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Improving tobacco dependence treatment outcomes for smokers of lower socioeconomic status: A randomized clinical trial*

Christine E Sheffer¹, Warren K Bickel², Christopher T Franck³, Luana Panissidi¹, Jami Pittman¹, Helen Stayna¹, Shenell Evans¹

¹City University of New York School of Medicine, City College of New York, 160 Convent Ave, New York, NY 10031; Telephone: 212.650.6217

²Advanced Recovery Research Center, Virginia Tech Carilion Research Institute, 2 Riverside Circle, Roanoke, VA 24016; Telephone: 540.581.5103

³Department of Statistics, Virginia Tech, Blacksburg, VA 24061; Telephone: 540-231-4375

Abstract

Introduction—Evidence-based treatments for tobacco dependence are significantly less effective for smokers of lower socioeconomic status which contributes to socioeconomic disparities in smoking prevalence rates and health. We aimed to reduce the socioeconomic gradient in treatment outcomes by systematically adapting evidence-based, cognitive-behavioral treatment for tobacco dependence for diverse lower socioeconomic smokers.

Methods—Participants were randomized to adapted or standard treatment, received six 1-hour group treatment sessions, and were followed for six months. We examined the effectiveness of the adapted treatment to improve treatment outcomes.

Results—Participants (n=227) were ethnically, racially, and socioeconomically diverse. The adapted treatment significantly reduced the risk ratio for days to relapse for the two lowest socioeconomic groups: SES1: RR = 0.63 95% CI, 0.45, 0.88, p = 0.0013 (M=76.6 (SD 72.9) vs. 38.3 (SD 60.1) days to relapse); SES2: RR = 0.57 95% CI, 0.18, 0.70, p=0.0024 (M=88.2 (SD 67.3) vs. 40.1 (SD 62.6) days to relapse). Interactions between socioeconomic status and condition

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Correspondence: Christine E. Sheffer, PhD, Associate Member and Associate Professor of Oncology, Department of Health Behavior, Carlton House, Room 402, Roswell Park Cancer Institute, Buffalo, NY 14263, Telephone: (716) 845-1186, Christine.sheffer@roswellpark.org.

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Conflict of Interest

All authors declare that they have no conflicts of interest.

Contributors

All authors made substantial contributions to the conception, design, data acquisition, data analysis, and/or interpretation of data for this work as well as contributed to drafting the work and revising the work. Dr. Sheffer led this project and is responsible for the overall content as guarantor. Drs. Sheffer, Bickel, and Franck contributed to the overall conception and design. Drs. Sheffer, Stayna, and Evans and Ms. Panissidi and Ms. Pittman made substantial contributions to data acquisition. Drs. Sheffer, Franck and Ms. Pittman contributed to the data analysis. All authors provided final approval of this submission and agree to be accountable for all aspects of the work.

were significant for initial abstinence (OR= 1.26, 95% CI 1.09, 1.46, $p=.002$), approached significance for 3-month abstinence (OR= .90, 95% CI .80, 1.01, $p < .071$), and were not significant for 6-month abstinence (OR= .99 95% CI .88, 1.10, $p=.795$). No significant differences in long-term abstinence were observed.

Conclusion—Systematic adaption of evidence-based treatment for tobacco dependence can significantly improve initial and short-term treatment outcomes for diverse lower socioeconomic smokers and reduce inequities in days to relapse. Novel methods of providing targeted extended support are needed to improve long-term outcomes.

Keywords

Smoking cessation; treatment for tobacco dependence; lower socioeconomic status; Black or African American; relapse; disparities

1. Introduction

The prevalence of cigarette smoking among lower socioeconomic status (SES) groups in the US remains extraordinarily high (Jamal et al., 2016) and contributes significantly to smoking-related socioeconomic health inequities and costs (Kanjilal et al., 2006; Harper and Lynch 2007; Smith et al., 2009; Trinidad et al., 2011; Bosdriesz et al., 2015; Singh et al., 2015; Bosdriesz et al., 2016; Singh and Jemal 2017). At present, nearly 30% of adults with Medicaid, a low-income government-sponsored health insurance program, smoke compared with 15% of the population (Jamal et al., 2016) and 15% of all Medicaid costs are smoking-related (Xu et al., 2015). Few socioeconomic differences are observed in attempts to quit smoking (Kotz and West 2009; Reid et al., 2010; Christiansen et al., 2012); however, there is a significant socioeconomic gradient in cessation that is associated with a variety of social, clinical, environmental, and treatment-related factors (Hiscock et al., 2012; Sheffer et al., 2012b; Hiscock et al., 2013; Varghese et al., 2014; Hiscock et al., 2015).

Evidence-based treatment (EBT) for tobacco dependence greatly improves the odds of cessation (Fiore et al., 2008); however, lower SES groups do not benefit equally from EBT (Judge et al., 2005; Foulds et al., 2006; Fiore et al., 2008; Robles et al., 2008; Burgess et al., 2009; Sheffer et al., 2009; Hiscock et al., 2012; Sheffer et al., 2012b; Varghese et al., 2014; Nollen et al., 2017). Given the same EBT, lower SES smokers are significantly less likely to achieve short-term (ST) (Businelle et al., 2011; Hiscock et al., 2013) and long-term (LT) abstinence than higher SES smokers (Kotz and West 2009; Sheffer et al., 2012b; Varghese et al., 2014; Hiscock et al., 2015).

LT abstinence, defined as abstinence 6 months after the quit date (Hughes 2003), is an important milestone; but alone masks the processes required to achieve this milestone (Shiffman et al., 2006). Initial abstinence, defined as 24 hours of continuous abstinence (Hughes 2003; Shiffman et al., 2006) must be followed by avoiding the progression from lapse to relapse during ST abstinence, broadly defined as periods of abstinence > 24 hours and < 6 months (Hughes 2003). The UK smoking treatment services uses 4-week abstinence as a ST milestone (Judge et al., 2005; Hiscock et al., 2013). The number of days to relapse,

called latency to relapse, provides incremental abstinence information from initial to LT abstinence (Hughes 2003; Shiffman et al., 2006).

SES is an index of social and economic position (Galobardes et al., 2006a; 2006b) and are racially and ethnically diverse in the US; however, Black Americans are substantially over-represented (Bureau 2010; Macartney et al., 2013) and racial differences in cessation are sometimes found after making statistical adjustments for SES (Trinidad et al., 2011; Kulak et al., 2016). Cognitive-behavioral EBT for tobacco dependence adapted for Black Americans significantly improves ST abstinence rates for Black smokers (Webb Hooper et al., 2017); however, improvements in LT abstinence rates were not observed and the socioeconomic gradient in outcomes was not reported. Given the magnitude of smoking-related socioeconomic disparities and the impact of these disparities on public health, simply establishing socioeconomic equity in EBT outcomes would represent progress and provide significant public health benefits.

In this study, we compared the effects of cognitive-behavioral EBT adapted for diverse lower SES smokers with standard cognitive-behavioral EBT using multiple abstinence milestones among socioeconomically, racially, and ethnically diverse smokers. We hypothesized that the adapted treatment would increase the latency to relapse and show significantly greater initial, ST, and LT abstinence rates among the lowest SES smokers with little effect on the highest SES smokers. Thus, the interaction between condition and SES on abstinence milestones were of primary interest. Increased efficacy among lower SES smokers was expected to result in improved overall efficacy.

2. Methods

2.1 Participants

Participants (n=227) were recruited in New York City by word of mouth, fliers in the community, and newspaper advertisements. Participants were eligible if they were 18 years of age, smoked daily, were ready to quit in 30 days, were able to engage in group treatment, had no regular use of other tobacco products, had reliable telephonic communication, had no contra-indications for nicotine patch use, were not currently using cessation medications, screened negative for drugs of abuse, drank < 20 alcoholic drinks per week, and attended at least one group treatment session. A socioeconomically, racially, and ethnically diverse sample was sought to enable socioeconomic comparisons and support external validity.

2.2 Materials

2.2.1 Standard Treatment (StdT)—The StdT was a well-established, multi-component, manual-driven cognitive-behavioral EBT for tobacco dependence with 6 weekly 1-hour group sessions used in numerous programs and studies (Schmitz et al., 1993; Smith et al., 2003; Payne et al., 2006; Sheffer et al., 2009; Sheffer et al., 2012a; Sheffer et al., 2012b; Sheffer et al., 2013; Varghese et al., 2014). StdT components included understanding and applying the cue-urge-smoking cycle, developing individualized strategies for managing cues and urges, self-monitoring, guided scheduled rate reduction, goal setting, stress

management, problem-solving, conflict management, tobacco refusal training, relapse prevention, enhancing social support, and education about medication and the health effects of tobacco. The StdT participant workbook included treatment session content and psychoeducational materials.

2.2.2 Adapted Treatment (AdT)—The AdT was developed from the StdT with the goals of addressing treatment outcome disparities and the needs, experiences, and perspectives of diverse lower SES smokers in 6 weekly 1-hour group sessions. We used an established framework for adapting EBTs that included four broad steps:

1. Information Gathering: Identify modifiable factors that have theoretical and/or empirical support for reducing treatment outcome disparities;
2. Preliminary Adaptation Design: Incorporate data from Step 1 into a clinical and cultural adaptation;
3. Preliminary Adaptation Tests: Pilot test the preliminary adaptation from Step 2, obtain community and treatment provider feedback; and
4. Adaptation Refinement: Incorporate feedback from Step 3 into the final treatment manual (Barrera and Castro 2006; Lau 2006). See Evans et al., 2015 (Evans et al., 2015) for details.

2.2.3 Information Gathering—The team reviewed conceptual models of health disparities. Theoretical and empirical evidence indicated that health disparities emerge from complex reciprocal social, psychological, environmental, and biological determinants across the lifespan (Bandura 2001; Adler and Newman 2002; Baranowski et al., 2002; Gallo and Matthews 2003; Ghaed and Gallo 2007; Moolchan et al., 2007; Adler and Rehkopf 2008; Adler and Stewart 2010; Kawachi et al., 2010). The Adler et al. (2010) framework of health disparities was selected as the most comprehensive and applicable model (Adler and Stewart 2010). Factors empirically associated with socioeconomic disparities in cessation were mapped onto the Adler framework (Stronks et al., 1997; Gallo and Matthews 2003; Ferguson et al., 2005; Honjo et al., 2006; Siahpush et al., 2006a; Siahpush et al., 2006b; Fernander et al., 2007; Manfredi et al., 2007; Siahpush et al., 2007a; 2007; Kendzor et al., 2009; Siahpush et al., 2009; Businelle et al., 2011; Hiscock et al., 2012; Sheffer et al., 2012a; Sheffer et al., 2012b; Businelle et al., 2013; Kaplan et al., 2013; Bickel et al., 2014; Varghese et al., 2014). The factors determined to be modifiable included: Stress, negative affect, smoking in response to negative affect, delay discounting, locus of control, impulsiveness, smoking policies in the home, and treatment utilization.

2.2.4 Preliminary Adaptation Design—We adapted the treatment by including and/or emphasizing interventions to address the modifiable factors identified in the Step 1. We modified the clinical adaptation by systematically incorporating community values and perceptions. Values associated with many lower SES groups, such as greater sensitivity to social context, other-oriented emotional focus, and increased value on pro-social behaviors (Cote et al., 2011; Kraus et al., 2011) overlapped wholly with perspectives endorsed in the PEN-3 Model (Airhihenbuwa 1990; Airhihenbuwa 1992), a model for incorporating Black perspectives into health interventions. We cross-referenced each intervention component in

each session with the elements of the PEN-3 Model (e.g., perceptions, enablers, nurturers). Community partners reviewed the resulting matrix and provided structured feedback. Community partners also recommended a participant “Toolkit” (e.g., workbook) and this was developed accordingly.

2.2.5 Preliminary Adaption Tests—We pilot-tested the AdT with diverse smokers in two treatment groups (n=12, n=13) followed by two focus groups led by community consultants using a democratic deliberative approach.

2.2.6 Adaptation Refinement—We incorporated feedback from Step 3 into the final AdT treatment manual.

The final AdT incorporated new components (e.g., interventions to reduce delay discounting and impulsive decision-making), increased the emphasis on other components (e.g., stress management, treatment utilization), eliminated components (e.g., health effects of tobacco use), and incorporated greater sensitivity to social/family context, other-oriented emotional focus, and pro-social behaviors. Language, tailored options, and activities were designed to foster an internal locus of control and resonate with the experiences of lower SES smokers. For example, we emphasized stress management by including at least one stress management intervention in every treatment session and proactively discussing relevant sources of stress (e.g., financial stress, micro-aggressions, discrimination). We included a thematic emphasis on internal locus of control and self-determination by emphasizing the use of “tools” and “personal control,” and discussing internal locus of control in the management of stress, negative affect, and impulsive actions. See Treatment Manual and Participant Toolkit in Supplemental Materials¹.

2.3 Procedures

This study was approved by the City University of New York Institutional Review Board and conducted on the City College of New York campus from July 2013 to June 2015. Informed consent was obtained from all participants. Participants completed baseline assessment and were assigned to a treatment group. Groups were randomized by simple randomization in a 50/50 ratio by the study coordinator immediately prior to the first group treatment session. Participants were blind to condition. Daily smoking was assessed weekly during treatment, monthly by telephone afterward, and in-person during outcome assessments 3 and 6 months after the quit day.

Participants received 6 weekly 1-hour group treatment sessions of either the AdT or the StdT delivered by tobacco treatment specialists (TTSs) trained by accredited TTS training programs (www.ctttp.org). The third treatment session was the quit day. Participants were given 8 weeks of 24-hour nicotine patches (21mg/4 weeks, 14mg/2 weeks, 7mg/2 weeks). Patch use was initiated the morning of the quit day. All sessions were recorded. Treatment fidelity was addressed with 1) manual-driven sessions, 2) post-session treatment component

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checklists (TSCLs) completed by TTSs, and independent review of recorded sessions by team members who also completed TSCLs. A 60-minute session time limit was enforced.

2.4 Measures

Demographic, clinical, tobacco use, and psychosocial measures were administered. See Table 1 and Participant Characteristics Supplemental Materials². A composite index for SES incorporated educational level and household income consistent with previous studies (Sheffer et al., 2012b; Varghese et al., 2014). Composite measures adjust for the limitations of single indicators (Galobardes et al., 2006a; 2006b). Household income was assessed with the six income categories (Bureau 2012). Educational level was grouped into 4 categories. Values assigned to income level (lowest=1 to highest=6) and educational category (lowest=1 to highest=4) were combined resulting in a discrete analogue SES scale (range=2–10). This scale was blocked into 3 equal SES levels SES1 (2–4), SES2 (5–7), and SES3 (8–10) which are observed to differentiate along pertinent socioeconomic dimensions (Sheffer et al., 2012b).

Baseline assessment included cigarettes per day, partner smoking status, timing/duration of last quit attempt, use of mentholated cigarettes, age began smoking, years of regular smoking, and number of alcoholic drinks per week. Motivation, self-efficacy, and concern about weight gain were assessed on a 0–10 scale with 0= “not at all” and 10= “most ever” and the questions: “How much do you want to quit smoking?”, “How confident are you that you can quit using tobacco and stay quit for good?” and “How concerned are you about gaining weight after you quit?” (Perkins et al., 2001; Moolchan et al., 2003; McKee et al., 2005; McCarthy et al., 2010) Nicotine dependence was assessed with the Fagerström Test for Nicotine Dependence. Higher scores (range 0–10) indicate greater dependence (Heatherton et al., 1991; Fagerstrom et al., 1996). Smoking policies were assessed with: a) no smoking anywhere inside or outside, b) no smoking inside, but smoking is allowed outside, c) smoking is allowed in certain areas inside, or d) smoking allowed anywhere inside (Messer et al., 2008). Treatment utilization was assessed with number of treatment sessions attended, use of nicotine patches (yes/no), number of patches used, and perceived effectiveness of patches. Daily patch use was assessed weekly during treatment and monthly after treatment using the timeline follow-back procedure (Sobell and Sobell 1992).

2.5 Outcome Measures

Primary outcome measures were 1) latency to relapse, 2) initial abstinence, and 3) biochemically confirmed 7-day point prevalence abstinence 3 and 6 months after the quit date. Daily cigarette smoking was assessed using the timeline follow-back procedure shown to be accurate and reliable for past 30 days (Sobell and Sobell 1992; Toll et al., 2005). Relapse was defined as any smoking for seven consecutive days (Hughes et al., 2003). Point prevalence abstinence was confirmed with exhaled carbon monoxide levels < 8ppm (verification 2002).

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2.6 Statistical Analysis

Sample size was estimated from the slope of the effect of SES on LT StdT abstinence rates in community samples (Sheffer et al., 2009; Sheffer et al., 2012a; Sheffer et al., 2012b). The slope of SES (β_{ST}) was 0.14 (95% CI:0.10, 0.19) (Sheffer et al., 2012b). With projected StdT LT abstinence rates of 22%, we expected .80 power to detect a hazard ratio of 1.46 (a medium effect size) using a 1-tailed test ($\alpha = 0.05$) with $n=220$ participants. To estimate the power required to detect an elimination of the effect of SES ($\beta_{RT} = 0$), we simulated the SES distribution with confidence limits of 0.10 and 0.19. With $n=220$ participants, 1-sided tests to detect $\beta_{RT} = 0$ were estimated to have a power of 0.42, 0.75, and 0.93 when the $\beta_{ST}=0.10, 0.14$, and 0.19, respectively. We estimated 15% of those enrolled would not attend treatment. Thus enrollment was discontinued at $n=253$.

Descriptive analyses were conducted to characterize the sample. Cox Proportional Hazards (CPH) survival analyses were used to examine the effects of condition and SES on latency to relapse. Separate CPH models were used to examine the effects of condition on each SES level. The CPH analyses included all participants with cigarettes per day data beyond the quit date. Logistic regression was used to examine interactions between condition and SES and the main effect of condition on initial, 3, and 6 month abstinence rates using simple contrasts. Missing point prevalence data was imputed as smoking. We explored the effect of race and ethnicity by repeating these analyses with race and ethnicity as covariates.

3. Results

3.1 Participants

Participants ($n=227$) were primarily middle aged and identified as a racial and/or ethnic minority; three-quarters reported household incomes $<\$15,000$. About one-third did not complete high school. Over half were unemployed and nearly all had Medicare and/or Medicaid. About two-thirds were classified as SES1, one-quarter as SES2, and 10.1% as SES3. Over two-thirds reported that their basic needs were not being met to some degree. Participants were highly nicotine dependent, most smoked menthol cigarettes, and most were ambivalent about the effectiveness of nicotine patches. See Table 1.

Half of participants received AdT (50.2%) and half StdT (49.8%). No differences between the AdT and StdT were found in session attendance ($M=5.6$ (SD 1.0) vs. $M=5.6$ (1.0); $F(1,225)=0.05$, $p=.82$) and number of participants per group ($M=4.9$ (SD .9) vs. $M=4.8$ (SD 1.1); $F(1,49)=.19$, $p=.66$); however the AdT sessions were about 2 min longer than the StdT sessions ($M=60.7$ (SD 4.5) vs. $M=58.2$ (SD 4.5), $F(1, 299) <.01$). TTSs reported that they covered a smaller proportion of the AdT content ($M=98.6\%$ (SD 2.9%) vs. $M=99.4\%$ (SD 1.9%), $F(1, 297)=8.3$, $p <.01$); however, independent reviews ($n=95$) reported no difference in amount of content covered (AdT $M=95.2\%$ (SD 5.5%) vs. StdT 93.2% (SD 6.0%), $F(1, 93) = 2.8$, $p=.10$). Differences between AdT and StdT in patch use (95.5% vs. 90.7%; $\chi^2=1.94$, $df=1$, $p=.16$) and the number of patches used ($M=42.4$ (SD 22.2) vs. $M=39.8$ (SD 22.9); $F(1,200)=0.67$, $p=.41$) were not significant. Daily cigarette use data was available for 95.6% of participants. Biochemical validation of 3 and 6-month abstinence was available for 87.2% of participants. See Figure 1.

3.2 Primary Outcomes

Latency to relapse. The CPH models revealed the interaction between SES and condition (Likelihood ratio χ^2 with 2 df = 2.76, $p = 0.25$) and the effect of SES (Likelihood ratio χ^2 with 2 df = 0.1041, $p = 0.95$) were not significant; however, AdT significantly increased the number of days to relapse for the two lowest SES groups. For SES1, AdT participants maintained abstinence for a mean of 76.6 days (SD 72.9) compared with 38.3 days (SD 60.1) for StdT (χ^2 with 1 df = 10.41, RR = 0.49 95% CI, 0.32, 0.76, $p = 0.001$). For SES2, AdT participants maintained abstinence for a mean of 88.2 days (SD 67.3) compared with 40.1 days (SD 62.6) for StdT (χ^2 with 1 df = 9.21, RR = 0.35 95% CI, 0.18, 0.70, $p = 0.0024$). For SES3, AdT participants maintained abstinence for 66.5 days (SD 64.6) compared with 68.6 days (SD 73.5) for StdT (χ^2 with 1 df = .014, RR = 1.06, 95% CI, .38, 3.05, $p = .907$). See Table 2.

The effect of condition on overall latency to relapse was highly significant (Likelihood ratio χ^2 with 2 df = 6.51, $p = 0.01$). The mean days to relapse for AdT was 78.7 (SD 70.4) days and for StdT was 41.9 (SD 62.2) days (RR = 0.57 95% CI, 0.37, 0.87). The median latency to relapse for AdT was 66.0 (IQR 7 to 168) days; StdT was 8 (IQR 0 to 49) days. See Figure 2.

Point prevalence abstinence rates. The interaction between SES and condition was significant for initial abstinence (Wald $\chi^2 = 9.41$, df = 1, OR = 1.26, 95% CI 1.09, 1.46, $p = .002$), approached significance for 3-month abstinence (Wald $\chi^2 = 3.26$, df = 1, OR = 1.11, 95% CI .99, 1.25, $p < .071$), and was not significant for 6-month abstinence (Wald $\chi^2 = .068$, df = 1, OR = 1.02 95% CI .91, 1.14, $p = .795$). See Figure 3.

The main effect of condition was significant for initial, but not for LT abstinence. A higher proportion of AdT participants achieved initial abstinence than StdT (87.7% vs. 69.0%; Wald $\chi^2 = 11.05$, df = 1, OR = 3.21, 95% CI 1.61, 6.37, $p = .001$). No significant differences were found between conditions in 3-month (48.2% vs. 37.2%; Wald $\chi^2 = 2.83$, df = 1, OR = 1.57, CI .93, 2.68, $p = .09$) and 6-month (44.7% vs. 44.2%; Wald $\chi^2 = .005$, df = 1, OR = 1.02, CI .60, 1.72, $p = .941$) abstinence. Neither race nor ethnicity were statistically significant in any of these analyses. See Supplemental Race and Ethnicity Results³.

4. Discussion

This is the first study to examine the efficacy of EBT adapted for diverse lower SES smokers. The findings indicate that systematic adaption can incrementally increase latency to relapse among socioeconomically, racially, and ethnically diverse smokers by increasing initial and ST abstinence rates. The AdT reduced inequities in treatment outcomes by eliminating the socioeconomic gradient in days to relapse (see Figure 2). Among AdT participants, the lowest SES group was abstinent 10 *more* days than the highest SES group. Among StdT participants, SES1 were abstinent 30 days *fewer* days than the highest SES group (see Table 2). The socioeconomic gradient in treatment outcomes is a critical barrier to achieving equity in smoking prevalence rates and health outcomes. While no significant

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differences in LT outcomes were observed, these findings identify therapeutic targets for improving LT abstinence in this large, diverse, disparate population. These findings extend the work of Webb Hooper et al. (2017) by demonstrating that EBT adapted for socioeconomic factors and diverse perspectives obtains similar results with socioeconomically, racially, and ethnically diverse smokers without adversely affecting higher SES smokers.

Achieving initial and ST abstinence are essential steps to achieving LT abstinence (Shiffman et al., 2006). While the advantages of the AdT dissipated over time, specific therapeutic targets for improving LT abstinence rates for lower SES groups might include interventions specifically focused on avoiding lapses and the progression from lapse to relapse during ST abstinence. Future research also might examine factors differentially associated with achieving specific milestones among lower SES smokers (Shiffman et al., 2006) (e.g., the availability of loosies). Many lower SES smokers have little experience living as non-smoking adults and face a multitude of challenges in exceptionally difficult environments. Skills required to maintain abstinence, such as the management of stress and negative mood, are known to require extensive practice and support. Thus, achieving LT abstinence might require novel methods of providing targeted extended support after participating in AdT. AdT, however, will ensure diverse lower SES smokers can achieve initial and ST abstinence.

The strengths of this study include a rigorous comparative effectiveness design that controlled for contact time; the use of multiple methods and milestones to assess abstinence; biochemical validation of point prevalence abstinence; a strong theoretical and methodological approach; a socioeconomically, racially and ethnically diverse sample that increases the external validity of the findings; and the ability to compare abstinence between socioeconomic groups within and between conditions. The setting facilitated the recruitment and retention of lower SES and minority smokers.

Limitations include potential bias due to inability to blind treatment providers. We speculate that the unusually high abstinence rates for the StdT condition might be due to an indirect influence from the AdT. Additionally, the TTSs were highly skilled which contributed to high abstinence rates, but might decrease the generalizability of findings. Our setting did not facilitate recruitment of higher SES smokers which resulted in only 10% of participants classified as SES3 and limited power to detect a significant interaction between SES and condition in the higher SES range.

5. Conclusion

Systematic adaption of EBT for tobacco dependence for diverse lower SES smokers can incrementally improve abstinence rates among racially, ethnically, and socioeconomically diverse lower SES smokers and reduce socioeconomic disparities in treatment outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Treatments for tobacco dependence are less effective for lower socioeconomic groups
- Adapted treatment eliminates the socioeconomic gradient in outcomes
- Adapted treatment improves short-term outcomes for lower socioeconomic groups
- No long-term outcome differences are found between adapted and standard treatment
- Extended support might help sustain short-term outcomes

Figure 1.

CONSORT Diagram. The number of participants retained for the Cox Proportional Hazard analyses included all those with some cigarettes per day data beyond the quit date (n=217). All eligible participants (n=227) were included in the logistic regression; those with missing three and six month data (n=14 standard, n=15 adapted) were imputed as smoking.

Figure 2.

The raw data reflect no socioeconomic gradient in the number of days to relapse for the Adapted Treatment while the Standard Treatment reflects the familiar socioeconomic gradient. Socioeconomic status (SES) was assessed with a composite index composed of education and income levels, range 2–10.

Figure 3.

Significant interactions between condition and socioeconomic status were found for short-term treatment outcomes. For initial abstinence, the interaction between SES and condition was significant (Wald χ^2 with 1 df = 9.41, OR = 1.26, 95% CI 1.09, 1.46, $p = .002$). For 3-month abstinence, the interaction approached significance (Wald χ^2 with 1 df = 3.26, OR = .90, 95% CI .80, 1.01, $p < .07$). For 6-month abstinence, the interaction was not significant (Wald χ^2 with 1 df = .07, OR = .99, 95% CI .88, 1.10, $p = .80$). The AdT yielded a higher proportion of participants who achieved initial abstinence than ST (87.7% vs. 69.0%; $\chi^2 = 11.72$, df = 1, $p = .001$). No significant differences were found between conditions in 3-month (48.2% vs. 37.2%; $\chi^2 = 2.846$, df = 1, $p = .092$) and 6-month (44.7% vs. 44.2%; $\chi^2 = .005$, df = 1, $p = .941$) abstinence. Socioeconomic status was assessed with a composite index composed of education and income levels, range 2–10, SES1 = 2–4, SES2 = 5–7, SES3 = 8–10. Percent abstinent by socioeconomic condition, socioeconomic level, and abstinence milestones. Lower SES participants were more likely to achieve short-term abstinence if they were in the adapted treatment. For SES1, significant differences between conditions were found in initial abstinence (FET, $p = .039$) (blue lines), but not for 3-month (FET, $p = .249$) (red lines) and 6-month (FET, $p = .500$) (yellow lines) abstinence. For SES2, significant differences between conditions were found for initial abstinence (FET, $p = .001$)

(blue lines), marginal significance was found for 3-month abstinence (FET, $p=.057$) (red lines), and no significance was found for 6-month abstinence ($p=.50$) (yellow lines). For SES3, no significant differences were found between conditions for initial ($p=.466$), 3-month ($p=.593$), and 6-month ($p=.579$) abstinence. Socioeconomic status was assessed with a composite index composed of education and income levels (range 2–10, SES1=2–4, SES2=5–7, SES3=8–10).

Table 1

Demographic, environmental, clinical and psychosocial characteristics of participants (n=227)

Variable		Category, or Range	Percent (n) or Mean (SD)
Demographic characteristics			
Age, y		21–73	48.2 (9.0)
Sex		Male	72.2 (164)
Partnered status		Partnered ^f	19.4 (44)
Race		White or Caucasian	18.9 (43)
		African American or Black	66.1 (150)
		Other	15.0 (34)
Ethnicity		Hispanic	20.7 (47)
Work status		Full time	10.6 (24)
		Part time	13.7 (31)
		Retired	3.5 (8)
		Disabled	14.1 (32)
		Unemployed	56.8 (129)
		Homemaker	1.3 (3)
Socioeconomic status		2–10	4.1 (2.1)
Categories		SES 1	64.3 (146)
		SES 2	25.6 (58)
		SES 3	10.1 (23)
Household income		\$10,000	56.8 (129)
		\$10,000 – \$14,999	17.2 (39)
		\$15,000 – \$24,999	8.4 (19)
		\$25,000 – \$34,999	6.6 (15)
		\$35,000 – \$49,999	6.2 (14)
		\$50,000	4.8 (11)
Education, y		7–20	12.1 (2.2)
Categories		< 12 years	33.5 (76)
		12 years	37.0 (84)
		13–14 years	15.4 (35)
		> 15 years	14.1 (32)
Health insurance status		Medicaid and/or Medicare	89.9 (204)
		None	6.2 (14)
		Private	4.0 (9)
Deprivation of basic needs		0–10	6.8 (3.0)
Tobacco-related clinical characteristics			
Cigarettes per day		2–40	13.8 (7.4)
Categories		10	42.3 (96)

Variable		Category, or Range	Percent (n) or Mean (SD)
		11–20	43.2 (98)
		21–30	10.6 (24)
		31	4.0 (9)
Fagerstrom Test for Nicotine Dependence		0–9	4.5 (2.2)
Smokes menthol cigarettes		Yes	88.1 (200)
Age started smoking, y		7–53	16.7 (5.6)
Duration of regular smoking, y		2–50	26.6 (11.0)
Partner smoking status ²		Partner smokes	45.5 (66)
Smoke free indoor policy		Work ³	83.3 (100)
		Home	56.8 (129)
Timing of last quit attempt		Never	11.9 (27)
		< 6 months ago	32.6 (74)
		6–12 months ago	10.1 (23)
		> 12 months ago	45.4 (103)
Duration of longest quit attempt, weeks		0–1032	55.5 (115.5)
Readiness to quit		Already stopped	1.3 (3)
		Next 30 days	67.8 (154)
		Next 6 months	26.0 (59)
		Not in next 6 months	3.1 (7)
		No plans to stop	0.4 (1)
Sought help to quit in past		Yes	17.2 (39)
Motivation to quit		0–10	8.8 (1.9)
Self-efficacy for quitting		1–10	7.6 (2.3)
Alcoholic drinks per week		0–14	.87 (2.1)
Substance use history ⁴	In recovery	Yes	55.6 (100)
	Duration current recovery ⁵	12 months	38.0 (38)
		> 12 months	62.0 (62)
	Duration longest recovery ⁵	12 months	10.0 (10)
		> 12 months	90.0 (90)
Nicotine patch adherence	Can use all patches as directed	Not at all or very little	16.7 (38)
		Somewhat or extremely	83.3 (189)
	Believe patches have a positive effect	Not at all or very little	24.7 (56)
		Somewhat or extremely	75.3 (171)
	Believe relapse if non-adherent with patches	Not at all or very little	40.1 (91)
		Somewhat or extremely	59.9 (136)
Treatment utilization characteristics			
Number of sessions attended		1–6	5.6 (1.0)
Patch use (% ,n)		Yes	93.1 (202)

Variable		Category, or Range	Percent (n) or Mean (SD)
Number of patches used ⁷		1–146	41.2 (22.5)

¹ Married or living with significant other

² Of partnered respondents

³ Of employed respondents

⁴ Of respondents (n=180)

⁵ Of those in recovery from SUDs (n=100)

⁶ In the past month other than regular job.

⁷ Of those who used patches (n=202). Some participants purchased or were given more patches than provided by the study.

Note: SUDs= Substance use disorders; Other race = Asian/Pacific islander, American Indian/American Native, Multi-ethnic, or more than one race and non-specified.

SES 1, SES 2, SES 3: Values assigned to income level (lowest|=1 to highest|=6) and educational category (lowest|=1 to highest|=4) were combined resulting in a discrete analogue SES scale (range|=2–10). This scale was collapsed into 3 SES levels: SES1 (2–4), SES2 (5–7), and SES3 (8–10).

Table 2

Differences in days to relapse between the adapted and the standard treatment by socioeconomic status

	Adapted Treatment	Standard Treatment	Relative Risk (95% Confidence Interval)	p-value
SES1	76.6 (72.9)	38.3 (60.1)	0.63 (0.45, 0.88)	0.0013
SES2	88.2 (SD 67.3)	40.1 (SD 62.6)	0.57 (0.18, 0.70)	0.0024
SES3	66.5 (SD 64.6)	68.6 (SD 73.5)	1.06 (0.38, 3.05)	0.907
Across SES levels	78.7 (SD 70.4)	41.9 (SD 62.2)	0.57 (0.37, 0.87)	0.01

SES 1, SES 2, SES 3: Values assigned to income level (lowest=1 to highest=6) and educational category (lowest=1 to highest=4) were combined resulting in a discrete analogue SES scale (range=2–10). This scale was collapsed into 3 SES levels: SES1 (2–4), SES2 (5–7), and SES3 (8–10).