Thus, the findings support the potential harm reduction benefit of partial smoking bans. However, a larger sample size would be needed to examine the added benefits of complete smoke-free policies in terms of air nicotine concentrations.

This pilot study has several limitations. First, it included a small sample size. Also, the authors were unable to assess differences between participants who placed the monitors and those who did not due to the small sample size. Air nicotine concentrations were validated against self-reported smoking bans, which may have been subject to reporting bias. The estimates of distance based on stride length from previous literature may not have reflected the distance of stride lengths accurately for this population. Finally, the results may not be generalizable to the general population, as this study sample was predominantly urban, African American and low income.

In conclusion, the use of a telephone-assisted protocol for placing, removing and returning air nicotine monitors was feasible. Moreover, despite the variability of air nicotine concentrations in rooms reported to be smoke-free vs rooms where smoking was allowed,

there were significant differences, suggesting that the telephone-assisted placement methods were effective. The current work is critical in developing protocols for validating smoke-free home policies in similar distance-delivered interventions or research.

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Table 1Participant characteristics ($n=20$).

Variable	<i>n</i> (%) or mean (SD)
<i>Baseline</i>	
Age (years)	41.10 (10.38)
Race	
White	1 (5.0)
African American or Black	18 (90.0)
Other	1 (5.0)
Gender	
Male	6 (30.0)
Female	14 (70.0)
Education	
Less than high school	1 (5.0)
Some high school	8 (40.0)
High school graduate or GED	3 (15.0)
Vocational or technical school	2 (10.0)
Some college	6 (30.0)
Employment status	
Employed full time	6 (30.0)
Employed part time	3 (15.0)
Not employed	11 (55.0)
Annual household income (US\$)	
10,000	7 (35.0)
10,001–25,000	6 (30.0)
>25,000	7 (35.0)
Home ownership	
Own	5 (25.0)
Rent	15 (75.0)
Healthcare coverage	
No healthcare coverage	5 (25.0)
Coverage through employer	4 (20.0)
Medicaid or medical assistance	8 (40.0)
Other	4 (20.0)
Smoking status at baseline	
Smoker	10 (50.0)
Non-smoker living with smoker	10 (50.0)
<i>Follow-up^a</i>	
Ban status at follow-up	
Full ban	4 (23.5)
Partial ban	12 (70.6)
No ban	1 (5.9)

Variable	<i>n</i> (%) or mean (SD)
Rooms in which smoking allowed (%)	
Family/living room	7 (41.2)
Kitchen	2 (11.8)
Bathroom(s)	6 (35.3)
Participant's bedroom	6 (35.3)
Other adults' bedroom(s)	4 (23.5)
Children's bedroom(s)	5 (29.4)
Other (den)	1 (5.9)
Air nicotine concentrations per min, ($\mu\text{g}/\text{m}^3$) ^b	
Smoking not allowed in the room	0.62 (0.48)
Smoking allowed in the room	2.30 (2.04)

SD, standard deviation.

^aMissing three participants at follow-up.

^b $t(9, 11)=-2.39, P=0.04$