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Increasing Sun Protection in Winter Outdoor Recreation:

A Theory-Based Health Communication Program

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Abstract

Background—Unprotected and excessive exposure to ultraviolet radiation (UVR) is the primary risk factor for skin cancer.

Design—A pair-matched, group-randomized, pre-test/post-test, quasi-experimental design, with ski resorts as the unit of randomization, tested the effectiveness of Go Sun Smart, a multi-channel skin cancer prevention program. Independent samples of guests were taken at baseline (2001) and follow-up (2002); data were analyzed in 2006.

Setting and Participants—A total of 6516 adult guests at 26 ski resorts in the western U.S. and Canada were recruited, consented, and interviewed on chairlifts. This study was nested within an occupational intervention for ski resort workers.

Intervention—Ski resorts were pair-matched and randomized to receive Go Sun Smart, which consisted of print, electronic, visual, and interpersonal skin cancer prevention messages.

Main Outcome Measures—Sun-protection behaviors, sunburning, recall of sun-protection messages, and the association of message exposure to sun protection.

Results—The difference in recall of all sun-protection messages, messages on signs and posters, and the Go Sun Smart logo was significant between the intervention and control resorts. Reported use of sun-protection practices was higher by guests at intervention ski areas using more (a higher dose of) Go Sun Smart materials. Intervention-group guests who recalled a sun-safety message were more likely to practice sun safety than intervention-group guests who did not recall a message and control-group guests.

Conclusions—While the mere implementation of Go Sun Smart did not produce sun-safety improvements, Go Sun Smart appeared to be effective for guests who encountered and remembered it. Many factors can work against message exposure. Signage seemed to produce the greatest increase in exposure to sun-safety messages.

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Introduction

Skin cancer prevention is a national priority.[1,2] Excessive exposure to ultraviolet radiation (UVR) is the primary skin cancer risk factor, which could be decreased with sun-safety practices.[1,2] This article reports the effectiveness of Go Sun Smart, a theory-based health communication program designed to improve the sun-safety practices of guests who ski and snowboard at high-altitude resorts.

Reports estimate that 97.5% of all U.S. residents aged ≥ 15 participated in an outdoor recreation activity in 1999; 38.8 million participated in downhill skiing, snowboarding, or cross-country skiing.[3,4] While outdoor recreation has many benefits, it can also be the setting for intermittent, severe sun exposure and poor sun protection,[5–10] and few outdoor recreation organizations appear to promote sun safety to their clients or employees.[10,11]

Health communication campaigns can prevent skin cancer by influencing people to take precautions against excessive sun exposure, particularly in recreational settings.[1,8,12–16] Such interventions have been successful in warm-weather environments, but scant research exists on sun-protection programs for winter outdoor recreation.

The high altitude and climate of clear skies and dry air at ski resorts elevate UVR.[17,18] Most skiers and snowboarders have skin phenotypes that are at risk for skin cancer,[19,20] take inadequate sun precautions, and experience sunburns.[21] It was hypothesized that:

Hypothesis A: Guests at ski areas assigned to implement Go Sun Smart would engage in more sun protection than guests at ski areas in the control group.

Hypothesis B: Guests with more exposure to Go Sun Smart would (1) engage in more sun protection and (2) express more favorable attitudes toward sun safety than guests with less exposure to Go Sun Smart.

Methods

Participants

Participants were 6516 adult guests at 26 western U.S. and Canadian ski areas, who were recruited, consented, and interviewed on chairlifts from January to April 2001 (*n*=2991; 99.3% completion rate; 0.7% refused [*n*=23]) and January to March 2002 (*n*=3525; 99.1% completion rate; 0.9% refused [*n*=33]). Across both years, 382 guests (*n*=201 in 2001; *n*=181 in 2002) were ineligible because they were aged <18 (*n*=60); ski-area employees (*n*=198); previously interviewed (*n*=99); or not English speakers (*n*=25).

Located in Alaska, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, and British Columbia, the ski areas varied in size, lift-ticket prices, and guest demographics. All ski areas were National Ski Area Association (NSAA) members and had at least two aerial chairlifts.[22] See Buller et al.[22] for ski-area recruitment procedures.

Intervention

Diffusion of innovations theory[23] provided the theoretical framework for Go Sun Smart. Diffusion of innovations theory predicts that preventive behavior changes when persuasive messages are disseminated via multiple channels to inform a population about an innovative practice and to influence adoption of it—in this case, sun safety (i.e., applying sunscreen and lip balm and wearing a hat to avoid sunburn, as well as wearing eyewear to prevent vision damage).

Go Sun Smart, created by this study's researchers, consisted of print, electronic, and interpersonal messages. Employees were the primary audience, but some employee-targeted messages were simultaneously communicated to guests. Guest materials included posters and brochures for ski and snowboard schools, signage at the base of chairlifts and on chairlift poles, electronic signs and grooming reports, brochures, and table tents and posters in lodges. An employee-training program advocated that employees advise guests against excessive sun exposure. The Go Sun Smart logo branded all materials, and the mention of three key behaviors appeared in all messages: wear sunscreen, sunglasses, and a hat. See Buller et al.[22] and Walkosz et al.[24] for a detailed description of the theoretical model and a complete program description, respectively.

Ski-area contact personnel received three sets of program materials at intervention areas (see experimental design below) from late December to early March to rotate messages and to address the increased UVR in spring. Contact personnel met with investigators in August 2001 and received Go Sun Smart program guides. Investigators visited contact personnel in November and December 2001 to review the program implementation protocol, and Go Sun Smart was implemented from January to April 2002.

Experimental Design and Survey Procedures

A pair-matched, group-randomized, pre-test/post-test, quasi-experimental design was performed.[25] Independent samples of guests were recruited at baseline (2001) and post-test (2002) within a cohort of ski areas present in both survey periods and randomly assigned to either intervention or nontreatment control groups. Randomization of multiple groups creates a strong design, avoiding many common threats to internal validity and reducing contamination (while 22.7% of control guests reported visiting an intervention ski area and 45.8% of them recalled sun-safety messages, there was no evidence of contamination [visit ×condition and message recall ×condition, $p>0.05$]). Cross-sectional samples reduced testing threats.[25] Size and location (a surrogate for climate) of ski areas were the primary matching variables; ownership structure and the proportion of female employees were also included in the matching.[22]

Trained staff interviewed guests on chairlifts with a minimum run time of 4 minutes during 3-day periods (1 weekend day and 2 weekdays) to obtain pre-intervention data from January to April 2001 and post-intervention data from January to March 2002. Pairs of ski areas were visited during the same week in both years. Sample sizes per area varied from 57 to 220 participants determined by the number of guests on the mountain.

After boarding the chairlift, interviewers consented guests as approved by the IRBs at the authors' organizations. The interviewer sat at one end of the chair and recruited the guest immediately next to him or her (if seated in the middle, the guest to the right). If the initial guest refused or was ineligible, another guest on the chair was recruited, but only one 4-minute interview was completed per lift ride. Answers were recorded in a spiral-bound survey booklet. Respondents were given a sunscreen lip balm after completing the survey. Interviewers completed 12–20 surveys per day. Interviews were completed on all eligible chairlifts, but the main lifts accessing large areas of the mountain were over-sampled.

Outcome Measures

Sun-protection behaviors were ascertained by asking if the guest was wearing sunscreen (yes/no or don't know; and if so, the sun-protection factor [SPF], the parts of the body on which it had been applied, the time it had been applied, and whether it had been reapplied that day) and sunscreen lip balm (yes/no or don't know; and if so, the SPF) and observing if the guest wore a head cover, neck cover, face cover, gloves, and eyewear. Two unweighted summed composite

scores were created: (1) sunscreen SPF 15+ and lip balm SPF 15+ (range=0–2); and (2) sunscreen SPF 15+; lip balm SPF 15+; goggles; gloves; face cover; neck cover; and head cover (range=0–7).

Sunburning was measured by asking if the guest had ever been sunburned while skiing or snowboarding (yes/no or don't know; if so, whether the guest had been sunburned that winter [yes/no or don't know]). It has been recommended that sunburn be measured in program-evaluation studies when measurement time is limited. Sunburn was defined as skin that was red or painful, or both, from sun exposure but not exposure to wind or cold.[26,27] The period was shortened to the winter season (rather than a year[27]) to focus on the intervention period, but it was believed to be sufficiently long enough to capture this somewhat rare event. A similar sunburn measure was validated against a diary 6 months later,[28] and a measure of ever-sunburned showed high test–retest reliability.[29]

Likert-type items (*strongly agree* [5]–*strongly disagree* [1]) measured attitudes toward sun protection, self-efficacy expectations, sensation-seeking, and skepticism.

Several questions measured guests' exposure to sun-protection messages. Guests were asked whether they recalled any messages about protecting their skin, lips, or eyes from the sun while at the resort (*yes/no* or *don't know*; if so, whether it was on a poster, sign, brochure, trail map, or website). Guests also were asked if they had been told by anyone at the resort to protect their skin, lips, or eyes from the sun (*yes/no* or *don't know*; if so, whether by a lift operator, ski/snowboard instructor, ski patroller, or someone else). In the follow-up survey, guests were asked if they had seen the Go Sun Smart logo (*yes/no* or *don't know*; and if so, where). Potential contamination was determined by asking guests what other ski areas they had visited that winter (since November 1) and noting whether those who had visited other ski area(s) were randomly assigned to the intervention.

The guests were queried about their demographics (age, race, Hispanic ethnicity, education, gender); skin sun-sensitivity (always burn/unable to tan; usually burn/can tan if work at it; sometimes mildly burn/tan easily; rarely burn/tan easily) [20]; skiing/snowboarding expertise (beginner, intermediate, expert); number of days spent skiing/snowboarding during that winter (since November 1); time started skiing/snowboarding that day; and home ZIP code. The ZIP code was used to determine the distance from a guest's home to the ski area (those living more than 200 miles away were classified as destination rather than local guests). Interviewers observed whether guests used skis or a snowboard (or other equipment). Weather conditions (i.e., cloud cover [sunny, partly cloudy, cloudy]; wind [none, light, moderate/strong]; precipitation [none, flurries/light snow, heavy snow, other]; temperature; and the time, the date, and the chairlift name were recorded.

Statistical Analysis

Hypothesis A (guests at ski areas assigned to implement Go Sun Smart would engage in more sun protection than guests at ski areas in the control group) was tested by comparing the intervention and the control groups on the sun-protection outcome measures at the individual level nested within ski areas. Hypothesis B (guests with more exposure to Go Sun Smart would (1) engage in more sun protection and (2) express more favorable attitudes toward sun safety than guests with less exposure to Go Sun Smart) was first tested by examining the association of implementation scores with sun-protection outcomes.

Next, guests' recall of sun-protection messages and sun-protection outcome measures was examined within both experimental conditions by evaluating the interaction between the experimental group and message recall. Comparisons were examined using a mixed-effects model,[24,30] which is a variation of hierarchical linear modeling,[31] and adjusting for the

association among guests within ski areas (measured by the intraclass correlation)—which, when non-zero, inflates the variance among individuals beyond that estimated by traditional analysis methods and Type-I error (i.e., tests of significance are too liberal).[32,33]

The Statistical Analysis System (SAS), using the PROC MIXED program, was employed.[34] Analyses included pairs to account for the effect of matching. Eighteen covariates were analyzed (days since November 1; time started skiing; cloud cover; wind; precipitation; temperature; proportion of days skied this season; expertise; local or destination guest; equipment; contamination [visit to intervention ski area]; skin sun-sensitivity; race—white/all others; sensation-seeking; skepticism; age; education; and gender), using backwards stepwise elimination ($p<0.05$ criterion for retention). Significant covariates related to each outcome were included in the regression analysis. Outcome data were not transformed prior to analysis. Models employed casewise deletion of missing values on the outcome or covariates (due to item non-response). A *p*-value of 0.05 was used to evaluate models, unadjusted for multiple comparisons.

Guests were a secondary target population; Go Sun Smart was expected to have a weaker effect on them than on employees (the primary target), and the study was not primarily designed to analyze guests. Hence, adjustments that would reduce statistical power (e.g., Bonferroni correction) were avoided, because there is an increased risk of Type-I error, and *p*-values were stated to permit readers to assess differences with their preferred correction methods. Adjusted proportions and means are reported.

Results

Sample

The samples in both surveys were similar: predominantly male (72.4%); white (95.7%); college-educated (67.9%); young (68.3% aged <45); skiers (79.5%) rather than snowboarders; intermediate (54.9%) and expert (39%) skiers/snowboarders; and local (56.1%) rather than destination guests. Differences between the pre-test and post-test occurred on ethnicity, age, location, expertise, and weather (Table 1); however, the differences were small.

Hypothesis A: Treatment Group Comparisons on Guest Sun-Protection

The initial analysis of the effect of Go Sun Smart was the comparison of guests at ski areas assigned to the two experimental groups. Unfortunately, Hypothesis A—that guests at ski areas assigned to use Go Sun Smart would report more sun protection—was not supported (Table 2).

Hypothesis B: Association of Message Exposure with Guest Sun-Protection

Exposure to Go Sun Smart materials appeared to vary across the intervention ski areas. Project observers found that five intervention ski areas implemented 0–2 Go Sun Smart items; four implemented 3–4 items; and four implemented 5–6 items. Likewise, 60% of intervention-group guests recalled seeing or hearing a message on sun protection at post-test; 36% of the control-group guests reported seeing or hearing one at post-test. Recall was higher for all messages, signs, and posters, as well as the Go Sun Smart logo, at intervention rather than control ski areas (Table 2). Also analyzed to test Hypothesis B was the association between message exposure (as measured by the observed implementation of Go Sun Smart in the intervention group) and recall of sun-protection messages in both groups and sun-protection outcomes.

As expected, the implementation score was associated positively with several sun-protection outcomes (Table 3). Reported use of goggles/sunglasses, gloves, neck covering, and head covering (covering the ears); the reapplication of sunscreen; and the composite sun-protection

behaviors were higher at intervention ski areas implementing more Go Sun Smart materials, supporting Hypothesis B(1). The mean score for goggles/sunglasses and the composite score suggested that use might be highest at areas with moderate implementation scores. Ratings of self-efficacy for sun protection were highest in low- and high-implementation ski areas, but the perceived importance of skin cancer decreased with greater implementation. These findings failed to support Hypothesis B(2).

Hypothesis B(1)'s predicted positive impact of exposure was also supported by the interaction between message recall and the experimental group. Intervention guests who recalled a sun-safety message were more likely to report using either sunscreen or sunscreen and sunscreen lip-balm combined than either intervention guests who did not recall a message or control guests (Table 4). Recall of a sun-safety message was not related to other protection behaviors, self-efficacy beliefs, or the importance of skin cancer, failing to support Hypothesis B(2).

Discussion

The failure to support Hypothesis A indicated that guests at the ski areas assigned to Go Sun Smart did not improve their sun-protection behavior. However, this failure may be due to lower-than-desired implementation fidelity or structural and personal factors that reduced message exposure; at least 40% of guests did not encounter, pay attention to, or remember the sun-safety messages. However, implementation of Go Sun Smart did increase guests' exposure to sun-safety messages. Further, message exposure (degree of implementation and message recall) was positively associated with guest sun-protection in the intervention group. Pre-existing sun-safety messages at ski areas may have accounted for some portion of message recall, yet the results demonstrated that adding Go Sun Smart exposed a larger number of guests to sun-safety advice and generated additional sun protection compared to that achieved by the pre-existing advice.

Message Exposure

Sun protection improved among guests exposed to the Go Sun Smart messages as predicted by Hypothesis B. Message exposure was not surprising, as it is essential for affecting health behaviors,[35–37] just as it is for any media messages that seek to influence social behavior.[38–41]

Adults practice selective exposure to media messages[42] because of limited processing capacity.[41,43] Several structural features of ski areas and Go Sun Smart may have determined who was exposed to Go Sun Smart. Ski areas communicate numerous safety, procedural, and commercial messages, so Go Sun Smart competed for display space and guests' attention. Guests undoubtedly were selective in attending to messages in these competitive environments. Go Sun Smart was directed primarily to employees,[22] and most guests visited the ski areas for only a short time, resulting in less exposure. Selective exposure may also be dictated by personal factors such as issue involvement or pre-existing intentions or habits. It is telling that despite these factors, message recall increased at the intervention ski areas.

Go Sun Smart messages may have been more influential than other non–Go Sun Smart sun-protection messages. Message recall by control-group guests was unrelated to sun protection. Only at the intervention ski areas where Go Sun Smart was present was the recall of sun-protection messages associated with improved sun safety. Well-designed health communication is required to activate cognitive schemas associated with health behaviors and to close the knowledge–behavior gap in diffusion of innovations theory.[44] It is notable that even brief, limited exposure to Go Sun Smart may have improved sun protection.

While in most instances sun protection appeared highest at the ski areas with high program implementation, a few behaviors were most commonly reported at areas with moderate program implementation. This may suggest that the display of a large number of messages produced message fatigue or some resistance.

Posters and signs appeared to provide the most memorable messages for guests, perhaps because far more of them were implemented and because more signage was designed specifically for guests than were other materials. There were fewer places to distribute other materials; it may have been easiest to post signage, and signage, once posted, required very little further attention. By contrast, employee-training programs and the distribution of brochures required more time and follow-up.[23] Signage also may be an effective channel at ski areas because it achieves repetition; repetition might account for the finding that guests who spent more days at ski areas recalled more messages. High prevalence and repetition, however, simply may have made signage more memorable, causing guests to recall it more than other, less-prevalent materials.

Limitations

Several limitations existed. The extent of message exposure was not randomly assigned. However, guests were not informed of the experimental condition; message recall was measured after assessing sun protection, and exposure analyses were conducted within both randomly assigned experimental conditions—reducing the likelihood of demand effects—and confounding variables (e.g., issue involvement). Requiring the inclusion of the chairlifts' run times limited the number of measures, so the focus was on sun protection and potential moderators rather than theoretical mediators. The sample of western North America ski areas limited generalizabilty. Sunburning and the use of sunscreen and sunscreen lip balm were self-reported, and the sunburn measure was not pre-tested with guest populations and for the winter period as opposed to the entire year. Social desirability biases, demand effects, and memory errors were possible, although recommendations had been sought when the sunburn measure was designed.[27] Observations of other sun-safety behaviors were less open to reporting bias. Finally, contamination of the control group, while present, did not depress the observed effect of Go Sun Smart.

Summary

Go Sun Smart demonstrated the potential to influence the use of sun protection during winter outdoor recreation. The knowledge of risk factors and the existence of commercial messages selling sun-protection products are insufficient to prompt prevention; rather, theory-driven communication practices are needed. Researchers should investigate the processes—environmental, media, message, and audience—that determine exposure to health communication.[37] Outdoor recreation has many physical and mental health benefits, and sun-protection promotions appear to be effective in prompting participants to guard against excessive sun exposure during these healthy pursuits.[12]

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References

1. American Cancer Society. Cancer facts and figures. Atlanta GA: American Cancer Society; 2006.
2. CDC. Guidelines for School Programs to Prevent Skin Cancer Report. Report No. 51. Atlanta GA: CDC; 2002.
3. U.S. Bureau of Labor Statistics. Occupational outlook handbook, recreation and fitness workers. www.bls.gov
4. USDA Forest Service. 1999–2000 National survey on recreation and the environment. 2001.
5. Gallagher RP, McClean D, Yang P. Suntan, sunburn, and pigmentation factors and the frequency of acquired melanocytic nevi in children. Similarities to melanoma: the Vancouver mole study. Arch Dermatol 1990;126:770–6. [PubMed: 2346321]
6. Kricker A, Armstrong B, English D, Heenan P. Does intermittent sun exposure cause basal cell carcinoma? A case control study in Western Australia. Int J Cancer 1995;69:489–94. [PubMed: 7829262]
7. Newmann W, Agro A, Woodruff S, Mayer J. A survey of recreational sun exposure of residents of San Diego, California. Am J Prev Med 1996;12(3):186–94. [PubMed: 8743874]
8. Winett A, Cleaveland B, Tate D, et al. The effects of the safe-sun program on patrons' and lifeguards' skin cancer risk-reduction behaviors at swimming pools. J Health Psychol 1997;2(1):85–95.
9. Ting S. A sun protection survey of New England fishermen. Cutis 2003;71:407–10. [PubMed: 12769410]
10. Dozier S, Wagner R. Beachfront screening for skin cancer in Texas Gulf Coast surfers. South Med J 1997;90(1):55–9. [PubMed: 9003825]
11. Rosenberg C, Mayers J, Eckhardt L. Skin cancer prevention: a national survey of YMCAs. J Community Health 1997;22(5):373–85. [PubMed: 9353684]
12. Task Force on Community Preventive Services. Recommendations to prevent skin cancer by reducing exposure to ultraviolet radiation. Am J Prev Med 2004;(5):467–70. [PubMed: 15556745]
13. Weinstock M, Rossi J, Redding C, Maddock J. Randomized controlled community trial of the efficacy of a multi-component stage-matched intervention to increase sun protection among beachgoers. Prev Med 2002;35:584–92. [PubMed: 12460526]
14. Detweiler J, Bedell B, Salovey P, Pronon E, Rothman A. Message framing and sunscreen use: gain-framed messages motivate beach-goers. Health Psychol 1999;18(2):189–96. [PubMed: 10194055]
15. Mayer J, Lewis E, Eckjardt L, et al. Promoting sun safety among zoo visitors. Prev Med 2001;33:162–9. [PubMed: 11522156]
16. Glanz K, Lew R, Song V, Murakami-Akatsuka L. Skin cancer prevention in outdoor recreation settings: effects of the Hawaii SunSmart program. Eff Clin Pract 2000;3(2):53–61. [PubMed: 10915324]
17. Blumthaler M, Ambach W. Human ultraviolet radiant exposure in high mountains. Atmos Environ 1988;22:749–53.
18. Reiter R, Munzert K, Sladovic R. Results of 5-year concurrent recordings of global, diffuse, and UV radiation at three levels in the Northern Alps. Arch Met Geoph Biokl 1982;Ser B(30):1–28.
19. Rodenas J, Delgado-Rodriguez M, Tercedor J, Serrano S. Sun exposure, pigmentary traits, and risk of cutaneous melanoma: a case-control study in a Mediterranean population. Cancer Causes Control 1996;7:275–83. [PubMed: 8740740]
20. Weinstock MA. Assessment of sun sensitivity by questionnaire: validity of items and formulation of a prediction rule. J Clin Epidemiol 1992;45:547–52. [PubMed: 1588360]
21. Buller DB, Andersen PA, Walkosz B. Sun safety behaviours of alpine skiers and snowboarders in the western U.S. Cancer Prev Control 1998 June;2(3):133–9. [PubMed: 10093624]

22. Buller DB, Andersen PA, Walkosz BJ, et al. Randomized trial testing a worksite sun protection program in an outdoor recreation industry. Health Educ Behav 2005 August;32(4):514–35. [PubMed: 16009748]

23. Rogers, EM. Diffusion of innovations. New York: The Free Press; 1995.

24. Walkosz B, Voeks J, Andersen P, et al. Randomized trial on sun safety education at ski and snowboard schools in western North America. Pediatr Dermatol 2007 May;24(3):222–9. [PubMed: 17542868]

25. Murray, D. Design and analysis of group-randomized trials. New York: Oxford University Press; 1998.

26. Campbell, DT.; Stanley, JC. Experimental and quasi-experimental designs for research. Chicago IL: Rand McNally; 1966.

27. Lovato C, Shoveller J, Peters L, Rivers J. Canadian national survey on sun exposure and protective behaviours: parents' reports on children. Cancer Prev Control 1998;2(3):123–8. [PubMed: 10093622]

28. Shoveller JA, Lovato CY. Measuring self-reported sunburn: challenges and recommendations. Chronic Dis Can 2001;22(3–4):83–98. [PubMed: 11779421]

298. Brandberg Y, Sjoden P, Rosdahl I. Assessment of sun-related behavior individuals with dysplastic naevus syndrome: a comparison between diary recordings and questionnaire responses. Melanoma Res 1997;7(4):347–51. [PubMed: 9293486]

30. van der Mei I, Blizzard L, Ponsonby AL, Dwyer T. Validity and reliability of adult recall of past sun exposure in a case-control study of multiple sclerosis. Cancer Epidemiol Biomarkers Prev 2006;15:1538–44. [PubMed: 16896046]

31. Laird N, Ware H. Random-effects models for longitudinal data. Biometrics 1982;38:963–74. [PubMed: 7168798]

32. Raudenbusch, SW.; Byrk, AS. Hierarchical linear models: applications and data analysis methods. Vol. 2. Thousand Oaks CA: Sage Publications; 2002.

33. Scott MD, Buller DB, Andersen PA, et al. Testing the risk compensation hypothesis for safety helmets in alpine skiing and snowboarding. Inj Prev 2007;13(3):173–7. [PubMed: 17567972]

34. Andersen PA, Buller DB, Voeks JH, Walkosz BJ, Scott MD, Cutter GR. Testing the long term effects of the Go Sun Smart worksite sun protection program: a group-randomized experimental study. J Commun. 2008In press

35. SAS Institute, Inc. Statistical analysis system. Cary NC: The Institute; 2002.

36. Hornik, RC. Public health communication: making sense of contradictory evidence. In: Hornik, RC., editor. Public health communication: evidence for behavior change. Mahwah NJ: Lawrence Erlbaum Associates, Inc.; 2002.

37. Slater M. Operationalizing and analyzing exposure: the foundation of media effects research. Journalism and Mass Communication Quarterly 2004;81:168–83.

38. Southwell B, Barmada C, Hornik R, Maklan D. Can we measure encoded exposure? Validation evidence from a national campaign. J Health Commun 2002;7:445–53. [PubMed: 12455763]

39. Beaudoin C, Thorson E. Testing the cognitive mediation model: the role of news reliance and three gratifications sought. Communic Res 2004;31(4):446–71.

40. Eveland W. The cognitive mediation model of learning from news. Communic Res 2001;28:571–601.

41. Eveland W, Shah D, Kwak N. Assessing causality in the cognitive mediation model: a panel study of motivations, information processing, and learning during campaign 2000. Communic Res 2003;30:359–86.

42. Kim J, Rubin A. The variable of audience activity on media effects. Communic Res 1997;24:107–35.

43. Zillman, D.; Bryant, J., editors. Selective exposure to communication. Hillsdale NJ: Lawrence Erlbaum Associates, Inc.; 1985.

44. Lang A, Borse J, Wise K, David P. Captured by the world wide web: orienting to structural and content features of computer-presented information. Communic Res 2002;29:215–45.

Table 1
Guest profile: demographics, location, weather conditions

	Baseline 2001	Follow-up 2002	Combined
Race and ethnicity* (%)			
White	96.0	95.4	95.7
Hispanic	2.5	4.2	3.5
Education* (%)			
High school or less	9.3	9.7	9.5
Some college	24.3	21.3	22.6
College degree	66.4	69.0	67.9
Age (years; mean)*			
18–25	15.5	16.4	16.0
26–35	25.6	24.2	24.8
36–45	28.0	27.0	27.5
46–55	19.3	18.5	18.9
Over 55	11.6	13.9	12.8
Expertise* (%)			
Beginners	6.2	5.2	5.7
Intermediates	57.4	52.8	54.9
Experts	36.4	42.0	39.4
Location of ski area*(%)			
Rocky Mountains	34.1	36.1	35.2
California	30.9	30.4	30.7
Pacific Northwest	25.9	24.5	25.1
Southwest	9.1	9.0	9.0
Cloud cover* (%)			
Clear	44.4	44.0	44.2
Partly cloudy	27.7	24.6	26.0
Cloudy	27.9	31.4	29.8
Winds*(%)			
Calm	54.0	50.5	52.1
Light	29.5	31.4	30.6
Moderate/strong	16.5	18.1	17.3
Precipitation*(%)			
None	75.6	71.8	73.6
Flurries/light snow	17.4	20.1	18.8
Heavy snow	6.8	7.4	7.1
Other	0.2	0.7	0.5

* $p<0.05$

Table 2

Go Sun Smart effects on message recall: interaction between intervention and control groups' recall of messages about sun safety[a] (adjusted proportions and estimates)

Recalled seeing or hearing a message about protecting skin and eyes from the sun	Pre-test	Post-test	*F*	*p*
Control	0.313	0.357	50.48	<0.001
Intervention	0.371	0.597		
Recalled seeing message on a poster or sign				
Control	0.249	0.292	91.47	<0.001
Intervention	0.288	0.555		
Recalled reading a message in brochure or trail map				
Control	0.075	0.064	0.01	0.923
Intervention	0.079	0.070		
Recalled GSS logo[a]				
Control	—	0.065	31.71	<0.001
Intervention	—	0.374		
Recalled message told by employee				
Control	0.173	0.159	1.10	0.294
Intervention	0.145	0.151		

[a]Recall of logo was measured only at post-test; logo did not exist at pre-test.

GSS, Go Sun Smart

Table 3

Go Sun Smart implementation effects on sun protection within experimental group at post-test survey[a] (adjusted proportions and estimates)

	Number of types of GSS items observed[b]				
Reported outcome	**0–2**	**3–4**	**5–6**	***F***	***p***
Sunburned while skiing/snowboarding this winter	0.055	0.091	0.069	0.25	0.862
Sunscreen with SPF 15+	0.526	0.488	0.530	1.70	0.166
Lip balm with SPF 15+	0.425	0.426	0.399	1.15	0.328
Composite of sunscreen and lip balm with SPF 15+	0.925	1.000	0.924	0.99	0.398
Goggles/sunglasses	0.905	0.973	0.943	179.84	<0.001
Gloves	0.922	0.907	0.967	11.75	<0.001
Neck covering	0.352	0.593	0.503	4.04	0.007
Face covering	0.085	0.162	0.067	2.46	0.062
Head covering (e.g., hat/helmet)	0.884	0.970	0.941	40.25	<0.001
Head covering with brim	0.109	0.122	0.123	0.30	0.829
Head covering covering ears	0.779	0.823	0.867	22.41	<0.001
Composite sun protection behaviors[c]	4.07	4. 68	4.36	15.32	<0.001
Reapplied sunscreen	0.100	0.085	0.136	6.83	<0.001
Self-efficacy for practicing sun safety while skiing or snowboarding[d]	4.33	4.19	4.32	511.93	<0.001
Importance of skin cancer as a health concern[d]	4.15	4.06	4.09	189.65	<0.001

Note: Implementation effects include sunburning, sun protection, beliefs about sun safety, and recall of messages about sun safety.

[a] Analyses adjusted for clustering within ski areas and pair matching.

[b] An item was counted as observed if two or more pieces were seen (this criteria insured that this measure tapped broad use of an item); categories represent tertiles.

[c] Mean count of number of reported sun-protection behaviors, not including reapplying sunscreen.

[d] Mean ratings on scales: 1=strongly disagree to 5=strongly agree.

GSS, Go Sun Smart; SPF, sun-protection factor

Table 4

Go Sun Smart message recall effects within experimental group at post-test survey.[a] (adjusted proportions and estimates)

Reported outcome	Control	Intervention	F[b]	p
Sunburned while skiing/snowboarding this winter				
No message	0.099	0.075	1.78	0.182
Message		0.112	0.062	
Sun-protection behaviors				
Use of sunscreen with SPF 15+				
No message	0.520	0.472	7.83	0.005
Message	0.498	0.554		
Use of lip balm with SPF 15+				
No message	0.381	0.373	0.94	0.332
Message	0.422	0.448		
Composite of sunscreen and lip balm with SPF 15+				
No message	0.890	0.832	9.29	0.002
Message	0.894	1.013		
Composite of sun-protection behaviors practiced[c]				
No message	4.33	4.26	0.56	0.059
Message	4.31	4.40		
Reapplied sunscreen[d]				
No message	0.135	0.116	0.09	0.765
Message	0.121	0.113		
Self-efficacy for practicing sun safety while skiing or snowboarding[d]				
No message	4.22	4.25	2.56	0.109
Message	4.36	4.31		
Importance of skin cancer as a health concern[d]				
No message	4.09	4.06	0.06	0.806
Message	4.15	4.13		

Note: Recall effects include sunburning, sun protection, beliefs about sun safety, and recall of messages about sun safety.

[a] Analyses adjusted for clustering within ski areas and pair matching

[b] Interactions of experimental group (intervention versus control) and recall of message on sun protection (*yes* versus *no*/*don't know*)

[c] Mean count of number of reported sun-protection behaviors

[d] Mean ratings on scales: 1=*strongly disagree* to 5=*strongly agree*

SPF, sun-protection factor