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Comparison of Sunburn Protection Offered by Beach Umbrella Against High-SPF Sunscreen in a Randomized In-Use Study

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ABSTRACT

- Seeking shade is one way to avoid sun exposure. Other methods include wearing clothes and applying sunscreens. Shade works by physically shielding skin from direct and harmful ultraviolet (UV) rays. However, UV rays can also reach the skin from other angles. There is a lack of clinical evidence that shade can provide sufficient protection when used in real life, and it is not clear whether people still need to wear clothes or sunscreen under the shade.
- We directly measured sunburn protection offered by a beach umbrella in comparison to a high-SPF sunscreen in a randomized, evaluator-blinded, in-use clinical study. Eighty-one subjects were divided into two groups, one using only a beach umbrella and the other using only SPF 100 sunscreen as sun protection measures. The subjects of both groups were kept side-by-side for 3.5 hours on the beach at a park in Texas. Clinical sunburn evaluation was conducted at baseline and 24 hours following the exposure for all exposed body sites for each subject.
- Overall, the beach umbrella offered poor sunburn protection compared to high-SPF sunscreen. Of the subjects in the shade group, 78% showed an increase of erythema in one or more sites, versus only 25% of the subjects in sunscreen group. Of the total sites evaluated, 49.5% worsened after exposure for the umbrella group versus 6.1% for the sunscreen group. For all the body sites evaluated, the umbrella group showed a significant increase in clinical sunburn scores.
- We conclude that shade, such as that produced by a beach umbrella, may not provide sufficient sun protection for an extended exposure. It is important to consider multiple sun protection measures and combine them, rather than relying on a single approach.

STUDY DESIGN

- Randomized, evaluator-blinded, in-use comparative clinical study.
- Two groups side-by-side: One group used only Neutrogena® Ultra Sheer® SPF 100+ sunscreen (Johnson & Johnson, Los Angeles, CA, USA) versus only shade for sun protection.
- Three and a half hours of sun exposure to certain body sites at the beach. No water activities.
- Primary endpoint was sunburn protection evaluated by clinical grading 24 hours postexposure to the sun.
- Fitzpatrick skin type I to III included.
- Clinical grading scale:

Grade	Description
0	No burn
1	Possible burn, not clearly defined
2	Defined redness clearly caused by UV
3	Severe sunburn with pronounced redness
4	Edema and blisters

STUDY CONDITIONS

- Conducted in August in Texas (temperature 85–95°F, relative humidity 35–45%), sand beach (high albedo) in a park.
- The UV conditions: Direct UVB varied from 2 to 5 minimal erythema dose (MED)/h, direct UVA varied from 3.5 to 5.0 mW/cm^2 during the 3.5 hours. The diffuse UVB was 1 to 2 MED/h and diffuse UVA was 1 to 3 mW/cm^2.
- Beach umbrella as shade: Umbrella allowed <0.2% transmission in the entire UV spectrum as measured by spectrophotometer, 75 inches in height, with a 37-inch radius.
- Sunscreen application behavior and shade usage were monitored by the participant's diary.

RESULTS
Usage

Sunscreen application (Sunscreen group, N = 40)

Parameter	*Mean ± SD*
Initial sunscreen application amount (g)	15.83 ± 8.57
Total sunscreen application amount (g)	29.55 ± 16.57
Number of reapplications	2.30 ± 1.09

Amount of time outside the shade (Shade group, N = 41)

Parameter	*n*	*Mean ± SD*
Amount of time (min)	28*	7.07 ± 4.64

*Many participants did not leave the shade (13/41). Mean time outside of the shade includes only the 28 subjects who did not spend the entire exposure period in the shade.

RESULTS

Shade did not provide sufficient sunburn protection

Change from baseline for clinical evaluation of sunburn 24 hours postexposure

Body site	Treatment	N	Percentage improved	Percentage worsened	Mean change	*P* value
Face	Shade	41	0.0	56.1	0.83 ± 0.86	<.001
	Sunscreen	40	0.0	17.5	0.18 ± 0.47	.016
Upper chest	Shade	41	0.0	65.9	0.90 ± 0.88	<.001
	Sunscreen	40	0.0	10.0	0.08 ± 0.24	.125
Back of neck	Shade	41	0.0	34.1	0.33 ± 0.47	<.001
	Sunscreen	40	0.0	0.0	0.00 ± 0.00	–
Right arm	Shade	41	0.0	56.1	0.82 ± 0.95	<.001
	Sunscreen	40	0.0	5.0	0.04 ± 0.17	.500
Left arm	Shade	41	0.0	56.1	0.85 ± 0.97	<.001
	Sunscreen	40	0.0	7.5	0.06 ± 0.23	.250
Right leg	Shade	41	0.0	39.0	0.78 ± 1.24	<.001
	Sunscreen	40	0.0	2.5	0.01 ± 0.08	1.000
Left leg	Shade	41	0.0	39.0	0.71 ± 1.19	<.001
	Sunscreen	40	0.0	0.0	0.00 ± 0.00	–
Global (average of 7 sites)	Shade	41	0.0	78.0	0.75 ± 0.72	<.001
	Sunscreen	40	0.0	25.0	0.05 ± 0.10	.002

Calculated from Wilcoxon signed-rank test. Test hypothesis is that the mean change from baseline is equal to zero.

RESULTS

High-SPF sunscreen provided better protection than shade

Comparison between groups in change from baseline in sunburn score 24 hours postexposure

Body site	Mean difference (shade-sunscreen)	*P* value
Face	0.65	<.001
Upper chest	0.83	<.001
Back of neck	0.33	<.001
Right arm	0.78	<.001
Left arm	0.79	<.001
Right leg	0.77	<.001
Left leg	0.71	<.001
Global (average of 7 sites)	0.69	<.001

Calculated from Wilcoxon signed-rank test.

Subject with sunburn grade >2

DISCUSSION

- There were significant differences between the two groups in clinically evaluated sunburn protection for all seven body sites measured.
- The Ultra Sheer SPF 100+ sunscreen provided excellent sunburn protection for all the body sites (except for face) in real-life in-use beach conditions, as demonstrated by no significant changes in sunburn grading before and after UV exposure.
- Beach umbrella as shade provided very poor sunburn protection by itself even when there was no UV transmission for the shade materials. All seven body sites evaluated showed significant increase in clinical sunburn scores.
- Seventy-eight percent of the subjects in the shade group showed increase of erythema in one or more sites versus only 25% of the subjects in the sunscreen group. The percentages of sites worsened were 49.5% (142/287) versus 6.1% (17/280).
- The average change in erythema scores for the shade and sunscreen groups were 0.75 and 0.05, respectively.

CONCLUSIONS

- Seeking shade is a basic recommendation for decreasing skin cancer risk, but few studies have evaluated the protective benefits of shade for extended UV exposure.
- Shade alone from a beach umbrella may not offer sufficient protection for extended outdoor exposure in typical use conditions.
- High-SPF sunscreen use demonstrated significantly better UV protection compared to shade, although neither provided complete sunburn protection.
- A combination approach of sun protective measures should be considered for optimal UV protection.

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CONFLICTS OF INTEREST

- Hao Ou-Yang and Karen Meyer are employed by Johnson & Johnson Consumer Inc. (Skillman, NJ, USA), the manufacturer of Neutrogena Ultra Sheer SPF 100+ sunscreen.
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