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"Look At Your Health": Outcomes associated with a computer-assisted smoking cessation counseling intervention for community college students

Alexander V. Prokhorov [a,*], Tracey Yost [a], Mary Mullin-Jones [a], Carl de Moor [b], Kentya H. Ford [a], Salma Marani [a], Briseis A. Kilfoy [c], Joshua P. Hein [a], Karen Suchanek Hudmon [c,d], Karen M. Emmons [e]

[a] *Department of Behavioral Science, The University of Texas M. D. Anderson Cancer Center, Houston, TX, United States*
[b] *Supportive Oncology Services, Memphis, TN, United States*
[c] *Department of Epidemiology & Public Health, Yale University School of Medicine, New Haven, CT, United States*
[d] *Purdue University School Pharmacy & Pharmaceutical Sciences, West Lafeyette, IN, United States*
[e] *Department of Society, Human Development, and Health, Harvard University School of Public Health, Boston, MA, United States*

Abstract

Community college students represent 44% of all students enrolled in U.S. higher education facilities. To our knowledge, no previous smoking cessation intervention has targeted community college students. Previous studies suggest that a motivational smoking cessation intervention could be successful for young adult smokers. Combining motivational interviewing sessions with personalized health feedback is likely to increase participants' motivation to quit and movement through the stages of change. The purpose of this study was to evaluate the impact of a smoking cessation program based on these premises. We designed a computer-assisted, counselor-delivered smoking cessation program that addresses personal health risks and readiness to change smoking behavior among community college students. A group-randomized, controlled trial was used to assess the intervention in a sample of 426 students (58.5% females; mean age, 22.8±4.7 years) from 15 pair-matched campuses. At the 10-month follow-up assessment, the cotinine-validated smoking cessation rates were 16.6% in the experimental condition and 10.1% in the standard care condition ($p=0.07$). Our results indicate

* Corresponding author. Department of Behavioral Science, The University of Texas M. D. Anderson Cancer Center, P.O. Box 301439, Houston, Texas, 77230, United States. Tel.: +1 713 745 2382; fax: +1 713 745 4286.
E-mail address: aprokhor@mdanderson.org (A.V. Prokhorov).

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that our computer-assisted intervention holds considerable promise in reducing smoking among community college students.

Keywords: Community college students; Smoking cessation

1. Introduction

Cigarette smoking among college students is on the rise, but cessation interventions for college smokers are limited (Murphy-Hoefer et al., 2005; Patterson, Lerman, Kaufmann, Neuner, & Audrain-McGovern, 2004; Wechsler, Kelley, Seibring, Kuo, & Rigotti, 2001; Wechsler, Rigotti, Gledhill-Hoyt, & Lee, 1998). This is of particular public health concern as cigarette smoking is the primary known cause of preventable death in the United States (Mokdad, Marks, Stroup, & Gerberding, 2004), resulting in approximately 438,000 deaths each year (Centers for Disease Control, 2005; Mokdad et al., 2004). In 2006, more than 17 million students (including graduate and professional students) were enrolled in the nation's 4276 public and private colleges and universities (The Chronicle of Higher Education, 2007). More than 40% of these students—approximately 6.5 million—were enrolled in the nation's 1694 community colleges (The Chronicle of Higher Education, 2007). Community college students are an important target group for smoking cessation interventions, for at least two reasons. First, they may have higher rates of smoking than students at 4-year colleges. Compared with students at 4-year colleges, community college students typically come from lower-income backgrounds, which are associated with higher smoking prevalence (Prokhorov et al., 2003). In fact, Wechsler et al. (1998) suggested that students attending 2-year colleges may have higher smoking rates than their counterparts at 4-year colleges. Second, the population of community college student smokers is large. According to Mathieson, Faris, Stam, and Egger (1992), the smoking prevalence is 30% among community college students, therefore suggesting that approximately 1.95 million community college students currently smoke cigarettes. Because many young adults attend community colleges in the United States, these institutions are well positioned to conduct smoking cessation interventions (Hennrikus, Jeffery, & Lando, 1995; Hingson & Howland, 2002; Johnston, O'Malley, & Bachman, 2001; Sargent, Mott, & Stevens, 1998; Schofield, 1998; U.S. Department of Health and Human Service, 1994). While community colleges seem to be good venues for smoking cessation interventions, little is known regarding the efficacy of interventions with this population.

Previous research suggests that achieving tobacco control among college-aged students should be a major public health initiative, deserving of its own population-specific mitigation tools and strategies (Christie-Smith, 1999). Multiple factors distinguish the smoking cessation needs in young adults from those of the older adult population. One of the primary reasons for the failure of smoking prevention and cessation programs among young adult smokers is that they are less likely to be concerned about the risks of smoking than older smokers. They believe that the health consequences occur much later in life, and their personal disease risks from smoking are not clear to them. In addition to low perceived risk, researchers suspect that perceived advantages of smoking and lack of recognition of the benefits of quitting contribute to smoking behavior among adolescents and young adults (Ershler, Leventhal, Fleming, & Glynn, 1989; Prokhorov, Emmons, Pallonen, & Tsoh, 1996; Stanton, Lowe, & Gillespie, 1996; van Roosmalen & McDaniel, 1992).

Presenting tailored, individualized information about the risks of smoking appears to be an effective strategy for addressing smoking among community college students (Chan & Witherspoon, 1988). In Project "Look At Your Health" (LAYH), funded by the National Cancer Institute, we developed a computer-assisted, counselor-

delivered smoking cessation program that targets personal health issues and readiness to change smoking behavior among community college students. While there is evidence that computer-tailored smoking cessation programs are effective in adult populations (Lancaster & LF, 2002; Strecher, Greenwood, Wang, & Dumont, 1999), the effectiveness of such programs has not been tested specifically in community college students. The LAYH intervention delivers personalized estimates of the health effects of smoking; these estimates are derived from individual physiological and psychosocial measures. Integrating personalized normative and ipsative health feedback (e.g., a visual comparison of lung function and respiratory symptoms) into a motivational intervention during counseling sessions increases a tobacco user's awareness of the health consequences of smoking, particularly the short-term consequences to which they might be more likely to be responsive.

Here we describe a longitudinal evaluation of the LAYH intervention compared to a standard care (SC) condition among community college students in the greater Houston, Texas area. We hypothesized that students randomly assigned to the LAYH group would experience higher rates of smoking cessation and movement through the stages of readiness to quit compared to students assigned to the SC condition. Our long-term goal is to identify effective and feasible approaches for promoting smoking cessation among high-risk, young adult smokers.

2. Methods

2.1. Overview of the LAYH program

In this group-randomized, controlled study, community college student smokers received either standard smoking cessation advice or the LAYH computer-assisted, smoking cessation counseling. The latter, which was tailored to the individual student's personal smoking-related characteristics and stage of readiness to quit smoking, was delivered using a motivational interviewing approach. Our LAYH computerized program featured an expert system software that collected data as well as provided tailored feedback, individualized quitting strategies, and personalized newsletters. The Transtheoretical Model of Change (Prochaska, DiClemente, & Norcross, 1992) served as the underlying theoretical framework for both the intervention and the evaluation. Also, we drew upon the Health Belief Model (Rosenstock, 1974) by incorporating constructs of perceived risks and benefits, with the goal of heightening perceived benefits of quitting smoking and by increasing students perception of smoking risks. Intervention participants received individual, motivational counseling and completed computerized questionnaires. Feedback was provided on their carbon monoxide levels and their lung function, which was tested via spirometry. The spirometry results also were used to compute a "lung age" that was communicated to students. The program's theoretical underpinnings and technical issues (target variables depicted on the computer screen, etc.) are described in detail elsewhere (Prokhorov et al., 2007). In both the SC and LAYH conditions, the study design called for participants to meet one-on-one with project counselors at baseline and at 2, 4, and 10 months thereafter.

2.2. Subject recruitment

Students who smoked at least one cigarette per day were recruited from 15 community college campuses located in or near Houston, Texas. These campuses represented all the major community college systems in the greater Houston area. The recruitment period was from February 2000 through

September 2001. Initially, we recruited from 14 campuses, but in February 2001, we added an additional campus because of recruitment difficulties at one location. The campuses were pair-matched by size and then randomly assigned to either the SC group ($n=7$) or the LAYH group ($n=8$). The 15th campus was assigned non-randomly to the LAYH group. The smokers were recruited in a staggered fashion over the course of 18 months. Methods initially used to recruit participants included announcements by college instructors, public service announcements in student newsletters and newspapers, school marquee announcements, and flyers. Recruiters also attended organized campus activities, staffed sign-up booths, and distributed small promotional items.

2.3. Counselor training

Three counselors were hired and trained to operate relevant equipment and to implement study protocols used for the computerized survey and health feedback tests. Counselors received extensive training followed-up by role-playing sessions under the supervision of nationally and internationally renowned experts from Brown University. This training was videotaped and reviewed multiple times thereafter. Prior to the study, mock-up counseling sessions also were conducted multiple times with immediate supervisors from The University of Texas M. D. Anderson Cancer Center. Finally, the counselors each had a copy of the Miller and Rollnick (1991) book on Motivational Interviewing for reference, as needed. Furthermore, the counselors attended a 2-day, National Institute for Occupational Safety and Health-approved course on administering spirometry to assess pulmonary function, and met with a counselor from The University of Texas M. D. Anderson Cancer Center's outpatient smoking cessation clinic, to discuss aspects of nicotine addiction. In most cases, study participants interfaced with the same counselor at each of their four individual sessions.

2.4. Treatment conditions

As noted above, both conditions required study participants to meet one-on-one with project counselors at baseline and at 2, 4, and 10 months after baseline.

2.4.1. Standard care

Participants in the SC group received brief counseling (5–10 min), during which time they were strongly advised to quit, and were provided with a copy of the National Cancer Institute's *Clearing the Air* self-help manual (U.S. Department of Health and Human Service, 2003). At each follow-up session (2, 4, and 10 months post-baseline), the counselor inquired about the quitting progress, answered any questions about quitting, and provided an illustrated fact sheet excerpted from the *Clearing the Air* manual (a different sheet was provided for each session).

2.4.2. Intervention group

In the LAYH group, the intervention consisted of (1) a motivational counseling intervention and (2) feedback about lung function (as measured by spirometry and discussed in terms of a student's "lung age") and expired carbon monoxide (CO) levels. The counseling intervention and respiratory feedback were based on information generated by the LAYH expert system software program. This software provided counselors with real-time, on-screen, tailored feedback and quitting strategies that were generated in response to the participant's answers to a computerized questionnaire. Using the expert system software and motivational

interviewing techniques (Miller & Rollnick, 1991), the counselor-delivered smoking cessation messages that were tailored to each participant's smoking-related characteristics (e.g., nicotine dependence level, decisional balance, and temptations to smoke) and stage of readiness to quit (Prochaska et al., 1992). Each participant received a summary of his or her data in the form of a brief individualized newsletter. A detailed description of the computer-assisted intervention is provided elsewhere (Prokhorov et al., 2007).

2.5. Measures

Both groups completed a computerized questionnaire that assessed sociodemographic characteristics (age, sex, ethnicity, marital status, living conditions, employment, class attendance, and the area of study) collected at baseline only. We also assessed smoking-related beliefs and behaviors, and health status. Key constructs assessed via questionnaire are described below. For self-reported smokers, smoking status was validated with salivary cotinine at baseline and at the final (10-month) follow-up assessment using the NicoMeter™ semi-quantitative dipstick device, which is a convenient, reliable, and cost-effective indicator of tobacco use (Gariti et al., 2002). Self-reported quitters with salivary cotinine values ≤ 5 ηg/mL (i.e., level "0" on the NicoMeter™ scale) were considered to be validated quitters.

2.5.1. Sociodemographic characteristics

Sociodemographic factors examined included age, sex, ethnicity, marital status, living conditions, employment, class attendance, and the area of study.

2.5.2. Stage of change for smoking cessation

The stages of change were identified using the widely used 3-item measure (Prochaska et al., 1992). Specifically, smokers were classified into the precontemplation stage if they did not intend to quit in the next 6 months; contemplation stage if they intended to quit in the next 6 months; and the preparation stage if they intended to quit in the next 30 days and tried quitting in the past 12 months. Those who reported abstinence for less than 6 months were classified into the action stage of change. The maintenance stage was defined as staying abstinent for more than 6 months.

2.5.3. Decisional Balance

The Decisional Balance scale was (Velicer, DiClemente, Prochaska, & Brandenburg, 1985) used to evaluate the "pros and cons" of smoking. The scale score was computed as an unweighted sum of 12 items forming that scale, and scores were standardized to mean = 50 and standard deviation (SD) = 10. The scale is a 5-point Likert scale with responses ranging from "strongly disagree" to "strongly agree." A decisional balance score was computed as pro score (standardized) minus con score (standardized); a score of 0 indicates that the pros and cons are equal; a negative score indicates that the cons outweigh the pros, and a positive score indicates that the pros outweigh the cons.

2.5.4. Temptation to smoke

Temptations to smoke were measured using a scale developed by Velicer, DiClemente, Rossi, and Prochaska (1990). Scores were computed as unweighted sums of 13 items describing temptations to smoke. A 5-point Likert scale measured responses ranging from "not at all tempted" to "extremely tempted." Temptations to smoke are based on positive and negative affect, positive social situations, and habitual behavior and cravings. A higher score is indicative of a higher level of temptations.

2.5.5. Withdrawal symptoms

Withdrawal symptoms were measured using a scale derived from a widely recognized instrument (Hughes & Hatsukami, 1986); this scale contained items describing emotional/affective disturbances and physiological disturbances. The score was computed as an unweighted sum of the responses on a 5-point Likert scale ranging from "never" to "always." A higher score indicates greater withdrawal symptoms.

2.5.6. Respiratory symptoms

We used the American Thoracic Society's inventory to assess the frequency of self-reported respiratory symptoms (Comstock, Tockman, Helsing, & Hennesy, 1979). This score was computed as an unweighted sum of the responses on a 5-point Likert scale ranging from "never" to "everyday," with a higher score indicating greater respiratory symptoms. The respiratory symptoms included morning cough, daytime cough, phlegm production, wheezing, shortness of breath during walking and exercise, and chest pain/tightness.

2.5.7. Other tobacco use variables

Other key variables used to characterize tobacco use status included number of smoking years, number of cigarettes smoked daily, nicotine dependence as assessed using the Fagerström Test for Nicotine Dependence (Heatherton, Kozlowski, Frecker, & Fagerström, 1991), and number of quit attempts (a single item assessing the number of quit attempts for at least 24 hours in the past year, ranging from "none" to "six or more" times).

2.6. Statistical analysis

Our primary dependent variable was 7-day point-prevalence abstinence. Secondary outcomes included progression through the stages of change, determinants of smoking, and number of quit attempts.

2.6.1. Baseline comparisons

The study population was characterized using simple descriptive statistics, and scaled scores were computed for individuals who provided responses to all of the items underlying a given measure. To detect baseline differences between the treatment groups, we used generalized linear mixed model regression. Because the campus was the unit of randomization, models included the campus as a random effect to adjust for potential correlation of measurements within campuses. All statistical analyses were completed using SAS statistical software version 8.02 (SAS Institute Inc.).

2.6.2. Abstinence at 10-month follow-up

Generalized linear mixed model regression was used to detect group differences in abstinence at 10-month follow-up. To adjust for potential correlation of measurements within campus, we modeled campus as a random effect nested within treatment condition. The outcome was binary (smoker or non-smoker at 10-month follow-up), and Proc Glimmix in SAS was used to model the relationships. Both self-reported and biochemically confirmed abstinence rates were analyzed and are presented here.

2.6.3. Progression through the stages of change

The percentage distribution across the four stages of change—precontemplation, contemplation, preparation, and action (Prochaska et al., 1992)—was compared between the treatment groups at

baseline and at the 10-month follow-up. Contingency tables, Pearson chi-square analysis, and *P* values were used to summarize the results.

2.6.4. Determinants of smoking

For determinants of smoking, the primary method of analysis was a pre-post test analysis using mixed model ANCOVA (PROC MIXED in SAS). In this analysis, primary mediators at the 10-month follow-up were compared between the two groups, while controlling for baseline values of these outcomes. Campus was modeled as a random effect nested within treatment condition, and condition and baseline values were modeled as fixed effects. This approach provided an estimate of the intervention effect in terms of an adjusted difference in the 10-month outcomes. The effect of the intervention at 10 months was evaluated by comparing the mean outcomes between the control and intervention groups adjusted for baseline values and campus effect.

Table 1
Descriptive characteristics: baseline and 10-month follow-up

Characteristic (*p*-value)	Baseline (*n*=426)		10-month follow-up (*n*=326)	
	SC (*n*=207)	LAYH (*n*=219)	SC (*n*=168)	LAYH (*n*=158)
Age, years (*p*=.85)	22.9 (4.6)	22.8 (4.7)	22.9 (4.7)	22.6 (4.4)
Sex (female) (*p*=.09)	54.0%	63.0%	53.6%	65.8%
Ethnicity				
White	54.6%	56.2%	56.0%	57.6%
African American	15.5%	9.1%	14.3%	7.6%
Hispanic	15.5%	18.3%	14.9%	19.0%
Other	14.5%	16.4%	14.9%	15.8%
Marital status (single) (*p*=.90)	87.9%	85.3%	88.7%	84.8%
Children=yes (*p*=.14)	21.7%	26.0%	19.6%	24.7%
Employment (*p*=.20)				
Full time	21.7%	17.4%	21.4%	18.4%
Part time	44.0%	40.2%	45.8%	42.4%
Not employed	34.3%	42.5%	32.7%	39.2%
Exercise (*p*=.83)				
>3 times/wk	34.8%	35.6%	32.7%	34.8%
<3 times/wk	32.9%	34.7%	35.1%	35.4%
Not at all	32.4%	29.7%	32.1%	29.7%
Nicotine dependence score (*p*=.60)	2.9 (2.4)	2.8 (2.3)	2.9 (2.4)	2.8 (2.3)
"Have you ever attempted to quit?" (yes) (*p*=.23)	82.6%	88.6%	83.3%	88.6%
Number of years smoked (*p*=.25)	6.9 (4.7)	6.3 (4.9)	6.9 (4.8)	6.1 (4.7)
Number of cigarettes per day (*p*=.14)	12.9 (9.5)	12.0 (7.5)	12.9 (9.8)	12.0 (7.5)
Stage of Change (*p*=.25)				
Precontemplation	10.6%	9.1%	11.9%	10.8%
Contemplation	65.7%	63.9%	66.1%	62.7%
Preparation	23.7%	26.9%	22.0%	26.6%
Decisional Balance score (*p*=.72)	−0.28 (15.3)	0.27 (15.3)	−0.27 (15.2)	−0.10 (14.1)
Temptations to Smoke score (*p*=.42)	46.0 (7.8)	46.9 (8.1)	46.2 (7.9)	47.3 (8.0)

Values in table are mean (standard deviation) or percentages.

3. Results

3.1. Sample characteristics

Table 1 summarizes characteristics of the participants at baseline and 10-month follow-up. The baseline sample consisted of 426 students (80.1% of the targeted; $n=532$). The mean age was 22.8± 4.7 years (range=18 to 35 years). Most participants were female (58.5%) and Caucasian (55.4%). The majority of students had never been married (82.4%), lived with parents or other family of origin (53.5%), and were employed part-time (42.0%). Most students attended classes on a full-time basis (70.9%), and about one third (30.5%) were enrolled in their first semester of college. The most common area of study cited was "academic" (24.6%). Combined, the "undecided" and "other" areas of study accounted for 36.8% of the sample.

At baseline, there were 207 students in the SC group and 219 in the LAYH group. Although our sample was composed of compensated volunteers, the sample characteristics reflected the overall student populations at the two largest participating community colleges—Houston Community College and San Jacinto College (Houston Community College System, 2007). There were no differences between the LAYH and SC groups in terms of age, sex, ethnicity, marital status, number of children, employment, exercise, nicotine dependence, smoking profile (dependence and quit attempts), or the key Transtheoretical Model constructs including stages of change, situational temptations to smoke, and decisional balance.

On average, participants smoked 12.5 (standard deviation [SD]=8.5) cigarettes per day, began smoking regularly at 16 years of age (SD=3.3), and had smoked regularly for 6.6 years (SD=4.8). At baseline, 10% of students were in the precontemplation stage, 65% were in the contemplation stage, and 25% were in the preparation stage. Nineteen percent had never attempted to quit, 30% had quit once or twice, 24% had quit three to five times, and 27% had quit six or more times. Twenty-seven percent of participants exhibited a substantial degree of nicotine dependence (Fagerström Test for Nicotine Dependence [FTND] score of 5 or more), 38% had a moderate degree of nicotine dependence (FTND score of 2 to 4), and 35% had negligible levels of dependence on nicotine (FTND score of less than 2). The average withdrawal symptom score was 10.16 (SD=4.60). Salivary cotinine values at baseline

Table 2
Smoking abstinence at 10-month follow-up, by sex and ethnicity

	Quit rate (%)	
	Standard care ($n=168$)	Look at your health ($n=158$)
Overall ($n=326$)	10.1	16.6
Sex		
Male ($n=132$)	2.6	11.1
Female ($n=193$)	16.7	19.4
Ethnicity		
White ($n=184$)	10.6	14.4
African American ($n=36$)	4.2	8.3
Hispanic ($n=55$)	20.0	20.0
Other ($n=50$)	4.0	24.0

confirmed smoking status for 95% of the students; the other 5% of the tests were invalid because of initial methodological deficiencies that were quickly rectified.

Dropout rates for the two groups as computed at the 10-month assessment were as follows:LAYH 27.9% (61/219), SC: 18.8% (39/207), $p=.0748$. Baseline level of nicotine dependence, number of daily cigarettes smoked, age, sex, race, stage of change, and their interactions with intervention group were tested as predictors of abstinence using a random effects logistic regression model with campus of origin as random factor (Proc Glimmix in SAS). No significant differences (baseline or 10-month) were observed. In addition, no significant interactions were found between study conditions and the aforementioned characteristics for predicting abstinence.

A total of 326 students completed all 4 individual sessions with the counselor: 168 (81.1%) in the SC group and 158 (72.1%) in the LAYH group. No group differences on any of the variables were found in the subsample who completed the final 10-month survey. Table 1 summarizes these results.

3.2. Quit rates, by treatment condition

Cotinine-validated quit rates (7-day, point-prevalence abstinence) are shown in Table 2. At the 10-month follow-up, 86 students (26.4% of total $n=326$) self-reported quitting smoking. Self-reported quit rates were 24.4% ($n=41$) for the SC group and 28.5% ($n=45$) for the LAYH group ($p=.21$). Upon biochemical verification, of the 326 total cotinine samples (of which 325 underwent validation to verify self-reported quitting status), we observed 43 (13.5%) validated quits—25 (16.6%) in the LAYH group, and 17 (10.1%) in SC (two-sided $p=.068$).

3.3. Quit rates, by sex and ethnicity

Quit rates by sex and ethnicity are shown in Table 2. Higher quit rates were observed among women than among men in both the SC and LAYH groups. For all ethnicities except Hispanics, quit rates were higher in the LAYH group than in the SC group. The results were not statistically significant.

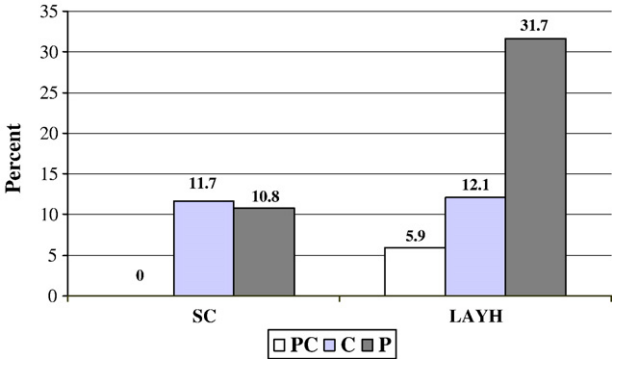

Fig. 1. Quitters at 10-month follow-up by stage change. Note: PC= Precontemplation; C= Contemplation; P= Preparation; SC= Standard Care; LAYH= Look At Your Health.

3.4. Quit rates, by stage of change

Cotinine-validated quit rates by stage of change at 10-month follow-up are shown in Fig. 1. For those in the precontemplation and contemplation stages of change, there were no significant differences in quit rates between the SC and LAYH groups. Among students in the preparation stage of change, quit rates were significantly higher for those in the LAYH group than for those in the SC group (31.7% vs. 10.8%, $p<.05$).

3.5. Movement through the stages of change

One hypothesis that we tested was to determine whether the LAYH would have a more significant impact than SC on students' progression through the stages of change from the baseline session to the 10-month follow-up (Fig. 2). As shown, most students were in contemplation or preparation stage at baseline. For students in the precontemplation or contemplation stages at baseline, no significant differences in progression through the stages were observed between the SC and LAYH groups. For students in the preparation stage at baseline, 48% of the LAYH group progressed to action by 10 months, compared to 28% of the SC group, and 14% of the LAYH group regressed to contemplation, compared to 49% of the SC group ($p=.01$). None of the participants reached the maintenance stage.

3.6. Determinants of smoking

Changes in determinants of smoking between baseline and the 10-month follow-up differed significantly by intervention group. Compared to the SC group, the LAYH group displayed significantly stronger anti-smoking beliefs and perceptions of the benefits of quitting as reflected by changes in the Decisional Balance score[1] (for total sample, changes were 2.1 for SC versus −2.2 for LAYH, adjusted for baseline, $p<.05$; for smokers, changes were 2.57 for SC versus −0.65 for LAYH, adjusted for baseline, $p<.01$). Compared with the SC group, the LAYH group also reported decreased temptations to smoke (for total sample, 42.1 for SC versus 36 for LAYH, adjusted for baseline, $p<.001$; for smokers, 43.1 for SC versus 38.2 for LAYH, adjusted for baseline, $p<.05$); fewer withdrawal symptoms (for total sample, 9.6 for SC versus 7.5 for LAYH, adjusted for baseline, $p<.001$; for smokers, 9.4 for SC versus 7.8 for LAYH, adjusted for baseline, $p<.05$); and milder respiratory symptoms (for total sample, 18.4 for SC versus 16 for LAYH, adjusted for baseline, $p<.001$).

3.7. Number of quit attempts

Among self-reported non-quitters at 10-month follow-up, there were no significant differences between the LAYH and SC groups in the mean number of quit attempts when adjusted for baseline numbers (3.5 attempts vs. 3.4 attempts). The total number of quit attempts was compared at baseline and at each of the follow-up sessions between intervention and control groups. The results are presented separately for quitters and smokers at 10 months.

At baseline, there were no significant differences between the LAYH and SC groups with respect to the number of quit attempts (3.3 [SD=1.4] vs. 3.2 [SD=1.5]). The number of quit attempts were compared

[1] A lower score means the student agrees with reasons to not smoke more than the reasons to smoke.

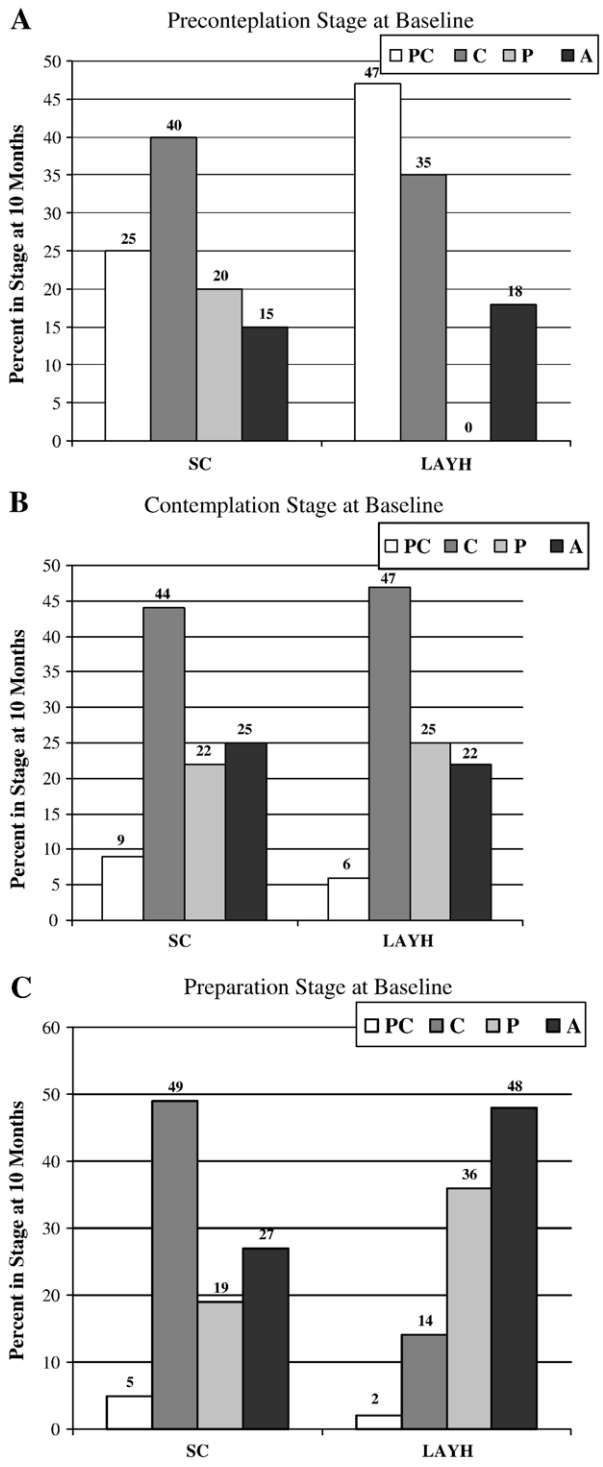

Fig. 2. Changes in stage membership by study condition. Note: PC=Precontemplation; C=Contemplation; P=Preparation; A=Action; SC=Standard Care; LAYH=Look At Your Health.

between LAYH and SC among biochemically validated quitters and smokers at 10 months. At the first follow-up, the mean number of quit attempts was higher for the LAYH group than the SC group (3.6 [SD=1.2] vs. 2.9 [SD=1.6]); however, the difference was not statistically significant.

Among students who were smokers at the 10-month follow-up, the mean number of quit attempts was virtually identical for both study conditions (3.4 [SD=1.3] vs. 3.3 (SD=1.4]). The mean number of attempts for quitters at 10 months was somewhat higher among the LAYH group compared to SC (3.5 [SD=1.4] vs. 3.0 [SD=1.3]), but results were not statistically significant. For smokers, the mean number of quit attempts did not differ significantly (3.3 [SD=1.4] vs. 3.1 [SD=1.4]). At the final follow-up, the number of quit attempts was recorded for smokers only. The mean number of quit attempts was virtually the same for both conditions and was similar to results seen among smokers at the previous assessment points (3.5 [SD=1.3] vs. 3.4 [SD=1.4]).

4. Discussion

Our study evaluated the impact of a novel smoking cessation intervention for community college students. In conjunction with motivational interviewing, counselors used an expert system software program to provide the participants with individually tailored, highly personalized feedback on respiratory health, presence of alveolar carbon monoxide, quitting strategies, and other smoking-related characteristics.

Our findings suggest that this intervention may reduce the smoking prevalence among community college students. This is particularly important in light of the fact that community college students are a severely understudied population, and few, if any community colleges offer smoking cessation programs to this rapidly growing population of young individuals.

Tailored, personalized, and individualized feedback about the negative consequences of smoking appear to be especially meaningful to this group, who because of their young age rarely suffer from chronic diseases, tend to minimize the health effects of smoking, and display limited insight into their personal risks of smoking-attributable illness. To our knowledge, it is the only smoking cessation intervention for this population that brought positive outcomes in terms of increased number of quitters at 10-month follow-up.

Although the differences in biochemically validated quit rates between the intervention and control groups approached but did not achieve statistical significance, we believe that our results show promise. First, our SC condition offered considerably more than students would receive ordinarily on a college campus; therefore, cessation rates for this group might be inflated. Second, the impact of our intervention resulted in smoking cessation rates comparable with the state-of-the-science knowledge related to the highest achievable efficacy from individual counseling. Specifically, our results were remarkably similar to efficacy rates described in the corresponding section of the *USDHHS Clinical Practice Guideline for Treating Tobacco Use and Dependence* (Fiore et al., 2000). We found that at the 10-month follow-up, 10.1% of SC participants remained abstinent compared with 16.6% in the intervention group (cotinine-validated results). According to the meta-analysis of 58 randomized controlled trials presented in the *Clinical Practice Guideline*, the lowest estimated abstinence rates (10.8%) were among smokers who did not seek treatment with a provider (“no format”), and the highest rates (16.8%; CI=14.7,19.1) were among smokers who received individual cessation counseling. In other words, our intervention appears to exhibit similar efficacy as the current “best practices” reported by the U. S. Department of Health and Human Services in 2000 (U.S. Department

of Health and Human Service, 2000). Moreover, when stage of change is taken into account, our intervention yielded abstinence rates for those in the preparation stage ($n=42$) that were almost three times greater than the aforementioned "no format" condition in the *Clinical Practice Guideline* (31.7% vs. 10.8%) and nearly twice as high as those found in the guideline's individual cessation counseling (31.7% vs. 16.8%).

A noteworthy finding from this study was the substantial discrepancy between self-reported and biochemically validated abstinence rates at 10 months. Only about half of the self-reported quitters were validated with the cotinine test (16.6% vs. 28.5% in the LAYH group and 10.1% vs. 24.4% in the SC group) suggesting that the rates of misreported quitting among community college students are phenomenally high and a biochemical validation of their self-reports is essential. The rationale for biochemical tests, especially among adult populations, has been debated in the literature (Luepker, Pallonen, Murray, & Pirie, 1989; Velicer, Prochaska, Rossi, & Snow, 1992). However, we submit that there might have been a number of possible reasons (e.g., social desirability in general, desire to please the counselor, or embarrassment because of the failure to quit) why students failed to accurately report their current smoking behavior post-treatment. Another possible contributor to the aforementioned discrepancy could be misreporting of social smoking (captured by the cotinine test) and mistaking it for "quitting." Clearly, this methodological issue requires additional in-depth investigations among community college students.

The intervention group (LAYH) students also made significant progress through the stages of change and through the psychological and physiological determinants of smoking, compared to those in SC. More LAYH participants progressed from preparation to action and fewer regressed from preparation or action to contemplation. The LAYH group espoused significantly higher anti-smoking and pro-quitting beliefs, and fewer temptations to smoke, as well as fewer withdrawal and lower respiratory symptoms. For those not abstinent at 10 months, these outcomes are likely to signify the intervention effect promoting readiness to quit smoking which eventually might move them towards future quit attempts.

Our findings pertinent to the other key Transtheoretical Model constructs (decisional balance and temptations to smoke) indicate that our intervention program resulted in their favorable changes in sharp contrast to the SC that did not exhibit such changes. These findings appear to validate the aforementioned movement of continued smokers through the stages of change in the right direction, as it was shown in previous Transtheoretical-guided studies (Prochaska et al., 1994). Although we realize that the stages of change is a dynamic and cyclical construct, in our study we saw greater progression of participants who were in the LAYH preparation group at baseline to action by 10-month follow-up compared to those who were in the SC group.

Among the study limitations, the relatively low sample size should be mentioned. Also, at mid-point, one of the targeted LAYH campuses had to be replaced with another one due to unanticipated worsening of cooperation with its personnel and corresponding difficulties with recruitment. Although we continued to treat and follow-up students recruited from both campuses in the same fashion, this glitch might have affected the rigor of the study randomization. It is difficult to isolate the effects received from MI and health feedback which is a limitation in this study. However, we merged these two key components into one cohesive intervention strategy; therefore we can only report the combined effect of the intervention. Also, we acknowledge that stages of change is a clinically relevant construct, but not predictive of quitting in every individual. Despite these limitations, we believe that this provides us with many important lessons and considerable experience in dealing with the high risk, yet grossly understudied population of community college students.

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