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KEY WORDS
adolescent, smoking, smoking cessation

ABBREVIATIONS
MI—motivational interviewing
SBA—structured brief advice
OR—odds ratio
CI—confidence interval

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WHAT'S KNOWN ON THIS SUBJECT: Adolescent cigarette smoking is a significant public health problem. More research on adolescent smoking cessation treatment is needed to identify effective interventions for a range of adolescent smokers in a medical setting.

WHAT THIS STUDY ADDS: To effectively treat adolescent smokers, decisions to change smoking behavior facilitated by motivational interviewing may need to be supported by additional treatment approaches such as pediatrician's advice and cognitive-behavioral smoking cessation strategies.

abstract

OBJECTIVE: In this study we sought to evaluate the efficacy of motivational interviewing (MI) compared with structured brief advice (SBA) for adolescent smoking behavior change.

METHODS: Participants ($N = 355$) were randomly assigned to 5 sessions of either MI or SBA. The primary outcomes were attempts to reduce and to quit smoking, smoking reduction, and cotinine-validated 7-day point-prevalence smoking abstinence at the end of treatment (week 12) and the 24-week follow-up.

RESULTS: White adolescents were ~80% less likely to attempt to cut back (odds ratio [OR]: 0.21; confidence interval [CI]: 0.08–0.53) and >80% less likely to attempt to quit smoking compared with black adolescents (OR: 0.17 [CI: 0.06–0.46]). Adolescents who were at least planning to cut back or quit smoking at baseline were almost 3 times more likely to attempt to cut back (OR: 2.87 [CI: 1.26–6.52]) and to attempt to quit smoking (OR: 3.13 [CI: 1.19–8.26]). Adolescents who received MI were ~60% less likely than adolescents who received SBA to try to quit smoking (OR: 0.41 [CI: 0.17–0.97]). However, adolescents who received MI showed a greater reduction in cigarettes smoked per day than adolescents who received SBA (5.3 vs 3.3 fewer cigarettes per day). There were no statistically significant differences between MI and SBA in smoking abstinence (5.7% vs 5.6%, respectively).

CONCLUSIONS: The effects of MI on adolescent smoking behavior change are modest, and MI may best fit within a multicomponent smoking cessation treatment approach in which behavior change skills can support and promote smoking behavior change decisions. *Pediatrics* 2011;128:e101–e111

Every year in the United States there are 400 000 new adolescent daily smokers, many of whom will later develop a smoking-attributable disease.[1] Although adolescent smoking cessation treatment outcomes are showing promise,[2] especially school-based programs, we need to ensure that effective adolescent smoking cessation treatment approaches can reach a diversity of adolescents including those who are less connected to their school and less interested in quitting smoking. Adolescent health care settings provide an opportunity to reach adolescents who are not seeking smoking cessation services and may not be reached in other contexts, such as schools.[3] Given that the majority of adolescents utilize some form of adolescent health care each year, smoking cessation interventions provided within medical settings may be another important context to reach and treat adolescent smokers.[4]

One promising, yet understudied, approach in the health care setting is motivational interviewing (MI). MI is a brief person-centered method to enhance an individual's motivation and confidence to change harmful behaviors by development of the discrepancy between current behavior and future goals, support of autonomy, expression of empathy, and resolution of ambivalence to facilitate behavior change.[5] Several small studies have provided evidence that 1 MI session has effects on smoking reduction among non–treatment-seeking adolescent smokers in the emergency department but only modest effects on smoking cessation[6,7] and no significant effects among adolescent smokers hospitalized for psychiatric treatment.[8] The lack of an MI intervention effect on smoking cessation may be attributable to small sample sizes, an inadequate number of MI sessions, or the need for MI to be delivered in combination with other smoking cessation treatment components in the presence of psychiatric comorbidity.

To provide an adequate test of MI, isolated from other treatment components,[9] within a setting affiliated with adolescent medicine and to be consistent with recent treatment recommendations,[2] the present study sought to evaluate the efficacy of 5 sessions of MI compared with 5 sessions of structured brief advice (SBA) for adolescent smoking behavior change in a diverse sample of adolescent smokers. The selection of comparison group was governed by current practice guidelines for adolescent smoking cessation and the desire to approximate treatment contact time across groups. Variables important to adolescent smoking cessation treatment outcomes, MI, and the theoretical underpinnings of the transtheoretical model[10] were considered in the models of attempts to change smoking behavior (ie, cut back, quit), smoking reduction, and smoking cessation.[11–14] We anticipated that MI would facilitate more attempts to cut back and quit smoking and produce a higher prevalence of actual cutting back and smoking cessation than SBA at the end of treatment and at follow-up.

METHODS

Procedures

Participants were screened, enrolled, and followed from October 2007 to June 2009 at 1 of 3 adolescent medicine sites including the Children's Hospital of Philadelphia, the Children's Hospital of Pittsburgh, and the Lehigh Valley Hospital. Participants were recruited and self-referred through flyers and brochures that advertised the study and were available in the examination rooms, waiting room, and publicly accessible areas in and around the participating medical sites. Participants were also referred to the study by their physicians and by other participants. Adolescents completed a voluntary screening form with questions about tobacco use and whether they give their permission to be contacted by research staff if they were eligible. All adolescents aged 14 to 18 years who gave permission to be contacted and who reported smoking at least 1 cigarette a month and at least 100 cigarettes in their life time[15,16] were contacted by the research staff, who explained the study. At this time, additional inclusion criteria (fluency in spoken English, willingness by participants aged 14 to 17 years to obtain parental/legal guardian consent) and exclusion criteria (severe mental retardation) were described. The adolescents were provided with a brief description of the study and told that interest in quitting smoking was not required to participate.

Research staff obtained consent and assent from interested and eligible adolescents in a private room at or near each medical care setting. They then completed a baseline assessment of smoking history and behavioral and psychological variables. At this initial assessment, participants were randomly assigned (stratified by precontemplation stage of quitting smoking) to receive either 5 sessions of MI lasting 30 to 45 minutes or 5 sessions of structured brief advice (SBA) lasting 15 minutes for a period of 12 weeks. Subsequently, participants came to an adolescent medicine–affiliated office at each participating site and met with either an MI ($n = 12$) or an SBA ($n = 11$) counselor, depending on their treatment assignment. For continuity, the same counselor met with the participant across the 5 sessions. For both groups, sessions 1 through 3 were completed in person and sessions 4 through 5 completed in person or via telephone, depending on the participant's preference. Table 1 provides

TABLE 1 Comparison of MI and SBA Treatment Approaches

Treatment Component	SBA	MI
Treatment goals	Smoking cessation (counselor defined)	Smoking behavior change (participant defined)
Counselor role	Expert educator and advice-giver	Collaborative, autonomy-supportive change facilitator
Communication style	Directive, persuasive	Guiding, exploratory
Motivation for change	Instill through strong advice and encouragement	Evoke through targeted questions, reflections, and structured strategies
Expression of empathy	Natural, nonsystematic	Systematic; noncontingent (develop relationship) and contingent (reinforce talk favoring change)
Support for self-efficacy	Verbal praise of current efforts	Exploration and affirmation of participant strengths and past successes; counselor expression of optimism
Smoking change plan	Counselor-provided reasons for quitting, methods for quitting, strategies for coping with temptation	Collaboratively identified and developed reasons to change, plans for change, barriers and strategies to overcome them

a comparison of the 2 treatment approaches.

Structured Brief Advice

The SBA intervention was based on the clinical practice guidelines for treating nicotine dependence,[17] which has been endorsed for use with adolescents by the American Academy of Pediatrics.[18,19] The guidelines recommend the use of the "5 A's" for those interested in quitting and the "5 R's" for patients not interested in quitting smoking. In each session, the 5 A's/R's were followed by a review of self-help materials (ie, smoking cessation print materials, list of resources), followed by a brief check-in to see if the adolescent needed help in gaining access to services (eg, appointment with their physician for pharmacotherapy). For a more detailed description of the intervention see Supplemental Information.

Motivational Interviewing

The MI intervention consisted of three 45-minute office sessions and two 30-minute office or telephone sessions over 12 weeks. MI promotes adolescent behavior change through (1) expression of empathy, (2) development of discrepancy between current behavior and important goals, beliefs, and personal values, (3) acceptance of ambivalence as normal and emphasis on personal choice, autonomy, and control, and (4) support of self-efficacy.[5] Our MI intervention was based on motivational enhancement therapy (MET),[20] an adaptation of motivational interviewing developed by Miller and colleagues as a stand-alone intervention for alcohol dependence.[21] MET adds personalized feedback about assessment results (eg, adolescent's tobacco use at baseline and during treatment) and collaborative development of a formal change plan to the standard principles and techniques of MI. For a more detailed description of the intervention please see Supplemental Information. Table 1 provides a comparison of the 2 treatment approaches.

To promote treatment integrity, all treatment sessions were audio recorded and reviewed weekly by the treatment supervisor, who used an adherence checklist. MI and SBA counselors received extensive training on the treatment protocol and received weekly individual or group supervision. To promote study retention, treatment was typically initiated within a week of randomization, appointment times were convenient for participants' schedules, participants were compensated for their travel (given $5 for each on-site session attended or a bus card) and for their time spent completing the assessments before each of the 5 counseling sessions ($25) and for completing the 12- and 24-week in-office assessments ($25 for the 12-week assessment and $50 for the 24-week assessment). We also obtained several alternative contact numbers for each participant when they could not be reached via their primary telephone number. Fig 1 provides an overview of trial participation.

Measures

Predictor Variables

The demographic variables included age, gender, race, and ethnicity. Nicotine dependence was measured with the 7-item Modified Fagerstrom Tolerance Questionnaire.[22–24] Baseline level of smoking, alternative tobacco use, alcohol use, and marijuana use were determined by use of a 90-day Timeline Followback to evaluate the number of days of use over the previous 90 days.[25–27] Participants also reported the number of cigarettes smoked, on average, each day. Household smoking was assessed with 1 item asking "Does anyone living in your household smoke cigarettes?" Peer smoking was assessed by asking participants to indicate how many of the participants' 5 closest friends smoke cigarettes (range: 0–5).

Depression symptoms were measured with the Center for Epidemiologic Studies-Depression Scale (CES-D). The 20-item CES-D is a widely used self-report measure[28,29] with items rated on a 4-point Likert scale to indicate how frequently in the previous week each symptom occurred (0 = rarely or none of the time; 3 = most of the time).

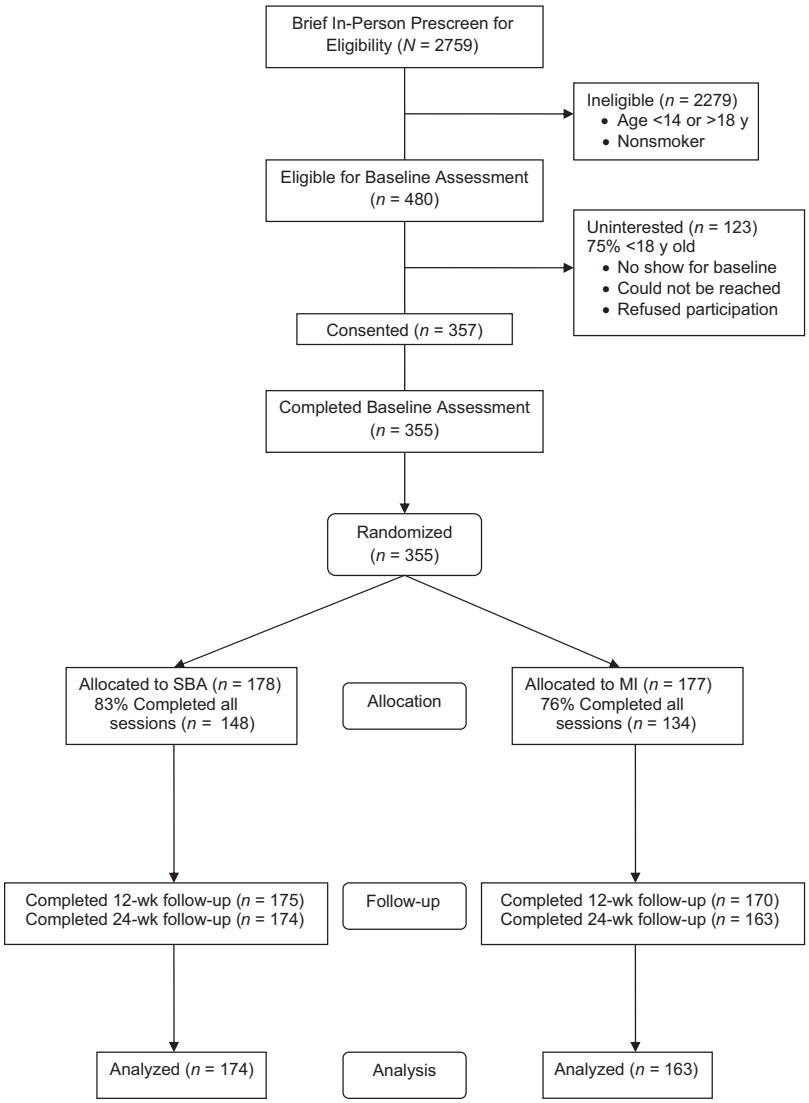

FIGURE 1
Flowchart of study participants, randomization, treatment, follow-ups, and analyzed sample.

The 13-item Smoking Consequences Questionnaire was used to measure adolescents' smoking expectancies.[30] Responses options range from 1 = disagree to 4 = agree, with higher scores indicative of more positive expectancies associated with smoking.

Stage of readiness to cut back and to quit smoking were assessed with the Staging to Assess Readiness to Cut Back and Quit Smoking questionnaire.[31] The stages included precontemplation, contemplation, preparation, action, and maintenance. The self-efficacy measure consisted of 18 self-report items to assess how adolescents would feel when faced with situations that typically trigger a desire to smoke. The items were rated on a 5-point Likert scale ranging from 1 = "not at all tempted" to 5 = "extremely tempted."[12,32]

Smoking Outcome Variables

For the variable "attempt to change smoking," at each posttreatment assessment participants were asked 2 questions about attempts to cut back on smoking and to quit smoking; "Since your baseline assessment, did you try to cut back your smoking?" and "Since your baseline assessment, did you try to quit smoking cigarettes?."

"Reduction in smoking" was determined by calculation of the change in the number of cigarettes smoked from baseline to posttreatment. The continuous measure could capture a decrease in smoking, no change, or an increase in smoking.

To assess the "smoking cessation" variable, adolescents who reported smoking abstinence at the 12-week and 24-week follow-up (ie, report of 0 cigarettes for ≥7 days before assessment) provided a saliva cotinine sample for biochemical validation of self-reported smoking abstinence.[33,34] Saliva cotinine is most sensitive for detection of smoking within the previous 2 to 3 days of smoking a cigarette.[33] Adolescents with a saliva cotinine result of ≤15 ng/mL were classified as being abstinent.[33]

Data Analysis

Bivariate associations were evaluated by using χ^2 and *t*-test analyses. Multivariate analysis involved mixed-effects regression models. We included variables as potential predictors in the multivariate models of attempted to cut back, attempted to quit smoking, smoking reduction, and smoking cessation if the bivariate relationship between the predictor and outcome was $P \leq .25$ at either of the 2 posttreatment follow-ups.[35] However, treatment (1 = MI, 0 = SBA) was included in each model, as was the effect of time. A process of stepwise elimination removed predictor variables from the specific regression model if the variable had a $P < .20$ and retained predictor variable at $P < .10$ at reentry. After a main-effects model was established for a smoking outcome, a treatment according to time interaction was tested and retained in the model only if it was significant.

TABLE 2 Baseline Participant Characteristics According to Treatment Group

Variable	MI, *n* (%)	SBA, *n* (%)	Bivariate Statistics	*P*
Gender			$\chi^2_2 = 0.35$	.55
Female	100 (51)	95 (49)		
Male	77 (48)	83 (52)		
Race			$\chi^2_2 = 1.46$	.48
Black	80 (50)	80 (50)		
White	65 (45)	78 (55)		
Other or mixed race	31 (60)	21 (40)		
Hispanic			$\chi^2_1 = 7.97$	.005
Hispanic	29 (71)	12 (29)		
Not Hispanic	148 (47)	165 (53)		
Other tobacco use			$\chi^2_1 = 0.15$	.70
Yes	64 (48)	69 (52)		
No	109 (50)	108 (50)		
Household smoking			$\chi^2_1 = 0.15$	.70
Yes	59 (49)	62 (51)		
No	107 (51)	103 (49)		
Readiness to cut back			$\chi^2_1 = 0.18$	.67
Precontemplation or contemplation	82 (49)	86 (51)		
Planning or action	94 (49)	90 (51)		
Readiness to quit			$\chi^2_1 = 6.42$	.07
Precontemplation or contemplation	118 (46)	140 (54)		
Planning or action	59 (61)	38 (39)		
Depression symptoms			$\chi^2_1 = 1.31$	.25
>22	79 (54)	68 (46)		
≤22	97 (48)	107 (52)		
	Mean (SD)	Mean (SD)	Bivariate Statistics	*P*
Alcohol use	17.02 (26.59)	21.05 (27.38)	$t_{348} = -1.40$	.16
Marijuana use	24.70 (33.79)	23.96 (32.84)	$t_{348} = -0.21$	.84
Nicotine dependence	4.30 (1.85)	4.21 (1.82)	$t_{350} = -0.48$	.63
Smoking expectancies	35.84 (7.54)	36.23 (6.75)	$t_{351} = 0.51$	.61
Self-efficacy	65.96 (13.46)	65.78 (12.66)	$t_{351} = -0.13$	.89
Peer smoking	2.75 (1.62)	2.79 (1.41)	$t_{343} = 0.24$	.81

RESULTS

Sample Characteristics

Participants were 355 adolescents (54% female, 45% black, 15% other/mixed race, 40% white, 12% Hispanic ethnicity). Participants smoked on average 9.80 (SD: 6.60) cigarettes per day. Approximately 51% of the participants smoked 1 to 8 cigarettes per day, 24% smoked 9 to 12 cigarettes per day, and 25% smoked 13 to 35 cigarettes per day. The study participants were moderately nicotine dependent (mean: 4.26 [SD: 1.83]). The average level of depressive symptoms was 21.00 (SD: 11.74). Analyses indicated that the treatment groups did not differ on any of the variables at baseline (all $P >$ .20), except for Hispanic ethnicity (see Table 2).

MI Treatment Integrity

To formally evaluate MI treatment integrity, 20% of MI sessions were randomly selected and were coded using by the Motivational Interviewing Treatment Integrity Code, version 2.1, and analyzed for the achievement of standards for MI quality.[36–38] Benchmarks for MI competency (≥6) were approached or achieved for the 2 global ratings of empathy (mean: 5.2 [SD: 0.87]) and spirit (mean: 5.9 [SD: 0.81]) using a 7-point Likert scale ranging from 1 = low to 7 = high. The ratings for the behavioral counts met the benchmarks for proficiency, including ratio of reflections to questions (1.8), percentage of open questions (61%), and MI adherence (96%). The percentage of complex reflections (28%) approached the benchmark only for beginning proficiency (40%).

Bivariate and Multivariate Associations With Attempting to Cut Back

Overall, 61% of participants attempted to cut back on their smoking at 12 weeks and 64% attempted to cut back at the 24-week follow-up. Bivariate associations are presented in Table 3.

Race, Hispanic ethnicity, treatment group, time, baseline alcohol use and marijuana use, smoking expectancies, and readiness to cut back on smoking were entered into the model. The final model included treatment, time, race, Hispanic ethnicity, smoking expectancies, and readiness to cut back. Only 2 of these variables were significant independent predictors of the odds of attempting to cut back on smoking. White adolescents were ~80% less likely to attempt to cut back on their smoking than were black adolescents (odds ratio [OR]: 0.21 [confidence interval [CI]: 0.08–0.53]). Adolescents who were in the planning stage or a higher stage of readiness to cut back on their smoking at baseline were almost 3 times more likely to attempt to cut back their smoking (OR: 2.87 [CI: 1.26–6.52]). The treatment according to time interaction was not significant ($P = .50$).

Bivariate and Multivariate Associations With Attempting to Quit

Overall, 66% of participants reported an attempt to quit smoking at 12 weeks and 74% reported an attempt to quit smoking at the 24-week follow-up. The bivariate associations are summarized in Table 4.

TABLE 3 Univariate Statistics and Bivariate Associations With Attempt to Cut Back Smoking at 12 and 24 Weeks

Variable	Week 12				Week 24			
	Attempted to Cut Back		Bivariate	*P*	Attempted to Cut Back		Bivariate	*P*
	Yes, *n* (%)	No, *n* (%)			Yes, *n* (%)	No, *n* (%)		
Gender			$\chi^2_1 = 0.03$	.87			$\chi^2_1 = 1.53$	.22
Male	111 (85)	20 (15)			126 (92)	11 (8)		
Female	135 (85)	23 (15)			141 (88)	20 (12)		
Race			$\chi^2_2 = 1.01$	.60			$\chi^2_2 = 2.35$	.31
Black	116 (84)	22 (16)			124 (87)	18 (13)		
White	92 (84)	17 (16)			101 (90)	11 (10)		
Other or mixed race	37 (90)	4 (10)			41 (95)	2 (5)		
Hispanic			$\chi^2_1 = 2.66$	.10			$\chi^2_1 = 4.77$	.03
Hispanic	33 (94)	2 (6)			36 (100)	0 (0)		
Not Hispanic	212 (84)	41 (16)			230 (88)	31 (12)		
Treatment			$\chi^2_1 = 1.12$	.29			$\chi^2_1 = 2.11$	.15
MI	124 (87)	18 (13)			131 (92)	11 (8)		
SBA	121 (83)	25 (17)			135 (87)	20 (13)		
Other tobacco use			$\chi^2_1 = 0.13$	.72			$\chi^2_1 = 0.0001$	.99
Yes	97 (86)	16 (14)			102 (89)	12 (11)		
No	145 (84)	27 (16)			161 (89)	19 (11)		
Household smoking			$\chi^2_1 = 0.21$	.65			$\chi^2_1 = 0.16$	.67
Yes	143 (84)	28 (16)			156 (89)	20 (11)		
No	84 (86)	14 (14)			92 (90)	10 (10)		
Readiness to cut back			$\chi^2_1 = 4.42$	.03			$\chi^2_1 = 25.24$	<.0001
Precontemplation or contemplation	114 (19)	27 (81)			58 (27)	21 (73)		
Planning, action, or maintenance	130 (90)	15 (10)			182 (95)	10 (5)		
	Mean (SD)	Mean (SD)	Bivariate	*P*	Mean (SD)	Mean (SD)	Bivariate	*P*
Alcohol use	18.9 (20.1)	18.9 (26.6)	$t_{71} = -1.18$[a]	.24	19.9 (27.2)	10.9 (15.5)	$t_{55} = -2.77$[a]	.01
Marijuana use	24.1 (33.5)	25.3 (15.2)	$t_{283} = 0.31$	.21	24.9 (33.8)	24.1 (31.7)	$t_{292} = -0.12$	.90
Nicotine dependence	4.2 (1.8)	4.1 (1.5)	$t_{284} = -0.31$	.76	4.3 (1.8)	4.1 (1.6)	$t_{293} = -0.42$	.67
Smoking expectancies	36.3 (7.0)	34.8 (7.7)	$t_{287} = -1.29$	.20	36.3 (7.0)	33.6 (7.4)	$t_{294} = -2.12$	.03
Self-efficacy	65.8 (13.0)	64.9 (12.5)	$t_{286} = -0.41$	.68	66.0 (12.9)	64.3 (12.8)	$t_{294} = -0.70$	.49
Depression symptoms	21.6 (11.6)	19.9 (11.5)	$t_{284} = -0.86$	.39	21.6 (11.8)	19.6 (11.1)	$t_{292} = -0.91$	.36
Peer smoking	2.8 (1.5)	2.7 (1.4)	$t_{279} = -0.52$	.60	2.8 (1.5)	2.5 (1.4)	$t_{287} = -0.95$	.34

[a] Unequal sample *t* test used as equality of variance was rejected.

Race, treatment group, time, alcohol use, marijuana use, other tobacco use, nicotine dependence, smoking expectancies, self-efficacy beliefs, depression symptoms, readiness to quit smoking, and peer smoking were entered into the mixed effect logistic regression model. The final model included treatment, time, race, depression, smoking expectancies and readiness to quit. Three of these variables were significant independent predictors of the odds of attempting to quit smoking. White adolescents were over 80% less likely to attempt to quit smoking compared with black adolescents (OR: .17 [CI: 0.06–0.46]). Adolescents who received MI were ~60% less likely than adolescents who received SBA to try to quit smoking (OR: .41 [CI: 0.17–0.97]). Adolescents who were in the planning or a higher stage of readiness to quit smoking at baseline were almost 3 times more likely to attempt to quit smoking (OR: 3.13 [CI: 1.19–8.26]). The treatment by time interaction was not significant ($P = .14$).

Bivariate and Multivariate Associations With Smoking Reduction

Approximately 78% of participants had reductions in smoking from baseline to the 12-week follow-up, 10% had no change, and 12% had an increase in smoking. Approximately 74% of participants had reductions in smoking from baseline to the 24-week follow-up, 10% had no change, and 16% had an increase in smoking. The bivariate associations are summarized in Table 5.

Variables with significant bivariate associations with smoking reduction were entered into a mixed-effects linear regression model evaluating independent predictors of a reduction in smoking from baseline to the post-treatment follow-up time points. These variables included race, treatment group, alcohol use, use of other tobacco products, smoking expectancies, self-efficacy, and readiness to cut back on smoking. The variables retained in the model were treatment,

TABLE 4 Univariate Statistics and Bivariate Associations With Attempt to Quit Smoking at 12 and 24 Weeks

Variable	Week 12				Week 24			
	Attempted to Quit		Bivariate	*P*	Attempted to Quit		Bivariate	*P*
	Yes, *n* (%)	No, *n* (%)			Yes, *n* (%)	No, *n* (%)		
Gender			$\chi^2_1 = 0.45$	.50			$\chi^2_1 = 0.56$	.45
Male	85 (69)	39 (31)			99 (76)	31 (24)		
Female	99 (65)	54 (35)			112 (72)	43 (28)		
Race			$\chi^2_2 = 10.24$	.01			$\chi^2_1 = 9.89$	.01
Black	99 (74)	34 (26)			113 (81)	26 (19)		
White	57 (55)	47 (45)			66 (63)	38 (37)		
Other or mixed race	27 (69)	12 (31)			31 (76)	10 (24)		
Hispanic			$\chi^2_1 = 0.09$	.76			$\chi^2_1 = 0.21$	.64
Hispanic	24 (69)	11 (31)			27 (77)	8 (23)		
Not Hispanic	159 (66)	82 (34)			183 (73)	66 (27)		
Treatment			$\chi^2_1 = 1.42$	.23			$\chi^2_1 = 1.30$	.25
MI	83 (63)	49 (37)			95 (71)	39 (29)		
SBA	101 (70)	44 (30)			116 (77)	35 (23)		
Other tobacco use			$\chi^2_1 = 0.73$	.39			$\chi^2_1 = 1.91$	.17
Yes	69 (63)	40 (37)			75 (69)	33 (31)		
No	112 (68)	52 (32)			133 (77)	40 (23)		
Household smoking			$\chi^2_1 = 0.37$	.54			$\chi^2_1 = 0.55$	.46
Yes	108 (65)	57 (35)			125 (73)	47 (27)		
No	65 (69)	29 (31)			73 (77)	22 (23)		
Readiness to quit			$\chi^2_1 = 15.47$	<.01			$\chi^2_1 = 50.01$	<.0001
Precontemplation or contemplation	119 (59)	81 (41)			75 (54)	65 (46)		
Planning, action, or maintenance	65 (84)	12 (16)			115 (93)	9 (7)		
	Mean (SD)	Mean (SD)	Bivariate	*P*	Mean (SD)	Mean (SD)	Bivariate	*P*
Alcohol use	17.0 (27.2)	22.6 (31.6)	$t_{141} = 1.51$[a]	.13	17.3 (23.2)	22.5 (30.3)	$t_{103} = 1.33$[a]	.19
Marijuana use	25.2 (33.6)	23.8 (31.7)	$t_{271} = -0.33$	.74	24.8 (33.2)	27.6 (35.0)	$t_{279} = 0.61$	.54
Nicotine dependence	3.9 (1.7)	4.7 (1.7)	$t_{272} = 3.83$	<.01	3.9 (1.8)	4.8 (1.7)	$t_{280} = 3.48$	.001
Smoking expectancies	35.3 (6.9)	37.4 (7.3)	$t_{275} = 2.33$	.02	35.3 (6.9)	37.9 (7.4)	$t_{294} = 2.69$	.01
Self-efficacy	64.1 (12.2)	67.8 (13.8)	$t_{274} = 2.24$	.03	64.2 (12.6)	69.6 (12.8)	$t_{281} = 3.15$	.002
Depression symptoms	22.0 (11.2)	19.8 (12.0)	$t_{272} = -1.54$	.12	21.7 (11.7)	20.4 (12.0)	$t_{279} = -0.80$	.42
Peer smoking	2.6 (1.5)	3.0 (1.5)	$t_{267} = 2.06$	.04	2.6 (1.5)	3.1 (1.5)	$t_{276} = 2.33$	.02

[a] Unequal sample *t* test used as equality of variance was rejected.

time, gender, and smoking expectancies. Only treatment was significant. Adolescents who received MI showed a greater reduction in smoking rate (ie, the number of cigarettes smoked daily) than adolescents who received SBA (5.3 fewer cigarettes per day versus 3.3 fewer cigarettes per day). The treatment according to time interaction was not significant ($P = .38$).

Bivariate and Multivariate Associations With Smoking Cessation

Fifteen percent ($n = 54$) of the participants reported being smoking abstinent at 12 weeks (7-day point prevalence), and 22 (6%) were cotinine verified as smoking abstinent. Twelve percent ($n = 43$) of the participants reported being smoking abstinent at 24-weeks (7-day point prevalence), and 20 (6%) were cotinine verified as smoking abstinent. The bivariate associations are summarized in Table 6. Gender, race, treatment group, nicotine dependence, alcohol use, marijuana use, use of other tobacco products, smoking expectancies, self-efficacy, depression symptoms, peer smoking, and readiness to quit smoking were entered into a mixed-effects logistic regression model to evaluate their independent contributions to the likelihood of quitting smoking. The overall regression model was not significant, thus individual model effects could not be interpreted.

DISCUSSION

Motivation to change smoking behavior is an important obstacle to recruiting adolescents into smoking cessation studies. This difficulty is compounded by the fact that adolescence is a developmental period characterized by increasing needs for autonomy and respect for choices, which are not typically supported in general approaches to smoking cessation.[39,40] An MI approach seems to be well suited for adolescent behavior change because it can facilitate motivational processes, while conveying respect for autonomous decision making. The results of this study indicate that MI may help adolescents reduce their smok-

TABLE 5 Univariate Statistics and Bivariate Associations With Smoking Reduction at 12 and 24 Weeks

Variable	Week 12				Week 24			
	Smoking Reduction		Bivariate	*P*	Smoking Reduction		Bivariate	*P*
	Yes, *n* (%)	No, *n* (%)			Yes, *n* (%)	No, *n* (%)		
Gender			$\chi^2_1 = 0.88$	.35			$\chi^2_1 = 0.38$	.54
Male	91 (76)	29 (24)			94 (76)	30 (24)		
Female	124 (81)	30 (19)			111 (73)	42 (27)		
Race			$\chi^2_2 = 2.77$	.25			$\chi^2_2 = 5.42$	.07
Black	105 (82)	23 (18)			105 (80)	27 (20)		
White	78 (74)	28 (26)			72 (67)	36 (33)		
Other or mixed race	32 (82)	7 (18)			28 (78)	8 (22)		
Hispanic			$\chi^2_1 = 0.04$	.85			$\chi^2_1 = 0.46$	.50
Hispanic	27 (77)	8 (23)			26 (79)	7 (21)		
Not Hispanic	187 (79)	51 (21)			178 (73)	65 (27)		
Treatment			$\chi^2_1 = 2.07$	.15			$\chi^2_1 = 0.62$	.43
MI	106 (82)	23 (18)			96 (76)	30 (24)		
SBA	108 (75)	36 (25)			108 (72)	42 (28)		
Other tobacco use			$\chi^2_1 = 4.36$	.04			$\chi^2_1 = 0.001$	.97
Yes	76 (72)	30 (28)			79 (74)	28 (26)		
No	136 (82)	29 (18)			123 (74)	44 (26)		
Household smoking			$\chi^2_1 = 0.25$	.62			$\chi^2_1 = 0.23$	.63
Yes	126 (77)	37 (23)			121 (73)	44 (27)		
No	72 (80)	18 (20)			70 (76)	22 (24)		
Readiness to cut back			$\chi^2_1 = 0.93$	.33			$\chi^2_1 = 13.43$	.0002
Precontemplation or contemplation	113 (81)	26 (19)			143 (81)	34 (19)		
Planning, action, or maintenance	101 (76)	31 (24)			46 (59)	32 (41)		
	Mean (SD)	Mean (SD)	Bivariate	*P*	Mean (SD)	Mean (SD)	Bivariate	*P*
Alcohol use	17.8 (29.4)	23.6 (29.4)	$t_{269} = -1.41$	.12	17.8 (25.9)	23.6 (29.4)	$t_{269} = 1.47$	.14
Marijuana use	25.0 (34.3)	20.1 (28.9)	$t_{269} = -1.01$	.31	25.0 (34.3)	20.1 (28.9)	$t_{269} = -1.01$	.27
Nicotine dependence	4.2 (1.8)	4.3 (1.5)	$t_{269} = 0.47$	.64	4.2 (1.8)	4.3 (1.5)	$t_{269} = 0.47$	.64
Smoking expectancies	35.9 (6.9)	37.5 (7.3)	$t_{272} = 1.54$	.13	35.9 (6.9)	37.5 (7.3)	$t_{272} = 1.54$	.13
Self-efficacy	65.1 (13.1)	68.9 (12.9)	$t_{286} = 2.00$	.05	65.1 (12.9)	68.9 (13.1)	$t_{271} = 2.00$	.05
Depression symptoms	21.7 (11.4)	21.1 (12.1)	$t_{269} = -0.36$	.71	21.6 (11.4)	21.1 (12.1)	$t_{269} = -0.36$	.71
Peer smoking	2.7 (1.5)	2.9 (1.5)	$t_{264} = 0.74$	.46	2.7 (1.5)	2.9 (1.5)	$t_{264} = 0.74$	.46

ing rate, but MI is not more efficacious than SBA for promoting smoking cessation. These modest effects of MI on adolescent smoking suggest that MI may best fit within a multicomponent or sequential smoking cessation treatment approach in which behavior-change skills can support decisions to change smoking behavior. However, additional research is needed.

Indeed, results of recent research indicate that in medical settings adolescent smoking cessation rates can approach or exceed 30% among regular and intermittent smokers when MI is combined with brief clinician advice, interactive computer feedback, and behavioral counseling.[41,42] Although the present study took place in an adolescent care setting, clinicians were not involved in intervention delivery. Another recent study identified adolescent smokers through a school setting and offered telephone counseling that incorporated MI and cognitive behavioral skills training, which produced superior 3-month (14.8% vs 8.6%) and 6-month (10.1% vs 5.9%) abstinence rates among daily adolescent smokers compared with a control condition.[43] Our cotinine-verified smoking cessation rates are closer to these control-group abstinent rates, although in these previous studies abstinence was not biochemically verified. The present sample of adolescent smokers was more racially diverse and also may have included adolescents with a broader range of readiness for behavior change. Our recruitment messages indicated that interest in quitting smoking was not required for participation.

Unexpectedly, adolescents who received MI were ~60% less likely to try to quit smoking than were adolescents who received SBA. As predicted, adolescents who received MI showed a 40% greater reduction in daily smoking rate than adolescents who received SBA. These findings may reflect central aspects of the 2 interventions. SBA focused on specific advice on quitting as opposed to reducing smoking. MI focused on bringing about smoking behavior change as opposed to quitting, per se. MI may have increased desire to move along a continuum of change, with smoking reduction as a goal for those initially not interested in

TABLE 6 Univariate Statistics and Bivariate Associations With Smoking Cessation at 12 Weeks and 24 Weeks

Variable	Week 12				Week 24			
	Smoking Abstinent		Bivariate	*P*	Smoking Abstinent		Bivariate	*P*
	Yes, *n* (%)	No, *n* (%)			Yes, *n* (%)	No, *n* (%)		
Gender			$\chi^2_1 = 3.05$	.08			$\chi^2_1 = 5.44$	.02
Male	6 (4)	155 (96)			4 (2)	157 (97)		
Female	16 (8)	179 (92)			16 (8)	179 (92)		
Race			$\chi^2_2 = 0.26$	.88			$\chi^2_2 = 6.06$	.05
Black	11 (7)	148 (93)			12 (8)	147 (92)		
White	8 (6)	136 (94)			3 (2)	141 (98)		
Other or mixed race	3 (6)	49 (94)			5 (10)	47 (90)		
Hispanic			$\chi^2_1 = 1.01$	.31			$\chi^2_1 = 0.25$	.62
Hispanic	4 (10)	37 (90)			3 (7)	38 (93)		
Not Hispanic	18 (6)	296 (94)			17 (5)	297 (95)		
Treatment			$\chi^2_1 = 0.18$	.67			$\chi^2_1 = 0.0002$	.99
MI	10 (6)	167 (94)			10 (6)	167 (94)		
SBA	12 (7)	166 (93)			10 (6)	168 (94)		
Other tobacco use			$\chi^2_1 = 1.42$	.23			$\chi^2_1 = 0.43$	.51
Yes	11 (8)	123 (92)			9 (7)	125 (93)		
No	11 (5)	207 (95)			11 (5)	207 (95)		
Household smoking			$\chi^2_1 = 0.76$	.38			$\chi^2_1 = 2.19$	.14
Yes	12 (6)	198 (94)			9 (4)	201 (96)		
No	10 (8)	112 (92)			10 (8)	112 (92)		
Readiness to quit			$\chi^2_1 = 6.12$	.01			$\chi^2_1 = 5.54$	.02
Precontemplation or contemplation	11 (11)	86 (89)			10 (10)	87 (90)		
Planning, action, or maintenance	11 (4)	248 (96)			10 (4)	249 (96)		
	Mean (SD)	Mean (SD)	Bivariate	*P*	Mean (SD)	Mean (SD)	Bivariate	*P*
Alcohol use	16.4 (19.2)	19.1 (33.5)	$t_{350} = 0.46$	.64	11.1 (16.5)	$t_{269} = 2.10$[a]	$t_{269} = 2.10$[a]	.05
Marijuana use	15.2 (27.4)	24.8 (33.5)	$t_{350} = 1.31$	.19	14.0 (29.1)	$t_{350} = 1.41$	$t_{350} = 1.41$	.15
Nicotine dependence	3.1 (1.3)	4.3 (1.8)	$t_{351} = 3.04$	.003	3.5 (1.8)	$t_{351} = 1.93$	$t_{351} = 1.93$	.05
Smoking expectancies	35.8 (7.6)	36.1 (7.1)	$t_{352} = 0.85$	.39	33.4 (8.3)	$t_{352} = 1.73$	$t_{352} = 1.73$	.08
Self-efficacy	60.9 (13.2)	66.2 (13.0)	$t_{352} = 1.85$	.07	60.4 (14.9)	$t_{352} = 1.97$	$t_{352} = 1.97$	.05
Depression symptoms	24.2 (9.6)	20.8 (11.9)	$t_{350} = -1.33$	.18	25.4 (11.1)	$t_{350} = -1.73$	$t_{350} = -1.73$	.08
Peer smoking	2.1 (1.1)	2.8 (1.5)	$t_{344} = 2.05$	.04	2.4 (1.3)	$t_{344} = 1.20$	$t_{344} = 1.20$	.19

[a] Unequal sample *t* test used as equality of variance was rejected.

quitting or an acceptable outcome for those who attempted to quit but were unsuccessful. This study does not provide clear evidence that MI or SBA led to increased quit rates, but it does suggest that perhaps an important function of a multiple-session intervention is that it enhances adolescents' efforts to make changes in their smoking behavior.

Considered together, the research provides support for the efficacy of adolescent smoking interventions that incorporate MI, but not interventions based predominately on MI. Moving adolescents along a continuum of change has been recommended for health care providers working with youth.[44,45] As we noted in regard to the present study, greater readiness to change smoking predicts a threefold increase in actual attempts to change smoking behavior. To effectively treat adolescent smokers, the process of facilitating decisions to change smoking behavior must be supported by additional treatment approaches such as physician advice or cognitive-behavioral smoking cessation strategies.

White adolescents were ~80% less likely to report both attempts at cutting back and attempts to quit compared with black adolescents. Because study population in previous studies of MI comprised mostly white adolescents, we are not aware of data documenting these racial differences in attempts to change smoking behavior. These findings raise important questions regarding why black adolescents are more likely to attempt smoking behavior change and why their greater efforts do not translate to successful or sustained change. Parental disapproval of smoking is greater among black parents than white parents, irrespective of their own smoking practices.[46,47] Thus, there may be more emphasis on cutting back and quitting smoking, but an array of less-articulated factors to mitigate success,[48] such as fewer bans on smoking inside the home.[49] Unsuccessful smoking behavior change during late adolescence and emerging adulthood may help account for

the increased smoking prevalence among black adults.[50]

Despite modest treatment effects, the present study had several strengths. The sample of adolescents was larger than that of many previous studies and more racially and ethnically diverse. Almost 80% of adolescents completed all treatment sessions, and 80% were retained to the last follow-up. Ability to retain adolescents in smoking-secession research has been one of the most frequently cited obstacles to the identification of effective interventions.[2,9] Treatment fidelity was carefully monitored and evaluated, and the blinded assessment of smoking outcome and biochemical verification of smoking cessation were also strengths. However, a potential limitation was that participants younger than 18 years were required to have written parental consent to participate in the study. This requirement may have affected some characteristics of the sample, because these parents were already aware of their adolescent child's smoking status. It is not clear how many adolescents were not interested in participating because their parent(s) were unaware of their smoking. In addition, although the quality of the MI delivered was good and comparable with that reported for other published studies, values that were less than ideal on 2 fidelity metrics slightly reduced the confidence in our findings.

CONCLUSIONS

The present study offers little support for MI as a sole treatment for adolescent smoking behavior change and points to its role within a multicomponent approach to smoking cessation treatment in which behavior change skills can support increased motivation and decisions to change smoking behavior. Although the effects of multicomponent intervention are promising, they highlight the need for additional research to optimize adolescent smoking cessation outcomes. For example, determining why specific interventions are helpful will highlight the active treatment ingredients. Identifying which adolescents benefit from what type(s) of smoking cessation interventions will help guide particular adolescents to the treatment that is most likely to facilitate their sustained smoking cessation. Reducing smoking prevalence earlier in life rather than later may have a significant impact the medical and economic consequences of long-term cigarette smoking.

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The Efficacy of Motivational Interviewing Versus Brief Advice for Adolescent Smoking Behavior Change

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