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Authors

Johal, Ritika
Leo, Michael S
Ma, Brian
[et al.](#)

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Original

The Economic Burden of Sunscreen Usage

Ritika Johal¹, Michael S. Leo^{2,3}, Brian Ma¹, Raja K. Sivamani²

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¹University of California-Davis, Davis CA USA

²Department of Dermatology, University of California-Davis School of Medicine, Sacramento, CA USA

³University of Wisconsin-Madison, School of Medicine and Public Health

Correspondence:

Raja Sivamani, MD MS CAT
Assistant Professor of Clinical Dermatology
Department of Dermatology
University of California, Davis
3301 C Street, Suite 1400
Sacramento, CA 95816
Phone: 916-703-5145
Email: rksivmani@ucdavis.edu

Abstract

Excessive sun exposure is known to be the leading cause of skin cancer. The direct cellular damage inflicted by the ultraviolet (UV) radiation from the sun results in premature aging, DNA damage, and mutations that ultimately lead to skin cancer. Sunscreens are highly recommended to protect against UV radiation. However, little research has been conducted on the economic burden of sunscreen use. In this study, we aimed to evaluate the annual cost of sunscreen under both ideal and actual use conditions while stratifying for the sun protection factor (SPF) and by the name brand or equivalent store brand sunscreen. Pricing data was collected for sunscreens of SPF 30, 50, 70, and 100. For each type of sunscreen, the size and price of the container were recorded. Our results demonstrated that sunscreen prices increased with SPF but purchasing a generic sunscreen resulted in savings of 40%-50%. Our estimates reveal that sunscreens are affordable with annual expenditures ranging from \$30.21 to \$61.94, depending on brand, for SPF 50 sunscreens used with minimal application density for the average person.

Introduction

Overexposure to ultraviolet radiation leads to sunburns, skin cancers, and photoaging [1]. The practice of good sun protective habits is paramount in minimizing these consequences. Diligent sunscreen use is one of the important components to good sun protection but little has been reported on their annual economical burden. One previous study showed that under ideal use situations sunscreens can be economically burdensome when applied year-round [2].

In this study we sought to estimate the cost incurred by consumers in purchase of sunscreens. Multiple reports note that although sunscreen testing is performed at 2 mg/cm² most consumers, including dermatologists, apply their sunscreen at 1 mg/cm² or less [3]. Therefore we estimated the costs of sunscreens when using both 2 mg/cm² and 1 mg/cm² application densities.

Methods

Sunscreen Cost Collection

To best mimic how most people purchase their sunscreen, prices were obtained from local retail stores. The data was collected from five different widely prevalent retail store branches in the greater Sacramento area. For each store branch, three locations in

Sacramento, Woodland, Davis, and Dixon were studied for a total of 12 stores in each branch. The sunscreens that we evaluated ranged from SPF of 30 to 100 and data was only collected on sunscreens that were labeled with SPFs of exactly 30, 50, 70, or 100 to allow for comparisons. For each type of sunscreen, the size and price of the bottle were recorded. The data was used to calculate a normalized price that was reported as price per ounce.

Sunscreen Usage

To estimate the daily use of sunscreens, the Du Bois formula [4] was used to calculate body surface area of an average adult man and woman based on their average weight and height [5]:

$$\text{Body Surface Area} = 0.007184 \times (M^{0.425} \times H^{0.725}) \text{ [4]}$$

in which M is mass in kilograms and H is height in centimeters.

Two estimates were performed. We defined moderate sun exposure as exposure of the face, arms, upper chest, upper back, and legs during the spring and summertime and exposure to the face, arms, upper chest, and upper back during the fall/winter. We made a second estimate in which we defined minimal sun exposure as year round exposure to the face, forearms, and hands. In each case, the rule of nines was used to approximate the percent of the exposed body surface area [6]. To estimate the total sunscreen used, calculations were made based on application densities of 2 mg/cm² and 1 mg/cm² as follows:

$$\text{Total Sunscreen Applied} = \text{Applied BSA} * \text{Application Density}$$

in which BSA is body surface area.

Statistical comparisons were performed with a one-way ANOVA with statistical significance defined as p < 0.05.

Results

Cost of Sunscreen Based on Sun Protection Factor

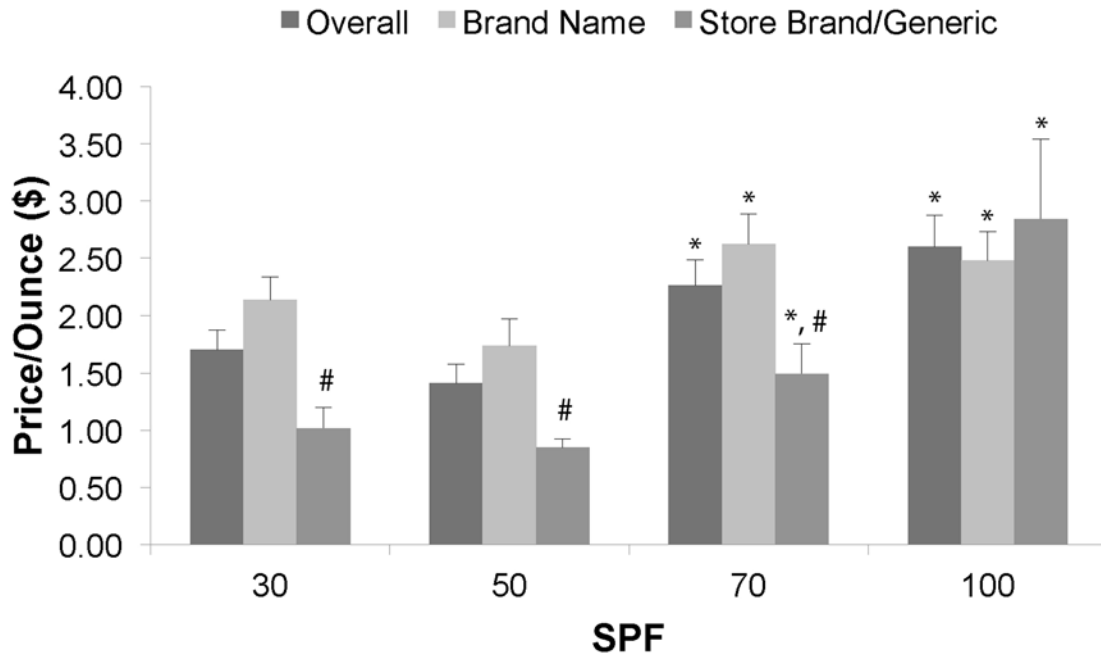


Figure 1. Prices of sunscreen. Sunscreen prices were stratified by SPF and by whether they were brand name or store brand sunscreens. Prices were normalized as dollars per ounce of sunscreen. * = p < 0.05 in comparison to the respective SPF 30 sunscreen estimate; # = p < 0.05 in comparison of store brand (generic) sunscreen with name brand sunscreen. N = 39, 41, 25, and 15 distinct sunscreens with averaged prices of pricing from at least six different stores for each particular sunscreen.

Overall, the cost of sunscreens typically increased with SPF (Figure 1). SPF 30 sunscreen prices were not statistically different from SPF 50 sunscreens.

Cost of Sunscreen Based on Brand Name vs Store Brand/Generic

Store brand/generic sunscreens were considerably less expensive compared to name brand sunscreens (Figure 1). This relationship held true at SPF 30, 50, and 70. However at SPF 100, there was no statistical difference in the pricing of name brand and store brand/generic sunscreens.

Annual Economic Cost for Sunscreen Use

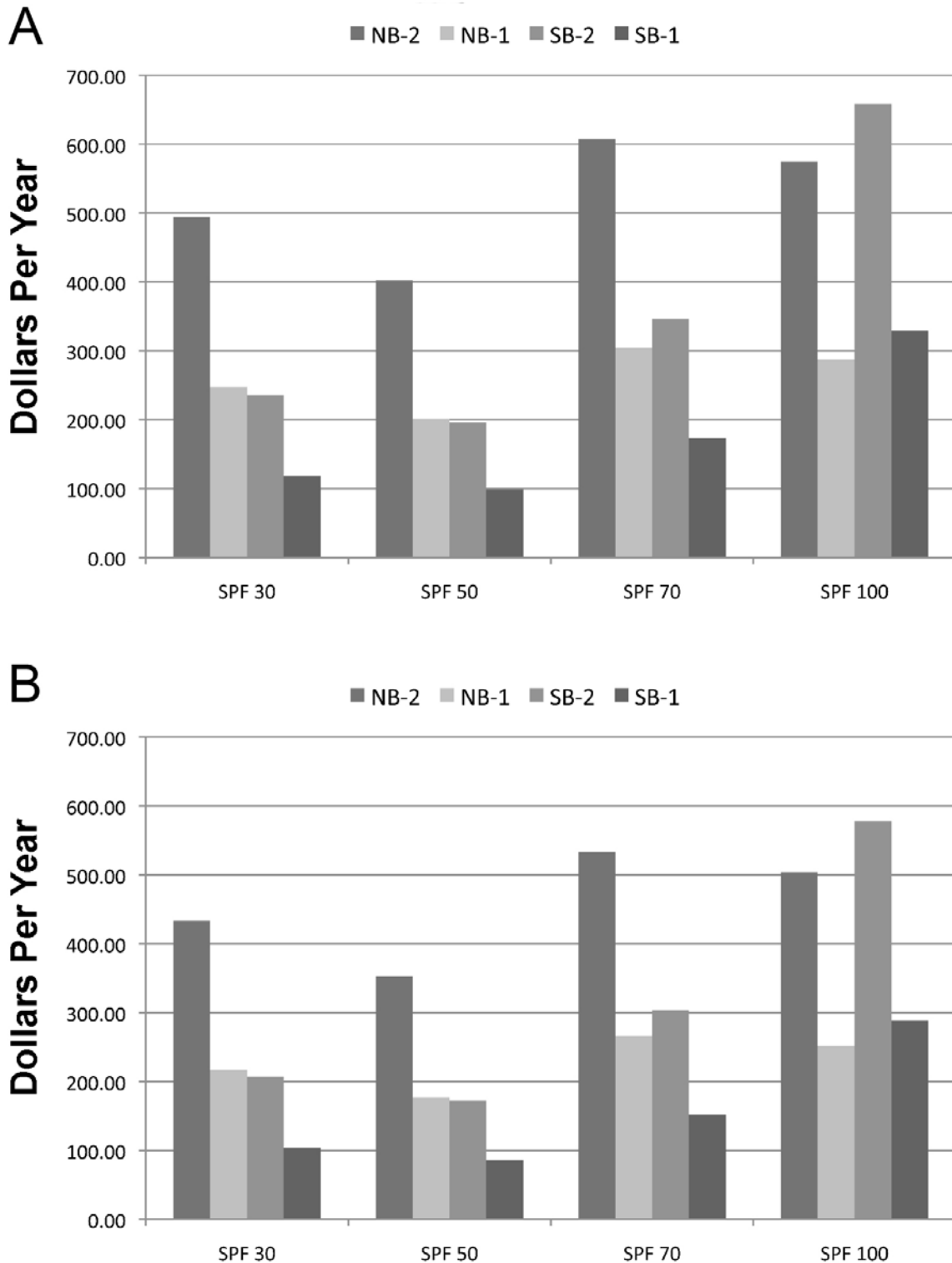


Figure 2: Annual Cost for Moderate Sunscreen Use. The yearly cost of applying sunscreens for an average adult man (A) and average adult woman (B): NB-2 = name brand sunscreen at 2 mg/cm², NB-1 = name brand sunscreen at 1 mg/cm², SB-2 = store brand/generic sunscreen at 2 mg/cm², SB-1 = store brand/generic sunscreen at 1 mg/cm².

Moderate Application Density

For the average man under ideal conditions (2 mg/cm^2), the annual economic burden is depicted in Figure 2A. The economic burden of using SPF 50 sunscreens ranged from \$196.36 to \$402.61 depending on name brand or store brand use, respectively. However, under actual use conditions (1 mg/cm^2), this burden is halved and ranges from \$98.18 to \$201.30. For the average woman under ideal conditions (2 mg/cm^2), the annual economic burden is depicted in Figure 2B. The economic burden of using SPF 50 sunscreens ranged from \$172.16 to \$352.99 depending on name brand versus store brand use, respectively. However, under actual use conditions (1 mg/cm^2), this burden is halved and ranges from \$86.08 to \$176.49.

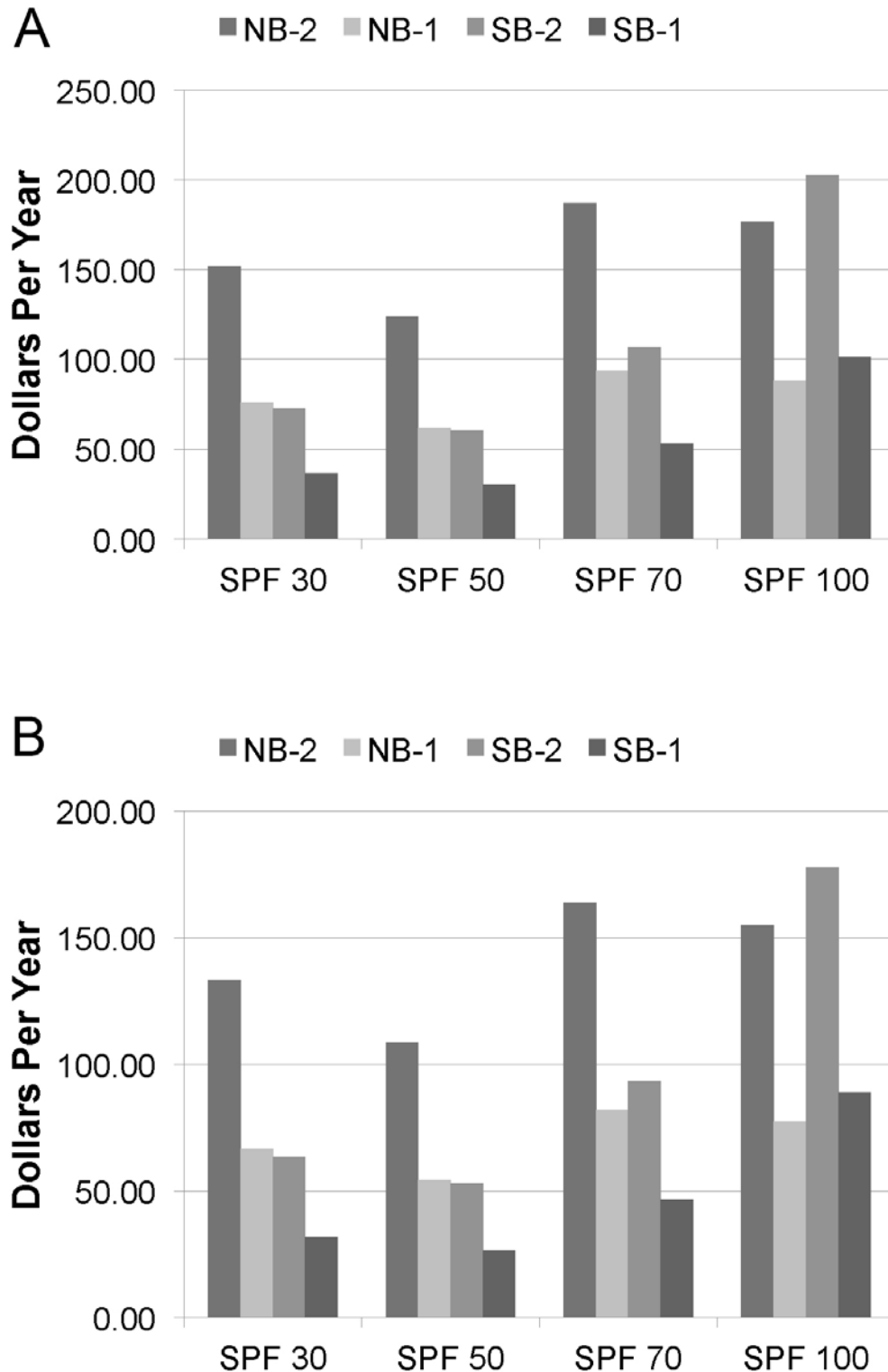


Figure 3. Annual Cost for Minimal Sunscreen Use. The yearly cost of applying sunscreens for an average adult man (A) and average adult woman (B). NB-2 = name brand sunscreen at 2 mg/cm^2 , NB-1 = name brand sunscreen at 1 mg/cm^2 , SB-2 = store brand/generic sunscreen at 2 mg/cm^2 , SB-1 = store brand/generic sunscreen at 1 mg/cm^2 .

Minimal Application Density

For the average man under ideal conditions (2 mg/cm²), the annual economic burden is depicted in Figure 3A. The economic burden of using SPF 50 sunscreens ranged from \$60.42 to \$123.88 depending on name brand vs store brand use, respectively. However, under actual use conditions (1 mg/cm²), this burden is halved and ranges from \$30.21 to \$61.94. For the average woman under ideal condition (2 mg/cm²), the annual economic burden is depicted in Figure 3B. The economic burden of using SPF 50 sunscreens ranged from \$52.97 to \$108.61 depending on name brand versus store brand use, respectively. However, under actual use conditions (1 mg/cm²), this burden is halved and ranges from \$26.49 to \$54.31.

Discussion

In this study we collected our data from local retail stores to mimic how consumers typically purchase their sunscreens. Our estimates at an application density of 1 mg/cm² are likely to be more accurate than the estimates at 2 mg/cm². Our study reveals several interesting patterns.

Not surprisingly, store brand/generic sunscreens were found to be cheaper than name brand products. However it was surprising that the savings were between 40 to 50% in purchasing a store brand/generic sunscreen.

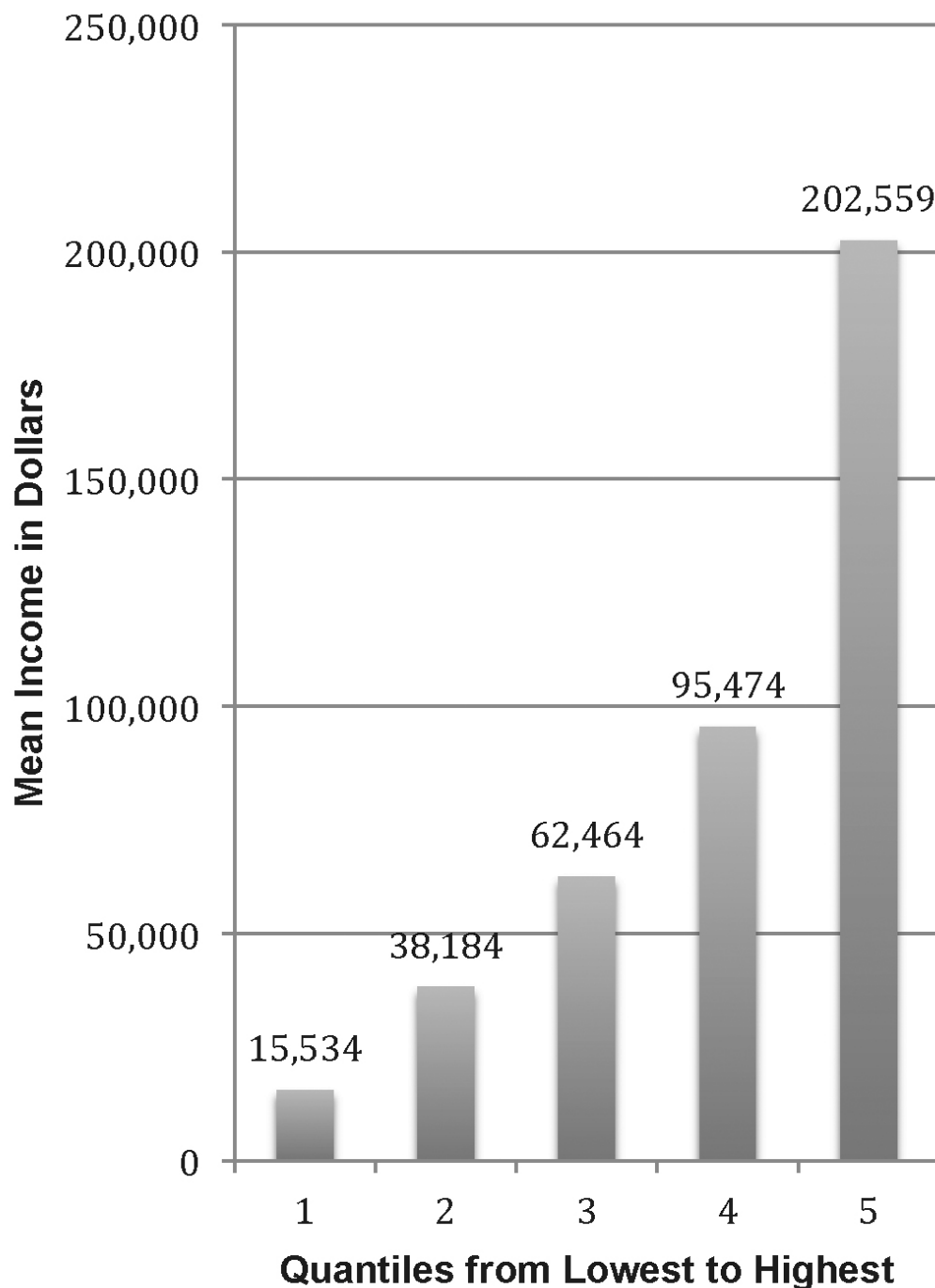


Figure 4. 2012 U.S. Mean household Income in Dollars Divided into Quantiles

The data used to generate this figure was obtained from [8]

Table 1: Annual Cost of Sunscreen

	Man				Woman			
	Name Brand		Store Brand		Name Brand		Store Brand	
	Ideal Use (2 mg/cm ²)	Actual Use (1 mg/cm ²)	Ideal Use (2 mg/cm ²)	Actual Use (1 mg/cm ²)	Ideal Use (2 mg/cm ²)	Actual Use (1 mg/cm ²)	Ideal Use (2 mg/cm ²)	Actual Use (1 mg/cm ²)
SPF 30	\$494.21	\$247.10	\$235.96	\$117.98	\$433.30	\$216.65	\$206.88	\$103.44
SPF 50	\$402.61	\$201.30	\$196.36	\$98.18	\$352.99	\$176.49	\$172.16	\$86.08
SPF 70	\$607.64	\$303.82	\$346.27	\$173.13	\$532.76	\$266.38	\$303.59	\$151.80
SPF100	\$574.38	\$287.19	\$658.79	\$329.39	\$503.59	\$251.80	\$577.60	\$288.80

The sunscreens became more expensive as SPF increased to 50, 70, and 100. What was surprising is that SPF 30 sunscreens were as expensive as SPF 50 sunscreens. This may reflect a greater demand for SPF 30 sunscreens that may be driven by current position statements from the American Academy of Dermatology, which recommends the use of at least SPF 30 sunscreens, among other recommendations. With the new labeling changes adopted by the Food and Drug Administration (FDA), sunscreen in the United States can only be labeled as 50+ and SPF 70 and SPF 100 labels will cease to exist. It will be interesting if this will ultimately drive up the cost of SPF 50+ sunscreens in comparison to SPF 40 sunscreens.

Our estimates for economic burden reveal that sunscreens are affordable. The median household income in the United States is \$51,371 in 2012 [7]. Therefore for a couple consisting of two male or female adults, the relative economical burden approximately ranges from .0012% to .0024% of their income under minimal application density depending on store brand or name brand use. Figure 4 shows the average household income in quantiles [8]. Patients without much reserve income should be encouraged to purchase generic sunscreens and at least use it to their face, forearm, hands, and neck, because the cost of this is less than \$40 per year.

The findings presented here are in agreement with the pricing found in a previous study of the economic burden of sunscreen [2]. However, this study differs and complements the previous study in several ways. Firstly, this study focused on pricing in retail stores rather than online stores and may more closely mimic how sunscreens are purchased by the average consumer. Secondly, the pricing presented in this study is stratified along SPF and store brand vs name brand. Finally, we estimate the economic burden under both 2 mg/cm² and 1 mg/cm². Interestingly, the yearly economic burden estimated here for name brand and store brand sunscreens are higher and lower, respectively, than the estimate provided in the previous study [2], further supporting the agreement between the two studies.

Our study has several limitations. All of our data collection was focused in the Sacramento, CA area and the prices may vary by state, region, and country. However, skin cancer rates are high in California and in Sacramento, CA with melanoma incidence rates of 17.6-21.0 per 100,000 people [9], which may be related to more frequent outdoor sun exposure and the fact that there 188 sunny days per year, making this region suitable for estimating annual economic burden. Therefore, our estimates may be an overestimate, but is unlikely to be an underestimate of the economic burden. Secondly, our study does not take into account that SPF values greater than 50 will no longer be allowed. As mentioned before, this may change the pricing of SPF 50 sunscreens in the future. Thirdly, our study was focused on the most popular brands that were available over the counter at local retail stores and we selected brands that had a store brand/generic alternative that is typically marketed right next to the brand name sunscreen on the shelves. This allowed for controlled pairing of the store brand/generic sunscreens to the name brands. However, our study does not include brands that would only be available through online purchases, at health food stores, or only over the counter in physician offices.

Conclusion

Sunscreens are an important part of sun protective habits. Some sunscreens may have a significant economic burden, but there are many options that will allow for individualization of sunscreen advice. Despite their potential affordability, sunscreens should not be used as a sole sun protective measure, but should be integrated into habits that heavily favor sun protective clothing and avoidance of intense and prolonged sun exposure.

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