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Randomized Controlled Community Trial of the Efficacy of a Multicomponent Stage-Matched Intervention to Increase Sun Protection among Beachgoers[1]

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Background. **Skin cancer is about as common as all other cancers combined and is preventable by sun protection. The most intense sun exposures often occur on the beach, so we chose this setting to test an intervention to affect sun protection behaviors.**

Methods. **We developed a multicomponent stage-matched intervention for beachgoers and evaluated its efficacy in a randomized trial for influencing stage of change and self-reported behavior.**

Results. **We randomized 2,324 persons ages 16 to 65 on the beach (83% of those approached). The intervention was effective in increasing self-reported sun protective behaviors. Effects were similar across gender and age groups.**

Conclusions. **The beach is a good site for recruitment and intervention to prevent skin cancer in high-risk populations. Our stage-matched intervention package was effective for increasing sun protective behaviors.** **© 2002 American Health Foundation and Elsevier Science (USA)**

Key Words: **skin cancer prevention; sun exposure; sunscreen agents; health-related behaviors; health surveys; beach.**

INTRODUCTION

Skin cancer incidence now roughly equals that of all other cancers combined (approximately 1.3 million cases per year) and continues to increase [*1,2*]. The primary cause of skin cancer is chronic unprotected exposure to the sun's ultraviolet light, as well as intense, intermittent exposures such as those that occur at the beach [*3–5*]. Most skin cancers are therefore largely preventable with appropriate environmental and behavioral changes to minimize exposure. Leading public health organizations have recommended reducing sun exposure, wearing protective clothing, and using sunscreen with a sun protection factor of 15 or higher [*6–8*].

Health promotion efforts designed to modify lifestyle behaviors related to primary or secondary disease prevention have met with only occasional success, although interventions based on established behavioral models have tended to show the largest and most consistent effects [*9*]. Our intervention was based on the transtheoretical model of health behavior change [*8,10*]. This model suggests that individuals attempting to change a problem behavior progress through a series of five stages of change: precontemplation (not thinking about change), contemplation (seriously considering change), preparation (deciding and planning to change), action (initiation of overt behavior change), and maintenance (sustained behavior change over time). Progression from one stage to the next involves: (a) use of distinct subsets of processes (strategies and techniques) of change; (b) assessment of the importance of the pros and cons of change (decisional balance); and (c) the ability to resist situational temptations to engage in the problem behavior and increasing situational self-efficacy to engage in more healthful behaviors.

The likelihood of successful behavior change is optimized when intervention strategies are matched to the individual's stage of change [*11*]. Interventions tailored to stage of change have been more successful at changing behavior than control or comparison interventions across a wide range of important public health problems, including smoking cessation, dietary fat reduc-

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tion, exercise adoption, condom adoption, and adherence to mammography screening [*12–23*]. We sought to extend these findings to sun protection by developing an individualized, multicomponent intervention targeted to study participants' stage of change [*8,24,25*]. The effectiveness of this intervention package to increase sun protection was evaluated in a randomized clinical trial of at-risk beach bathers.

METHOD

Sample

Sun bathers on beaches in or near Rhode Island (N = 2,800) were recruited to participate in the study during the summer of 1995 and 2,324 (83% of those approached) were enrolled. A baseline sample size of 2,400 was planned for the study based on several factors, including plausible recruitment (80%) and retention rates (67%) and expected intervention effect sizes (d = 0.20–0.25). Although these study design parameters could not be known with precision a priori, reasonable estimates were available based on several years of beach pilot work [*24,25*] and previous population-based studies using transtheoretical model interventions for other health behaviors [*17,23*]. A minimum statistical power of 0.90 was used for sample size calculations, providing some protection against the possibility of smaller than expected intervention effects or greater than expected attrition rates [*26–28*].

Participants from ages 16 to 65 completed a survey on the beach with a trained interviewer. The sample was primarily female (60%), white (94%), single (51%), or married (40%), with at least a high school education (88%) and with a median income of $45,000–65,000 per year. The average age of participants was 33 years (SD = 12), with 35% aged 16–24 (beachgoers 16–24 years of age were oversampled), 35% aged 25–39, and 29% aged 40–65. About 25% of the sample reported being current smokers and 64% reported exercising regularly at least 20 minutes a day, three times a week. Further details on the baseline characteristics of this sample have been reported elsewhere [*29*].

Procedures

Seven of the largest coast salt water beaches in southern Rhode Island were selected for the study. Upon receiving signed informed consent to participate, the interviewer administered the baseline survey and then randomized the participant to intervention or control conditions using a preassigned sequence. When the participant was in the treatment group, the interviewer would conduct the intervention and conclude by verifying contact information. When the participant was in the control group, the interviewer would just verify the contact information. Interviews lasted 15–25 minutes. Follow-up assessments were conducted by mail or telephone interview for all study participants at 2 and 12 months after baseline, and a final assessment was conducted at 24 months. Initial follow-up attempts were conducted by mail. After about 2 weeks, mail nonrespondents were contacted by telephone. We have used mixed-mode data collection procedures for most of our previous population-based intervention studies without discernable respondent bias [*17,18,23*]. All study participants were eligible for a lottery prize of $1,000 for completing each assessment. Study retention rates were 83% of baseline at 2 months (N = 1,930), 70% of baseline at 12 months (N = 1,628), and 62% of baseline at 24 months (N = 1,449). The average retention rate was 85% of those contacted at the previous time point. No differential dropout by treatment group was observed (see Fig. 1). Additional details on study procedures including site selection and training of interviewers have been reported elsewhere [*29*].

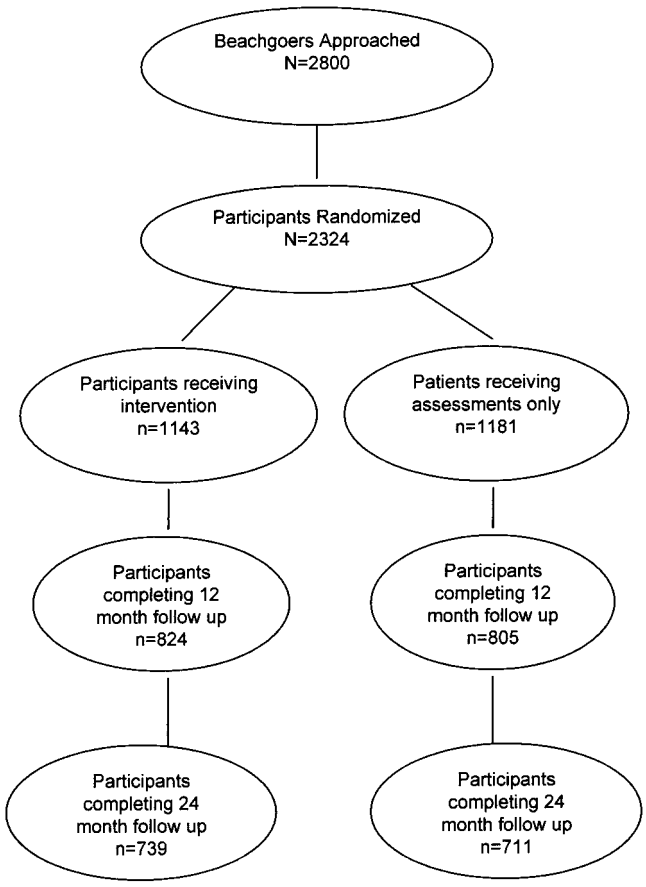

FIG. 1. Study participation.

Interventions

To maximize impacts on sun protective behaviors, the multicomponent intervention package was designed to be effective with individuals in each of the

five stages of change, as specified by the transtheoretical model. Interventions were designed to raise the pros and decrease the cons of sun protection, increase self-efficacy in dealing with challenging situations, and increase the frequency of use of the processes of change. Interventions delivered on the beach included an educational pamphlet, personalized sun sensitivity assessment and feedback (written and verbal), SPF 15 sunscreen, and instant sun damage imaging photographs that reveal damage to the skin that is not visible in normal light [*8*,*24*,*25*,*30*]. The pamphlet and sunscreen were generic, and the feedback and photographs were tailored to the participant. Intervention and measurement development was based on 3 years of pilot studies conducted on Rhode Island beaches [*24*,*25*,*31–33*].

Follow-up interventions included two three- to four-page expert system feedback reports matched to the individual's stage of change. Each report reflected the individual's current stage of change and provided information and suggestions on reducing unprotected exposure based on transtheoretical model constructs, including decisional balance, four to six stage-relevant processes of change, situational self-efficacy, and some final stage-tailored techniques an individual can use to aid in the behavior change process [*34*,*35*]. The first report was based on the data provided by participants at baseline and was mailed to participants 2 to 3 weeks after assessment. The baseline report contained normative feedback, in which an individual's change efforts on many variables were compared to that of others who had been successful at changing. The second feedback report contained both normative feedback and ipsative feedback, i.e., information on an individual's progress since his or her first report. This second report was delivered 12 months following baseline and was based on the 12-month assessment.

Additional interventions delivered by mail included (a) *Being Sun Smart*, a manual containing stage-tailored information on sun protection, and (b) a second educational pamphlet. Both interventions were delivered 8 months following baseline during the spring prior to the second summer (12 month) assessment and expert system intervention. These materials provided a booster to the previous year's intervention and provided a reminder to begin thinking about taking precautions early as the next summer approached.

The control group received no intervention. The assessments were the same for both groups.

Measures

The primary outcome measure was the nine-item Sun Protection Behavior Scale (SPBS) [*29*]. Each item was a self-report of behavior on a five-point Likert scale of frequency (never, rarely, sometimes, often, and always) "when in the sun for more than about 15 minutes." The SPBS included components of sun avoidance, sunscreen use, and hat use and has been shown to be both reliable and valid [*29*,*36*,*37*].

A second outcome measure was stage of change for sun protection [*8*,*29*]. Two algorithms were used to measure stage of change. Each algorithm consisted of a short series of questions designed to assess intentions and behaviors for reducing sun exposure. The purpose of the staging algorithm is to classify respondents into one of the five stages of change: precontemplation, contemplation, preparation, action, or maintenance. The general sun protection algorithm classified subjects by stage based on a combination of their intentions and behaviors to protect themselves from the sun consistently by: (a) avoiding sun exposure, (b) covering up with clothing/hats, and (c) using SPF 15 sunscreens. The sunscreen staging algorithm classified subjects by stage based on their behaviors and intentions to protect themselves from sun exposure by consistently using SPF 15 sunscreens. The development of the staging algorithms is described in more detail elsewhere [*8*]. For both algorithms, the precontemplation stage included participants who were not consistently protecting themselves from the sun and were not intending to start doing so within the next 12 months. The contemplation stage included participants who were not consistently protecting themselves but were seriously thinking about starting to do so within the next 12 months. Preparation stage individuals were not currently protecting themselves but were planning to start doing so within the next 30 days. Action stage individuals were protecting themselves consistently but had been doing so for fewer than 12 months. Maintenance stage individuals had been protecting themselves for 12 months or more.

Demographic variables included age, sex, income, marital status, educational level, and race/ethnicity. Brief health histories focusing on skin cancer risk factors were also obtained including sun sensitivity [*30*], sun exposure and sunburn history, presence of large moles, use of tanning/sun lamps [*38*], and personal/familial history of skin cancer.

Primary analytic techniques included t tests, χ^2 tests, analysis of variance, repeated-measures analysis of variance, and analysis of covariance.

This study was approved by the appropriate institutional review boards.

RESULTS

At baseline, 45% of the sample was in the precontemplation stage for general sun protection, 3% in contemplation, 14% in preparation, 4% in action, and 34% in maintenance. For sunscreen use at baseline, 56% were in precontemplation, 3% in contemplation, 10% in preparation, 5% in action, and 26% in maintenance. Strong age and gender effects were observed for both

staging algorithms [29]. Fewer than one-third of study participants were using a sunscreen with an SPF of 15 or greater at the time of the interview. Among those who were using sunscreen, about half were using a sunscreen with an SPF of 15 or greater.

Analyses were conducted to assess whether participants who did not complete the 24-month assessment differed in their sun behaviors and attitudes from those who completed the study. Study noncompleters were earlier in the stages of change, $\chi^2(4, N = 2{,}313) = 28.6$, $P < 0.001$, $\eta^2 = 0.012$, younger ($P < 0.001$, $\eta^2 = 0.017$), and less likely to use sun protection as assessed by the SPBS, $t(2{,}311) = 5.12$, $P < 0.001$, $\eta^2 = 0.011$. Noncompleters also reported having used tanning booths more frequently than study completers overall ($P < 0.001$, $\eta^2 = 0.007$) and in the past year ($P < 0.001$, $\eta^2 = 0.013$), were less likely to know someone with melanoma ($P < 0.001$, $\eta^2 = 0.007$), were more often male ($P = 0.007$, $\eta^2 = 0.003$), had fewer lifetime sunburns ($P = 0.013$, $\eta^2 = 0.005$), and spent more time outside on weekends ($P = 0.018$, $\eta^2 = 0.006$) and weekdays ($P = 0.029$, $\eta^2 = 0.005$). Study completers and noncompleters did not differ on sun sensitivity, number of severe sunburns in the past year, family history of melanoma, having any big moles, number of big moles, and general health (all P's > 0.05 without Bonferroni correction for multiple significance testing).

Among participants who completed the 24-month assessment ($N = 1{,}450$), t tests and χ^2 tests were run to assess baseline differences by treatment group. No significant differences were found for age, gender, sun sensitivity, sun protection, and stage of change for sun protection. The only significant difference was in stage of change of sunscreen ($\chi^2(4, N = 1{,}363) = 15.3$, $P < 0.01$), where control group participants were slightly more likely to be in precontemplation (56.0% vs 52.6%) and maintenance (28.9% vs 25.5%) and slightly less likely to be in action (2.9% vs 6.0%) and preparation (6.5% vs 10.3%) than treatment group participants.

Sun Protection Behavior Scale

Both the intervention and the control groups increased their sun protection behaviors $F(2, 1{,}287) = 116.36$, $P < 0.001$, $\eta^2 = 0.153$, but the improvement in the intervention group was double that of the control group at 24 months. The group (intervention vs control) by time interaction was significant, $F(2, 1{,}287) = 9.95$, $P < 0.001$, $\eta^2 = 0.015$). Figure 2 displays these changes over time. Each of the three subscales of the index (sun avoidance, sunscreen use, and hat use) also demonstrated significant increases in sun protective behavior for intervention subjects relative to controls from baseline to the 24-month follow-up assessment (see Table 1).

We confirmed the independent effects of the intervention on behavior at 24 months ($P < 0.001$) with separate analyses of covariance that controlled for age, gender, sun sensitivity, use of tanning booths in the past year, knowing anyone with skin cancer, and socioeconomic status. All of these variables were significant predictors of sun protection at baseline [29]. However, all of these analyses except gender also revealed significant effects of the covariates on the changes in behavior over the period of study. Further evaluation using repeated-measures analyses of covariance revealed differences in effect sizes across covariates. These suggested that the intervention was most effective for younger individuals, people who had low sun sensitivity, and individuals with incomes less than $25,000.

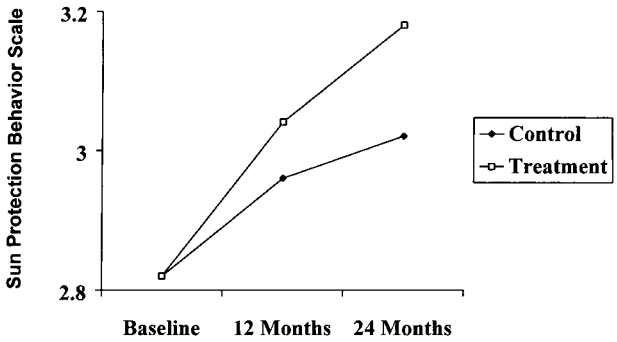

FIG. 2. Sun Protection Behavior Scale by group over time. Scores have been adjusted for initial baseline differences. Only participants with data at all three time points are included; analysis used repeated-measures analysis of variance.

Stages of Change

Among those who were in the preaction (precontemplation, contemplation, and preparation) stages at baseline, individuals in the intervention group were more likely than controls to have progressed to the action or maintenance stages for reducing unprotected sun exposure at 12 ($P = 0.049$) and 24 months ($P = 0.054$) and for sunscreen use at 12 ($P = 0.001$) and 24 months ($P = 0.001$). Results are shown in Table 2 along with the results for age groups and gender. Although all of our predictions were directional (treatment group > control group), we report here two-sided P values to be conservative.

We also examined the effect of the intervention on progressive advancement to any stage of change, whether or not the action stage was reached. The mean stage of people in the intervention group increased significantly more than that in the control group (see Table 1). Individuals in the intervention group were also more likely to progress to more advanced stages of change for both general staging and sunscreen staging at both 12 and 24 months. Results are reported in Table 3 along with the results for age groups and gender.

TABLE 1

Intervention Effect on Sun Protection at 12 and 24 Months

Variable	Means (SD)			P	η^2
	Baseline	12 months	24 months		
SPBS				0.001	0.015
Intervention	2.82 (0.87)	3.04 (0.82)	3.18 (0.86)		
Control	2.78 (0.88)	2.96 (0.85)	3.02 (0.85)		
Sunscreen use				0.001	0.010
Intervention	2.98 (1.28)	3.18 (1.23)	3.36 (1.24)		
Control	2.96 (1.26)	3.07 (1.23)	3.15 (1.24)		
Sun avoidance				0.008	0.008
Intervention	2.71 (0.86)	2.94 (0.82)	3.04 (0.87)		
Control	2.72 (0.86)	2.87 (0.84)	2.92 (0.85)		
Hat				0.047	0.005
Intervention	2.13 (1.14)	2.17 (1.10)	2.28 (1.19)		
Control	2.23 (1.18)	2.24 (1.15)	2.24 (1.15)		
General stage				0.004	0.009
Intervention	2.97 (1.78)	2.93 (1.78)	3.18 (1.81)		
Control	2.96 (1.80)	2.88 (1.82)	2.87 (1.84)		
Sunscreen stage				0.001	0.011
Intervention	2.54 (1.76)	2.73 (1.78)	2.87 (1.85)		
Control	2.68 (1.81)	2.61 (1.80)	2.67 (1.85)		
Age[a]					
16–24				0.004	0.027
Intervention	2.47 (0.81)	2.85 (0.82)	2.95 (0.84)		
Control	2.46 (0.78)	2.65 (0.81)	2.71 (0.79)		
25–39				0.046	0.014
Intervention	2.82 (0.86)	2.98 (0.83)	3.13 (0.86)		
Control	2.93 (0.82)	3.06 (0.81)	3.11 (0.84)		
40–65				0.065	0.012
Intervention	3.11 (0.86)	3.24 (0.77)	3.40 (0.83)		
Control	3.06 (0.90)	3.13 (0.84)	3.22 (0.85)		
Sun sensitivity[a]					
Low				0.001	0.033
Intervention	2.51 (0.84)	2.82 (0.87)	3.00 (0.90)		
Control	2.51 (0.83)	2.66 (0.83)	2.74 (0.83)		
Medium				0.049	0.010
Intervention	2.86 (0.88)	3.05 (0.78)	3.14 (0.84)		
Control	2.89 (0.85)	3.03 (0.82)	3.05 (0.83)		
High				0.501	0.005
Intervention	3.26 (0.75)	3.40 (0.69)	3.55 (0.73)		
Control	3.17 (0.82)	3.25 (0.80)	3.37 (0.79)		
Use tanning booth last year?[a]					
No				0.001	0.015
Intervention	2.94 (0.87)	3.13 (0.79)	3.26 (0.85)		
Control	2.95 (0.84)	3.06 (0.82)	3.11 (0.83)		
Yes				0.110	0.018
Intervention	2.32 (0.77)	2.68 (0.85)	2.84 (0.85)		
Control	2.27 (0.78)	2.53 (0.83)	2.62 (0.84)		
Do you know anyone who has skin cancer?[a]					
No				0.007	0.016
Intervention	2.68 (0.87)	2.94 (0.81)	3.08 (0.86)		
Control	2.63 (0.84)	2.84 (0.83)	2.87 (0.84)		
Yes				0.005	0.016
Intervention	2.97 (0.87)	3.15 (0.82)	3.28 (0.85)		
Control	3.00 (0.86)	3.07 (0.85)	3.15 (0.85)		
Socioeconomic status (assessed as annual household income)[a]					
<$25,000				0.026	0.042
Intervention	2.72 (0.92)	3.12 (0.85)	3.21 (0.97)		
Control	2.69 (0.83)	2.84 (0.87)	2.91 (0.83)		
$25,000–54,999				0.393	0.004
Intervention	2.73 (0.86)	2.93 (0.82)	3.07 (0.82)		
Control	2.75 (0.86)	2.91 (0.86)	3.00 (0.88)		
$55,000+				0.014	0.016
Intervention	2.91 (0.88)	3.10 (0.81)	3.23 (0.85)		
Control	2.91 (0.88)	3.03 (0.83)	3.08 (0.85)		
Gender[a]					
Female				0.031	0.008
Intervention	2.95 (0.88)	3.18 (0.84)	3.29 (0.85)		
Control	2.88 (0.88)	3.02 (0.87)	3.11 (0.86)		
Male				0.001	0.042
Intervention	2.59 (0.82)	2.80 (0.74)	2.97 (0.85)		
Control	2.71 (0.85)	2.85 (0.80)	2.85 (0.82)		

Note. Sample size with complete data at baseline, 12-month, and 24-month time points included in analyses, N = 1,294, repeated-measures ANOVA.

[a] Means reported are for the Sun Protection Behavior Scale.

TABLE 2

Group Differences (Percentage in Action/Maintenance) for Stage of Change

	Stage of change for sun protection							
	12 months				24 months			
	N	Treatment (% in A/M)	Control (% in A/M)	*P*	*N*	Treatment (% in A/M)	Control (% in A/M)	*P*
All	973	25.9	20.5	0.049	845	31.5	25.5	0.054
Ages 16–24	317	23.3	15.8	0.095	261	32.3	23.4	0.071
Ages 25–39	410	24.5	24.8	0.951	357	26.3	25.8	0.921
Ages 40–65	246	31.1	19.3	0.035	227	38.2	27.9	0.100
Females	589	27.9	20.0	0.025	503	30.9	26.0	0.219
Males	384	22.8	21.4	0.732	342	32.4	24.9	0.124
	Stage of change for sunscreen use							
All	1092	22.3	13.5	0.001	948	27.1	17.0	0.001
Ages 16–24	332	20.5	11.7	0.029	278	20.9	15.3	0.223
Ages 25–39	450	19.9	14.7	0.147	393	26.1	18.9	0.090
Ages 40–65	310	27.1	13.6	0.004	277	33.5	16.0	0.001
Females	647	25.0	14.4	0.001	551	31.7	20.5	0.003
Males	445	18.3	12.0	0.065	397	20.7	12.2	0.023

Note. Only individuals in preaction at baseline are included. Two-tailed *P* values are reported.

Finally, we examined the effect of the intervention on relapse rates, individuals in action or maintenance at baseline who regressed to a preaction stage at follow-up. No significant differences between groups were found in relapse rates for reducing unprotected sun exposure (treatment = 34.6% vs control = 30.0% at 12 months; treatment = 20.7% vs control = 21.2% at 24 months) or for sunscreen use (treatment = 29.4% vs control = 28.8% at 12 months; treatment = 26.6% vs control = 27.3% at 24 months).

DISCUSSION

Few previous intervention studies have been effective at reducing unprotected sun exposure behaviors, particularly on a population basis. Typical intervention programs are relatively brief in duration, adopt minimal or "one-shot" intervention strategies, are not targeted to entire populations, and are based on limited or no theoretical framework [*8*]. Not surprisingly, such programs at best demonstrate increases in knowledge and changes in attitudes but not changes in behaviors. Some more intensive and theoretically guided intervention approaches have been more successful (e.g. [*39*], 1,685 [*46*], [*40*]), while others have not [*41*]. Our study is one of the first to show demonstrable and lasting impacts on protective sun exposure behaviors in an at-risk sample on a population basis. The magnitude of these effects was modest, as may be expected in a large-scale, population-based public health intervention in which the study sample reflects the high proportion of people in the precontemplation stage that is found in the general population. Significant results were obtained for behavioral outcomes—including self-reported frequency of sunscreen use, sun avoidance, and wearing hats—and for stages of change. Stage of change results included both progression to the action stage and any forward stage progression and were obtained for both general sun protection behavior and a specific and salient marker behavior, sunscreen use. Increases in protective behavior at the end of treatment (12 months) were maintained and even increased at follow-up (24 months). These results support our high level of tailoring and retailoring on the variables: stages of change, decisional balance, self-efficacy, and processes of change characteristic of transtheoretical model-based interventions [*34*,*35*,*42*].

These results are consistent with two recent studies reporting the efficacy of sun protection expert system feedback (one component of this intervention) as part of a multiple behavioral risk intervention package in two different samples [*42*,*43*]. These results also add to the supportive evidence of previous studies demonstrating the effectiveness of transtheoretical model-based or stage-tailored interventions for a range of different health behaviors (e.g., [*12–17*,*19–23*,*42–45*].

Limitations of our study include reliance on self-reported outcomes, which allow for possible bias, particularly social desirability bias, or unbiased yet inaccurate responses. Although we found an effect of our overall intervention package, we could not differentiate the effects of its various components with this research design. We also could not assess outcome in the dropouts, so a complete intention-to-treat analysis may have found smaller effects.

Several aspects of these results are noteworthy. In particular, it is especially encouraging that the intervention not only moved individuals to the action stage but also accelerated all forward movement through the

TABLE 3

Group Difference in Stage Progression by Stage of Change

	Stage of change for sun protection							
	12 months				24 months			
	N	Treatment (% progr)	Control (% progr)	*P*	*N*	Treatment (% progr)	Control (% progr)	*P*
All	973	35.8	29.7	0.040	845	42.4	32.2	0.002
Ages 16–24	317	34.6	25.3	0.072	261	43.5	32.1	0.057
Ages 25–39	410	34.5	34.8	0.956	357	37.1	31.9	0.294
Ages 40–65	246	39.4	26.3	0.030	227	48.8	32.7	0.014
Females	589	37.8	29.2	0.027	503	41.0	35.0	0.171
Males	384	33.0	30.5	0.597	342	44.5	27.8	0.001
	Stage of change for sunscreen use							
All	1092	31.8	22.1	0.001	948	35.8	23.4	0.001
Ages 16–24	332	29.8	22.8	0.147	278	33.6	26.4	0.190
Ages 25–39	450	30.1	21.9	0.047	393	33.0	21.6	0.011
Ages 40–65	310	35.9	21.4	0.005	277	41.1	22.7	0.001
Females	647	35.7	22.9	0.001	551	39.7	26.9	0.001
Males	445	26.2	20.8	0.183	397	30.3	18.5	0.007

Note. Only individuals in preaction at baseline are included. Two-tailed *P* values are reported.

stages of change. This is important because a large proportion of the at-risk population for skin cancer is in the precontemplation stage and clearly not ready to adopt precautionary behaviors [*8,29*]. Intervention programs must include strategies designed to help these refractory and resistant individuals enhance their motivation to begin the process of behavior change. This process can be expected to take some time, as individuals struggle with and resolve the issues characteristic of each stage of the change process and consolidate these gains before moving on to the next stage. Individuals equipped to make stage-appropriate cognitive and behavioral changes appear to be able to continue to move forward through the stages of change even after the cessation of treatment. Results shown in Fig. 2 and in Tables 1–3 show a consistent pattern of continuing divergence between the treatment and control groups after the cessation of treatment, from 12 to 24 months. This pattern replicates for sun protection an effect found in previous studies of stage-matched interventions for smoking cessation [*16,17,23*].

We note that the greatest effect of this intervention was in the 16- to 24-year age group, which is sometimes assumed to be particularly difficult to reach and which often has particularly intense and consequential exposures. Transtheoretical model-based interventions such as this may be particularly important and useful among adolescents [*34*].

Also noteworthy is that the results of this study were accomplished with a high-risk population recruited at the beach site with high recruitment rates (83%) and, given the somewhat transitory nature of the population, with a reasonable retention rate (62%) over the 2 years of the study. Recruitment and retention rates are important considerations in assessing the disseminability and potential public health impact of behavioral interventions. Such interventions are often judged more on the efficacy component of the outcomes without due consideration of recruitment and retention that are important components of population-level effectiveness.

Increases in protective behavior were also noted for the assessment-only group, although these were smaller than those of intervention subjects. This effect may reflect secular trends due to increased attention to skin cancer in the popular press and media. Alternatively, increases in the control group may reflect some effect of repeated assessment of relevant sun protective attitudes and behaviors. This possibility is worthy of further investigation, since it has been speculated that proactively recruited samples may show effects of assessment alone [*17*]. Additional research should investigate these possibilities, as well as the effects of each of the various components of our multicomponent intervention package. Finally, the results of this study are especially encouraging since they provide additional support for the beach as a good site for reaching and intervening with individuals who are at increased behavioral risk for skin cancer.

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