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ORIGINAL ARTICLE

Efficacy of a Brief Image-Based Multiple-Behavior Intervention for College Students

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Abstract
Background Epidemiologic data indicate most adolescents and adults experience multiple, simultaneous risk behaviors.
Purpose The purpose of this study is to examine the efficacy of a brief image-based multiple-behavior intervention (MBI) for college students.
Methods A total of 303 college students were randomly assigned to: (1) a brief MBI or (2) a standard care control, with a 3-month postintervention follow-up.
Results Omnibus treatment by time multivariate analysis of variance interactions were significant for three of six behavior groupings, with improvements for college students receiving the brief MBI on alcohol consumption behaviors, $F(6, 261)=2.73$, $p=0.01$, marijuana-use behaviors, $F(4, 278)=3.18$, $p=0.01$, and health-related quality of life, $F(5, 277)=2.80$, $p=0.02$, but not cigarette use, exercise, and nutrition behaviors. Participants receiving the brief MBI also got more sleep, $F(1, 281)=9.49$, $p=0.00$, than those in the standard care control.
Conclusions A brief image-based multiple-behavior intervention may be useful in influencing a number of critical health habits and health-related quality-of-life indicators of college students.

Keywords Brief intervention · Multiple-behavior intervention · Image · College students · Drug use · Health quality of life

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Introduction

College students are exposed to a range of health risks that increase their chances for developing future chronic diseases, injury, and significant social problems. For example, national survey data on substance use show 84.5% of undergraduates drank alcohol in the previous year; 41.0% used tobacco products, and 30.1% used marijuana [1]. In addition, many college students fail to meet nationally recommended nutrition and physical activity guidelines [2–4]. Furthermore, US college students experience greater stress than their younger counterparts [5, 6]. Finally, research indicates that students do not get adequate sleep during their college years [7, 8] and that this lack of sleep is associated with a range of health and academic problems [9–11]. All totaled, attending college represents a period not only for personal and intellectual development but also a time of increased risk for future morbidity, mortality, and injury from multiple health behaviors [12].

To date, the bulk of behavioral medicine interventions developed for individuals have addressed single risk behaviors, belying the epidemiological data indicating that most adolescents and adults experience multiple, simulta-

neous risk behaviors [13]. Interest in multiple-behavior intervention (MBI) research and practice has been growing [14–16], however, even given concerns that MBIs could overwhelm participants, cost too much, be excessively lengthy, or fail to address any single behavior in sufficient depth to have a significant outcome [17].

Research on brief interventions indicates they can influence a range of health behaviors [18–20], in addition to enhancing health and quality-of-life outcomes [21, 22]. Because brief interventions are time-limited, they are potentially cost-effective, efficient, and transportable [23]. In addition, some research has suggested that brief interventions may actually impact multiple risk-taking behaviors among adolescents [24].

A number of studies have identified social and self-image as important factors in the development and maintenance of health behaviors among youth [25–27]. One mechanism by which image is thought to affect health behavior is through interpersonal social comparison processes in which young people compare themselves to social image prototypes of a typical peer who engages in a specific health behavior like drinking alcohol or exercising [28–32]. Another mechanism by which image may influence health behavior is through intrapersonal self-comparison processes where an individual compares his or her current self with a possible future desired self [33–36]. Recently, a number of studies have suggested that brief interventions targeting both social and self-images may simultaneously influence health risk (e.g., alcohol use) and health-promoting behaviors (e.g., physical activity) among adolescents and young adults [37–39].

One study evaluating brief image-based MBIs for college students showed that a consultation and contract strategy alone and in combination significantly enhanced frequency of moderate physical activity and exercise, consumption of foods containing healthy fats, the quantity and quality of one's sleep, frequency of riding with someone drinking alcohol, use of self-control behaviors to avoid or limit drug consumption, as well as indicators of health-related quality of life over a 1-month period [39]. Unlike previous adolescent studies [37, 38], however, the image-based interventions targeting college students did not influence substance use (other than riding with someone drinking) and suffered from a number of limitations including a brief follow-up, a relatively small sample, and lack of a comparison group.

The current trial was designed to further examine the potential of multiple-behavior interventions for influencing college student health-promoting and risk behaviors, while addressing the previous study's limitations. In particular, this paper presents the results of a randomized trial evaluating the efficacy of a brief, image-based MBI compared against a standard care control for influencing risk behaviors (i.e., alcohol, cigarette, and marijuana consumption and problems) and health-promoting behaviors (i.e., exercise, nutrition, sleep, stress management) as well as health quality of life, among a sample of college students 3 months postintervention.

Methods

Participants

A total of 303 college students attending a mid-sized southeastern university were recruited throughout the fall of 2006 to participate in this trial. During baseline data collection, a computer error resulted in the loss of four participants' data, yielding 299 usable surveys. The majority of participating students were female (59.5%), with a mean age of 19.2 years old (SD=1.12). The majority of the sample was Caucasian (71.6%), followed by African American (12.7%). Nine percent (8.7%) reported being Hispanic. Most participants lived in a coed residence hall (44.8%) or in off-campus housing (38.5%; see Table 1).

Design and Procedures

Students aged 18–21 years who were currently enrolled at the target university and who visited the campus medical services center were eligible for this trial. Students attending the medical center were recruited to participate in a study evaluating a health promotion program titled Project Fitness. Posters and flyers were placed in the center announcing the study. Students were asked to complete a registration sheet so that research staff could call them to schedule an appointment to provide a complete description of the study purpose and risks. Additional announcements were made on the university's weekly student email and by distributing flyers in selected undergraduate health courses and common areas throughout campus. Students were paid $20 for participating in each of two study data collections.

Participants were randomly assigned to one of two treatment arms: (1) a MBI consisting of a brief tailored consultation and fitness goal plan or (2) a standard care control consisting of commercial health education print materials, as they presented for appointments with a fitness specialist (i.e., trained bachelor's level research staff). All fitness specialists received a 2-day training that included demonstrations, role-playing with other research personnel, feedback from research staff, and take-home practice on how to implement the consultation and goal plan. The quality of consultation and goal plan implementation was ensured by using a standardized implementation protocol, with randomly selected intervention sessions audio-taped to monitor implementation quality across interventionists.

Table 1 Characteristics of participants at baseline by treatment

Characteristic	Total sample (n=299)		Intervention (n=146)		Control (n=153)		χ	df	p-value
	n	%	n	%	n	%			
Gender									
Male	121	40.5	64	43.8	57	37.3			
Female	178	59.5	82	56.2	96	62.7	1.34	1	0.25
Ethnicity									
Hispanic or Latino	26	8.7	12	8.2	14	9.2	0.08	1	0.78
Race									
Black or African American	38	12.7	21	14.4	17	11.1			
White	214	71.6	102	69.9	112	73.2			
Other	47	15.7	23	15.8	24	15.7	0.75	2	0.69
Age (M/SD)	19.19/1.12		19.18/1.18		19.20/1.07		t=−0.14	291	0.89
Family alcohol or drug problem									
Yes	132	44.1	65	44.5	67	43.8	0.02	1	0.90
Health education last year									
Yes	178	59.5	80	54.8	98	64.1	2.66	1	0.10
Living situation									
Coed residence hall or dormitory	134	44.8	66	45.2	68	44.4			
Off-campus house or apartment	115	38.5	54	37.0	61	39.9			
Single-sex residence hall or dorm and others	50	16.7	26	17.8	24	15.7	.37	2	0.83

After providing written consent, all students completed a brief paper-and-pencil health behavior screen and then the baseline survey via a secure online computer program in a quiet office on campus. Immediately after the collection of baseline data, participants were provided with one of the two interventions and then completed an online feedback questionnaire assessing the acceptability and perceived effects of the interventions. Participants were contacted 11 weeks after their initial appointment in order to schedule the follow-up survey at week 12 (3 months postintervention). A total of 283 students completed the postintervention data collection for a response rate of 93%. The university's institutional review board approved the research protocol prior to implementing the study.

Interventions

Fitness Behavior Image Screen

Participants in both groups were first asked to complete the Fitness Behavior Screen, a nine-item instrument designed to elicit responses on selected health behaviors and self-images addressed in the consultation and goal plan. The items asked participants about their physical activity, exercise, diet, sleep, stress management habits, gender, and their alcohol and cigarette use, as well as their desire to achieve selected images, using primarily yes and no response items. Responses were used to tailor consultation messages to each participant's specific health habits.

Consultation and Goal Plan

After participants completed the screen and baseline survey, those assigned to receive the one-on-one consultation were provided with scripted messages by the fitness specialist using a consultation protocol. Consultations lasted approximately 25 min. The consultation was based on the Behavior Image Model [40], an emerging paradigm for planning multiple-behavior interventions. The model recommends using gain-framed messages to illustrate how health-promoting behaviors promote salient social and self-images and loss-framed messages to show how health-risk behaviors interfere with image outcomes and achievement of health-promoting habits. Image-based gain- and loss-framed messages are hypothesized to activate prototypes and future self-images, thereby coupling and motivating multiple-behavior change within single, brief interventions. The consultation protocol provided tailored content addressing each of the health behaviors in the screen and their relation to salient image achievement. PowerPoint slides were shown at designated points in the consultation to reinforce key images and health behaviors using colorful text and illustrations during the dialog-based consultation. Illustrations represented a wide range of young adult ages (18–21 years old), ethnic backgrounds, and both genders.

At the conclusion of the consult, the fitness specialist provided participants with a one-page goal plan. The goal plan was also based on the Behavior Image Model [40] as well as research indicating that the selection of self-concordant goals reflecting one's image or aspirations

facilitates behavioral change [41, 42]. The plan included fitness recommendations which reiterated the key points of the consultation and coupled salient images with target behaviors. For example, one recommendation was to participate in moderate physical activity for at least 30 min on most days of the week if you want to be a more physically active young adult. Then, students were asked to select at least one goal from each of four behavior groups to improve during the next week, including: (1) increase physical activity and exercise, (2) decrease alcohol use, (3) decrease cigarette use, or (4) increase other fitness behaviors (i.e., nutrition, stress management, and sleep).

Standard Care Control

The control consisted of a commercial health education brochure titled "Fitness" [43]. The brochure included information about the benefits of being fit including characteristics of people who are physically fit, the three components of fitness, the Frequency, Intensity, Time method, and an action plan and commitment form to identify habits to start, stop, and keep. Participants assigned to this condition were asked to take time to read the brochure in the quiet, private office. After reading the brochure, students completed the same online feedback questionnaire provided to those receiving the intervention.

Measures

The updated Fitness and Health Survey [44] was used to collect data on alcohol, cigarette, and marijuana consumption, alcohol and drug problems, driving after drinking, exercise behaviors, nutrition habits, sleep quantity, frequency of using stress management techniques, and five areas of health-related quality of life. The instrument was first pilot-tested on a sample of college students to ensure a psychometrically sound and highly readable instrument for the target population and to develop standardized procedures for administering the questionnaire. An earlier version of this instrument was successfully employed in a previous multiple-behavior health intervention trial with college students [39]. The most recent instrument was implemented online using a secure server through SurveyMonkey.com [45].

Health-risk behaviors measures included alcohol, cigarette, and marijuana use items adopted from standard youth substance use instruments and research [46–49], including four measures of initiation of use, 30-day frequency, 30-day quantity, and 30-day heavy use for alcohol (alpha=0.85), cigarettes (alpha=0.89), and marijuana (alpha=0.93). Heavy use of alcohol was defined as five or more drinks in a row if a male and four or more drinks in a row if female, whereas heavy cigarette smoking was a pack or more of cigarettes, and heavy marijuana use was getting really high or stoned from marijuana. An 18-item measure of alcohol and drug problems experienced during the past 30 days was included (alpha=0.98). In addition, a single measure of driving after drinking alcohol was adopted from prior epidemiologic studies [50, 51].

Health-promoting behaviors measures included exercise, nutrition habits, sleep habits, and use of stress management techniques. Five exercise behavior measures were adopted primarily from validated measures of exercise used in past research examining both youth [50] and adults [52] and included initiation of exercise, 30-day vigorous exercise, 30-day moderate exercise, 7-day strenuous exercise, and 7-day moderate exercise (alpha=0.84). The initiation of exercise measure paralleled those items assessing initiation of substance use and asked how long participants had been regularly exercising or participating in physical activity, with a five responses ranging from "I do not regularly exercise" to "1 year or more." Three measures of nutrition habits were based on dietary guidelines from the US Department of Health and Human Services and US Department of Agriculture [53] and included past 30-day servings of fruits and vegetables, numbers of time eating foods containing healthy carbohydrates, and numbers of time eating foods containing healthy fats usually eaten each day (alpha=0.81). These items were scored using ten-point scales ranging from "0 servings per time," to "9 or more servings per time." Sleep was measured with one item of the number of hours usually slept each night during the past 30 days, taken from prior research on sleep patterns, with five responses ranging from "9 or more hours" to "5 or less hours" [54–56]. Frequency of five techniques used to relieve stress in the past 30 days was adopted from a health promotion scale for adolescents, with items including deep-breathing exercise or mediation, exercise–physical activity, sleeping 7–8 h each night, prayer, or other techniques to relieve stress [57].

Health-related quality of life was measured using five items. These assessed the number of days during the past 30 days that physical health, mental health, spiritual health, and social health was not good and the number of days that poor health of any kind kept one from doing their usual activities (alpha=0.73). These measures were adopted from research on health-related quality of life among adolescents [58].

Data Analysis

All analyses were performed using SPSS version 13.0 [59]. Baseline measures were compared across treatment group using chi-square tests for categorical variables and independent sample *t* tests for continuous variables. Repeated-measures multivariate analyses of variance (MANOVAs) and

analyses of variance (ANOVAs) were used to test intervention effects over time. Repeated-measures MANOVAs were performed to more efficiently address the multiple health behaviors targeted by the intervention. This approach creates a new dependent variable maximizing group differences, while controlling for type I error resulting from performing individual tests on multiple dependent variables. Effect sizes were calculated based on mean pre–post change in the treatment group minus the mean pre–post change in the control group, divided by the pooled pretest standard deviation. This approach has been shown to be the best choice for providing an unbiased estimate of the population effect size for studies using repeated measurements in treatment and control groups [60].

Results

Baseline and Attrition Analyses

Characteristics of participants at baseline by treatment group are shown in Table 1. No significant differences were found on any of the sociodemographic, substance use, or other health behavior measures between groups. Sixteen participants were lost to attrition (5%), with no differences in attrition between treatment groups. Significantly more students who dropped out of the study received mostly B grades (rather than A grades) on their last report card ($X^2(3)=18.83$, $p=0.001$), reported a family alcohol or drug problem ($X^2(3)=6.53$, $p=0.01$), and used marijuana in the past 30 days ($X^2(3)=4.07$, $p=0.04$) than those who did not drop out.

Response Reliability and Intervention Quality

To determine the likelihood that participants responded unreliably to questions on the outcome survey due to lying, sloppiness, or other factors, we included a bogus or fake drug (i.e., zanatel) among the list of substances that students were asked whether they used in the past 30 days. No one reported using the bogus drug, suggesting that widespread error due to falsification or careless data instrument completion was unlikely.

To assess implementation quality, we collected feedback from participants immediately after administration of both treatments using a computer-based, self-administered questionnaire. These process data showed that participants who received the consultation and goal plan rated the intervention significantly more positively than those who received the standard care control on eight of nine measures of acceptability and potential efficacy, p's<0.05. Participants receiving the brief intervention were more likely than those receiving the standard care materials to agree that it would help others make healthy choices, help them increase their physical activity, and avoid their overdrinking alcohol, they learned something, the information was meant for them, it was believable, they would recommend the intervention to others, and it received a higher overall evaluation, with most items scored on a four-point scale of strongly agree to strongly disagree.

Outcome Analysis

Estimated marginal means and standard errors of health behavior measures are shown by treatment and time in Table 2. Omnibus repeated-measures MANOVAs were performed for six groupings of health behaviors. These analyses showed significant treatment group by time interactions on alcohol consumption, $F(6, 261)=2.73$, $p=0.01$, marijuana use, $F(4, 278)=3.18$, $p=0.01$, and health-related quality of life, $F(5, 277)=2.80$, $p=0.02$.

Univariate tests for alcohol behaviors found that college students exposed to the brief intervention drank alcohol less frequently, $F(1, 266)=8.70$, $p=0.00$, drank heavily less frequently, $F(1, 266)=10.79$, $p=0.00$, and drove after drinking less frequently, $F(1, 266)=5.25$, $p=0.02$, whereas students receiving the standard care control increased the frequency of their alcohol use, heavy use, and drinking after driving. The intervention group was also less likely to initiate marijuana use, $F(1, 281)=5.67$, $p=0.02$, used less quantity of marijuana, $F(1, 281)=4.99$, $p=0.03$, and used marijuana heavily less frequently, $F(1, 281)=5.98$, $p=0.02$, while the control group showed increases on these three measures of marijuana use over time. In addition, brief intervention participants experienced a decrease in the number of days in which their spiritual health was not good, $F(1, 281)=6.90$, $p=0.01$, and the number of days in which their social health was not good, $F(1, 281)=9.55$, $p=0.00$, compared to control participants who experienced increases in the days their spiritual and social health was not good. No omnibus treatment by time interactions were found for cigarette smoking, exercise, and nutrition behaviors. ANOVAs were performed for two single-item health behavior measures. Participants receiving the intervention got more sleep, $F(1, 281)=9.49$, $p=0.00$, than those in the control group but did not differ on stress management techniques used.

Effect sizes were calculated for all measures. Effects for the brief intervention were uniformly small, with the largest effects seen for increased sleep and improved spiritual and social health-related quality of life, followed by reductions in heavy alcohol use and frequency of drinking. Very small negative effect sizes were seen for cigarette smoking because of greater reductions in smoking in the standard care control group than in the intervention group. Meanwhile, small positive effects were found for increased 30-day moderate exercise and increases on all three nutrition

Table 2 Repeated-measures MANOVAs and ANOVAs of health behavior measures for treatment by time

	Intervention (n=140)				Control (n=143)					
	Pretest		Posttest		Pretest		Posttest			
	M	SE	M	SE	M	SE	M	SE	D	p[a]
Alcohol (F=2.73, df=6, 261, p=0.01)										
Initiation of drinking	3.66	0.15	3.70	0.14	3.88	0.15	3.96	0.14	−0.02	ns
Frequency of drinking	2.63	0.12	2.41	0.12	2.61	0.12	2.77	0.12	0.27	0.00
Quantity of drinking	3.90	0.25	3.65	0.23	3.97	0.24	3.93	0.23	0.07	ns
Heavy drinking	1.95	0.11	1.74	0.10	1.88	0.11	2.03	0.10	0.29	0.00
Driving after drinking	.64	0.11	0.50	0.11	0.56	0.11	0.71	0.10	0.23	0.02
Alcohol/drug problems	2.59	0.27	1.92	0.26	2.69	0.26	2.53	0.25	0.17	ns
Cigarettes (F=0.76, df=4, 278, p=0.55)										
Initiation of smoking	1.43	0.10	1.43	0.09	1.47	0.10	1.35	0.09	−0.10	
Frequency of smoking	1.59	0.12	1.55	0.11	1.57	0.12	1.41	0.11	−0.08	
Quantity of smoking	1.38	0.08	1.35	0.07	1.36	0.07	1.29	0.07	−0.05	
Heavy use of cigarettes	1.13	0.06	1.12	0.06	1.12	0.06	1.09	0.05	−0.03	
Marijuana (F=3.18, df=4, 278, p=0.01)										
Initiation of using marijuana	1.90	0.14	1.70	0.13	1.95	0.13	2.06	0.13	0.19	0.02
Frequency of using marijuana	1.59	0.12	1.50	0.12	1.61	0.12	1.67	0.11	0.11	ns
Quantity of using marijuana	1.54	0.12	1.41	0.12	1.55	0.12	1.73	0.12	0.23	0.03
Heavy use of marijuana	1.46	0.10	1.33	0.10	1.48	0.10	1.58	0.10	0.19	0.02
Exercise[b] (F=1.19, df=5, 277, p=0.31)										
Initiation of exercise	3.46	0.15	3.66	0.13	3.67	0.15	3.75	0.13	0.07	
30-day vigorous exercise	3.71	0.15	3.97	0.14	3.96	0.15	4.19	0.14	0.02	
30-day moderate exercise	4.32	0.15	4.52	0.15	4.72	0.15	4.46	0.14	0.25	
7-day Strenuous exercise	3.44	0.19	3.56	0.18	3.80	0.19	3.83	0.17	0.04	
7-day Moderate exercise	5.18	0.22	5.25	0.19	5.15	0.22	5.22	0.19	0.00	
Nutrition[b] (F=1.33, df=3, 279, p=0.27)										
Nutrition: fruits/vegetables	4.06	0.21	4.31	0.17	3.97	0.20	3.73	0.16	0.20	
Nutrition: good carbohydrate	4.55	0.22	5.46	0.23	4.46	0.22	4.76	0.23	0.23	
Nutrition: good fats	3.71	0.22	4.34	0.21	3.54	0.22	3.59	0.21	0.22	
Sleep (F=9.49, df=1, 281, p=0.00)										
	3.29	0.09	2.83	0.08	3.20	0.09	3.08	0.08	0.32	0.00
Stress management[b] (F=0.42, df=1, 281, p=0.52)										
	2.31	0.05	2.57	0.05	2.25	0.05	2.47	0.05	0.07	ns
Health-related quality of life (F=2.80, df=5, 277, p=0.02)										
Physical health	2.90	0.12	2.56	0.11	2.40	0.12	2.21	0.11	0.10	ns
Mental health	3.11	0.13	2.71	0.11	2.90	0.13	2.63	0.10	0.09	ns
Spiritual health	2.40	0.14	1.91	0.13	2.09	0.14	2.15	0.13	0.32	0.01
Social health	2.34	0.11	1.96	0.10	1.90	0.11	2.01	0.09	0.38	0.00
Activity limitation	2.26	0.10	2.04	0.09	2.01	0.10	1.91	.09	0.10	ns

[a] p values=time × treatment interaction
[b] Higher mean score=lower risk, d=effect size

behaviors, even though overall MANOVA tests for these two sets of health behaviors were not significant.

Discussion

This trial is only the second to have examined the potential of a brief MBI using salient social and self-images for college students. While recent calls have been made to address the multiple health risks that many young people experience, very few studies have examined individually targeted interventions addressing two or more risks, and only a hand full have done so using brief image-based health communications. These results indicate that a brief MBI consisting of a screening survey, one-on-one consult tailored to targeted health behaviors, and behavioral goal plan appears to have decreased marijuana and alcohol consumption, increased sleep, and improved spiritual and

social health-related quality of life compared to students receiving standard health care information. These findings are supported by an earlier, initial study evaluating brief image-based interventions for college students [39], which found that brief strategies may have improved a number of health habits and health-related quality of life 1 month postintervention.

While no effects were found on substance use in the earlier study, the current trial found significant reductions on alcohol and marijuana consumption, including decreases in hazardous heavy drinking and heavy marijuana use, frequency of alcohol use, frequency and quantity of marijuana use, and frequency of drinking and driving. Since the content did not differ dramatically between the two intervention trials, the most likely reason for these differences is the extended follow-up period for the current investigation, which may have permitted more time for substance use changes to occur. This conclusion is supported by two earlier studies examining brief image-based MBIs for younger adolescents, which found reductions in substance use during 3-month follow-ups [37, 38].

Improvements on spiritual and social health-related quality of life are noteworthy. It is unclear at this time as to what health behaviors or other factors may be mediating alterations found on the various dimensions of quality of life. However, such changes suggest brief image-based MBIs may produce outcomes that extend beyond important health behaviors to include improvements on broader indices of health and quality of life. Research is needed to better understand the full range of possible health outcomes emanating from MBIs, as well as the mechanisms by which image-based multiple-behavior interventions influence specific health behaviors and quality-of-life factors.

While small positive effect sizes were found for participants receiving the brief intervention on 30-day moderate exercise and all three nutrition behaviors, it was disappointing that overall tests of these behaviors were not significant, particularly given that these behaviors improved in our initial study of brief image-based multiple-behavior interventions for college students [39]. One reason for the lack of differences between treatment arms in the current study was that participants receiving the standard care control also showed improvements on most of the exercise and nutrition behaviors. This may be due to using high-quality commercial health education materials in the standard care control which presented a number of salient social images of physically fit individuals and addressed future self-images by providing participants with information on setting realistic goals, keeping a log, and presenting an opportunity to make a written commitment to behavior change. In addition, those in the control also received the Fitness Behavior Image Screen which assessed participants' desire to achieve selected images and, together with the control materials, may have activated prototypes or future self-images influencing fitness-related behaviors. A second reason for improvements found among control participants on physical activity and nutrition was that students who volunteered to participate in the current study may have already been motivated to improve certain health habits. Providing students with an opportunity to participate in a fitness-oriented health promotion research program emphasizing exercise and nutrition may have supplied the necessary impetus needed to change selected health behaviors of participants regardless of treatment exposure. Lastly, gains on health promotion behaviors at 1 month postintervention found in the earlier study may have occurred in the current study but did not exist at 3 months postintervention due to deterioration of effects on these behaviors over the longer follow-up period. Previous research has documented that positive changes on exercise and nutrition behaviors are difficult to maintain over time for youth populations [61, 62].

While the current trial found that the brief intervention reduced alcohol and marijuana consumption, cigarette smoking appears to have been largely unaffected. Previous research indicates that brief image-based multiple-behavior interventions for adolescents can reduce cigarette use for up to a year postbaseline [38]. One likely reason for the lack of smoking outcomes in this study was that college students were already at low risk for smoking, particularly when compared to their level of consumption of alcohol and marijuana, thereby providing a basement effect with little room for assessing improvement on cigarette smoking habits.

This study had a number of limitations. First, this investigation was limited to a 3-month postintervention follow-up. While this follow-up period was longer than the original study of brief image-based MBIs for college students, additional trials are needed to determine the stability and trajectory of outcomes over longer periods for multiple behaviors, as well as to test strategies to strengthen and maintain effects longitudinally. Second, this study examined a sample of college students from a single university in the southeastern US. Additional research is needed to eventually determine the effectiveness of these intervention effects on students from other college campuses and under real-world conditions, as well as for young adults not attending college. Third, this study was limited to self-report measures with varying degrees of validation and did not include collaborating objective measures such as biochemical verification of substance use or accelerometers for exercise patterns. While such verification would have provided potentially useful information, they were viewed as being both cost prohibitive and impractical given the seven primary health behaviors targeted in this trial. While numerous studies and study reviews have shown that self-

reports by youth and young adults provide accurate substance use and health-risk data [63–67], we took great care to use multiple procedures to ensure the most reliable and valid data collection possible. Lastly, because this trial used high-quality commercial health care materials in the control which actually addressed social and self-image, future evaluations are needed comparing brief image-based MBIs against more typical standard health education found on college campuses which emphasize health risks and educational information about student health habits.

In conclusion, the results of this trial evaluating a multiple-behavior intervention suggest that social and self-image-based content in a brief screen, tailored consult, and goal plan holds potential to cost-effectively impact the epidemiologic reality of multiple risk factors facing college students, as well as selected dimensions of health-related quality of life. Such interventions, if supported by additional research, have significant implications for enhancing behavioral medicine and filling a gap in our scientific knowledge about how to influence multiple, simultaneous health risks experienced by emerging adults. More research is needed examining image-based interventions to determine the minimal content and format variations that would significantly impact and sustain multiple-behavior and quality-of-life changes among both youth and adult populations.

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