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Economic Impact Analysis and Public Health Benefits of Regular Sunscreen Use in Preventing Skin Cancer in Brazil: A Comprehensive Analysis

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Introduction & Objectives

Skin cancer (non-melanoma) represents a significant health and economic burden globally.[1] In Brazil, skin cancer incidence is particularly high due to factors such as geographic location and sun exposure patterns. To analyze the economic impact of skin cancer burden, we've developed an Impact Calculator. Its primary objective is to estimate the costs avoided in skin cancer treatment with sunscreen use and number of skin cancer cases prevented over a period of 5, 10 or 15 years.

Materials & Methods

The study was conducted in three phases.

The first involved a systematic literature review to identify sunscreen's effectiveness in preventing skin cancer. Sunscreen effectiveness ratio derived from the results of Nambour Skin Cancer Prevention Trial[2,3], which demonstrated significant reduction in skin cancer risk. For the calculations, the 15-year risk rate was converted to an annual risk rate and adjusted for annual probability (Table 1).The second entailed national population data collection, epidemiological data collection on skin cancer in Brazil, including projected Brazilian population by age group, skin cancer incidence and mortality rates (Table 2 exemplifies the stratification for population in 2025).

The third involved sunscreen use guidelines (Table 3), sunscreen costs were estimated based on market prices and skin cancer treatment costs based on last available national data[4,5], adjusted for inflation using IPCA index.

The Impact Calculator, based on above parameters, simulates the projected number of people with skin cancer by age range, with and without sunscreen use, calculating associated costs. In order to build a broad impact calculator, default parameters are set as reference, but some are variable to be set as per regionality (height, weight, %body exposure, number of hours of sun exposure, sunscreen usage recommendations, adherence to use, volume and time between reapplications).

The Calculator, built on Microsoft Excel®, allows the selection and projection with different population scenario, considering the estimation over 5,10 or 15 years in the future, allowing in the parameters set for projections and evaluation to be personalized.

Table 1. Impact Calculator - Sunscreen effectiveness parameters

Parameters	Value	Reference
Overall melanoma risk (HR)	0.50 (CI 95%: 0.24-1.02)	Green AC. et.al., 2010[3]
Invasive melanoma risk (HR)	0.27 (CI 95%: 0.08-0.05)	Green AC. et.al., 2010[3]
In situ melanoma risk (HR)	0.73 (CI 95%: 0.29-1.81)	Green AC. et.al., 2010[3]
Basal cell and squamous cell carcinoma risk (RR)	0.65 (CI 95%: 0.45-0.94)	Van der Pols J. C. et.al., 2006[2]

Table 2. Impact Calculator - Parameters for population and incidence estimation

Parameters	Value	Reference
Estimated population of Brazil in 2025	213,421,037	IBGE (2024)[6]
Incidence melanoma of skin	4.5 per 100,000 inhabitants	Globocan (2022)[7]
Incidence non-melanoma of skin	16.6 per 100,000 inhabitants	Globocan (2022)[7]
Mortality melanoma of skin	1.1 per 100,000 inhabitants	Globocan (2022)[7]
Mortality non-melanoma of skin	1.4 per 100,000 inhabitants	Globocan (2022)[7]

IBGE: Brazilian Institute of Geography and Statistics

Table 3. Impact Calculator - Sunscreen selection parameters and usage recommendations

Parameters	Value	Reference
Sunscreen characteristics	Body sunscreen SPF 30	Assumption (Variable data)
Average height (cm)	170	Assumption (Variable data)
Average weight (kg)	70	Assumption (Variable data)
Percentage of body exposed to the sun (%)	50	Assumption (Variable data)
Number of hours exposed to the sun (hours)	8	Assumption (Variable data)
Adhesion rate	47%	Assumption (Variable data)
Usage recommendation (mg/cm²)	2	Petersen B. and Wulf H. C., 2013[8]; SBCD
Time between reapplications (hours)	2	Petersen B. and Wulf H. C., 2013[8]; SBCD

CI: Confidence Interval; HR: Hazard Ratio; RR: Risk Relative SBCD: Brazilian Society of Dermatological Surgery.

Results

Sunscreen effectiveness ratio derived from the results of Nambour Skin Cancer Prevention Trial[2,3], which demonstrated significant reduction in skin cancer risk. For the calculations, the 15-year risk rate was converted to an annual risk rate and adjusted for annual probability (Table 1).

The results presented, for discussion purposes, assume data from Brazilian total population (Figure 1). That is, the incidence and mortality rates consider the estimated skin cancer incidence in the entire Brazilian population, without age stratification. As exposure to ultraviolet (UV) radiation is associated with the majority of non-melanoma skin cancers (NMSC), including basal cell carcinoma (BCC) and squamous cell carcinoma, we will focus our sunscreen results in this type of cancer.[9] Also, we assume an average of an individual who is 1.70m tall and weighs 70kg and has 50% of their body exposed to the sun. That is, sunscreen will be applied to the body area exposed, and the frequency of application assumed was every two hours. These factors, as well as the SPF and the chosen cost of sunscreen, will directly influence the results observed and discussion. The analysis considers for this example SPF 30 sunscreen and a conservative adhesion rate as 47%, considering that prevention adherence is variable and not complete in all population.

Considering that sunscreen use benefits are cumulative over time, the longer the period of use, the lower the skin cancer incidence rates (Figure 2). From projection, it is possible to estimate the number of prevented cases, that increases over the years. This is due to a reduction in the number of patients with skin cancer after continuous adequate sunscreen use, highlighting its long-term characteristics (Figure 3).

Developed Impact Calculator demonstrates that, in early years, there is a higher resources consumption, mainly due to sunscreen cost, covering prevention for all population. However, we can observe trend reversal of consumption pattern over time with savings starting from year 02 after intervention meaning that consistent sunscreen use brings savings over time to health system (Figure 4), with over U$500 million dollars cumulative savings in the first 5 years.

With time, estimated total skin cancer treatment cost, in population that does not use sunscreen was significantly higher compared to population with regular use, with notable reduction in costs over time due to cumulative sunscreen effectiveness in skin cancer incidence reduction. Impacts will change per parameters adjustment. For example, if stratified by age, skin cancer incidence and mortality rates tend to be higher in the population over 60, therefore, the avoided costs occur earlier and show greater savings proportion.

In a 15 years projection we can estimate that return of investment can be up to 20 times, this means that 1 dollar invested in sunscreen in Brazil can save up to 18.9 dollars for every dollar invested in sunscreen use in cancer treatment 15 years from now, with savings starting from Year 02. The mean over the next 15 years is a 7.8 ROI rate (Figure 5). Model estimates assume no prior cumulative sunscreen protection and are based on extrapolated melanoma data due to limitations in reference availability specific to this population, thus variability in population phenotypes, behavior or geographical influence might not be fully captured.

Figure 1. Population and incidence estimation

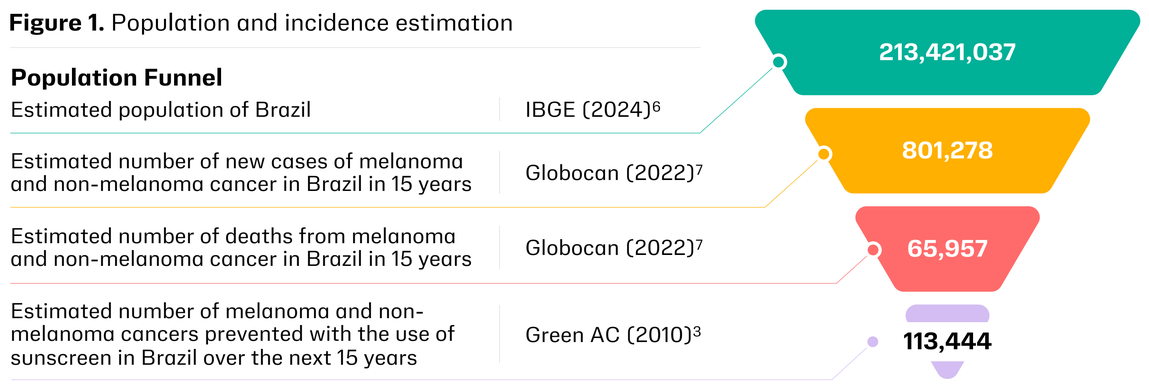
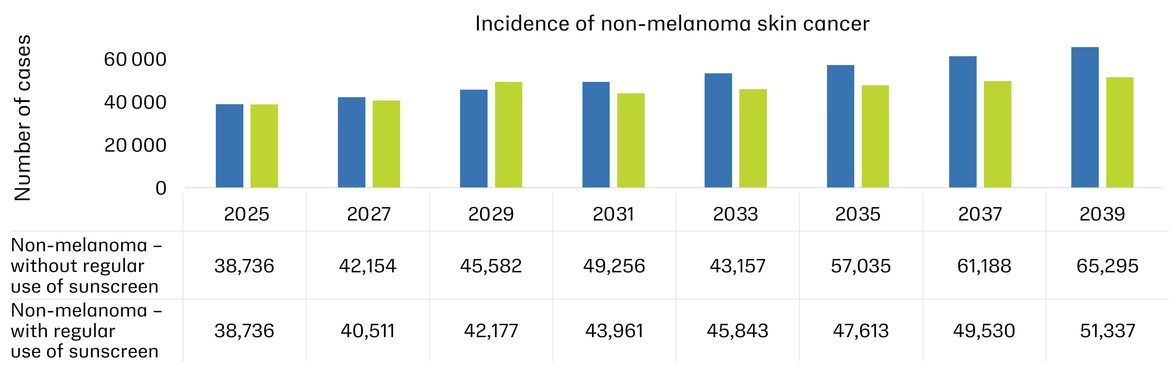


Figure 2. Incidence of non-melanoma skin cancer



	2025	2027	2029	2031	2033	2035	2037	2039
Non-melanoma – without regular use of sunscreen	38,736	42,154	45,582	49,256	43,157	57,035	61,188	65,295
Non-melanoma – with regular use of sunscreen	38,736	40,511	42,177	43,961	45,843	47,613	49,530	51,337

Figure 3a. Incidence of non-melanoma skin cancer

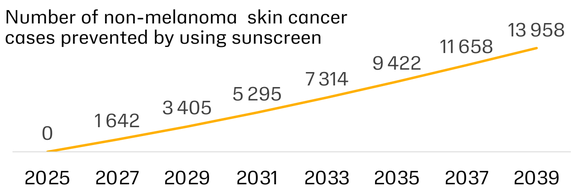


Figure 3b. Cumulative number of non-melanoma skin cancer cases prevented

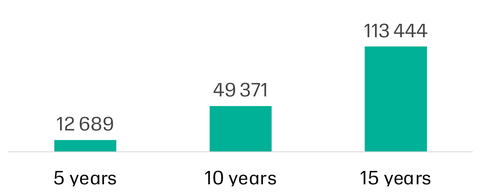


Figure 4. Costs of Non-Melanoma Skin Cancer without sunscreen and with sunscreen in 15 years *(Billion US Dollars, BN$)*

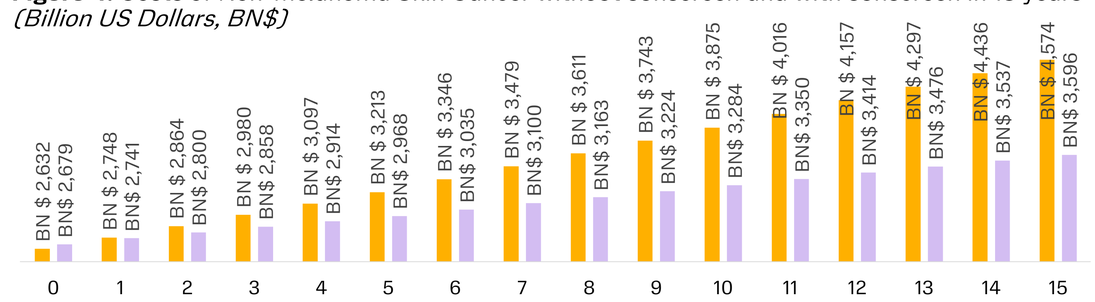
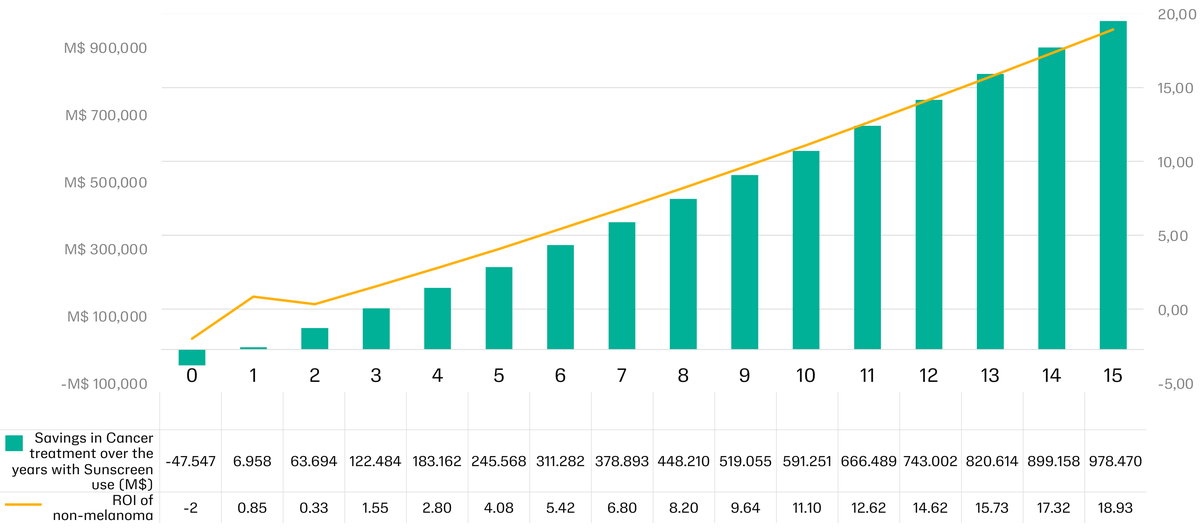


Figure 5. Savings in skin cancer (non - melanoma) treatment with sun protection use over the years *(Million US Dollars, M$)* and Return of Investment (ROI)



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Savings in Cancer treatment over the years with Sunscreen use (M$)	-47.547	6.958	63.694	122.484	183.162	245.568	311.282	378.893	448.210	519.055	591.251	666.489	743.002	820.614	899.158	978.470
ROI of non-melanoma	-2	0.85	0.33	1.55	2.80	4.08	5.42	6.80	8.20	9.64	11.10	12.62	14.62	15.73	17.32	18.93

Conclusion

Evidence has shown that daily use of sunscreen reduces the risk of developing skin cancer.[10] Its use is fully endorsed by national medical societies. However, the current lack of implemented public policies and awareness programs that encourage adequate use and access may be attributed to a lack of visible economic results. To our knowledge, this is the first economic impact study of this subject developed in Brazil. This Impact Calculator highlights cost-benefit relationship of regular sunscreen use, demonstrating a solid return of investment to health system. This model highlights that investing in such theme not only enables health promotion, due to reduction in skin cancer incidence, but also has potential to reduce treatment costs in the long term. The results presented provide relevant information for policymakers and healthcare providers, who are the main actors in implementing and supporting prevention policy strategies, guaranteeing continued access, as well as creating educational programs. Thus, improving public health scenario and alleviating financial pressure on most diverse healthcare systems. It can also be a useful tool for dermatologists in counseling regular sunscreen use.

References

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