

Paradoxical Associations Between Sun-Protective Behaviours and Mortality: Evidence From a Nationally Representative Cohort

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To the Editor,

The impact of sun-protective behaviours on health has long been a controversial topic. To prevent photodamage and reduce the risk of skin cancer, a variety of sun-protective measures are recommended by the American Academy of Dermatology (1). These measures include seeking shade, minimizing sun exposure during peak daylight hours, wearing protective clothing such as long sleeves, applying sunscreen, and wearing sunglasses (1). On the other hand, sunlight exposure is essential for human health. First, sunlight facilitates the synthesis of vitamin D, reducing the risk of osteoporosis, osteopenia, and fractures in adults (2). Insufficient sunlight exposure has been linked to depression and cognitive decline (3). An increasing number of epidemiological studies suggest that sunlight exposure is associated with a reduced risk of several chronic diseases, such as cancer, diabetes, and cardiovascular disease (4, 5). Given that, we conducted a cohort analysis using data from the National Health and Nutrition Examination Survey (NHANES) to directly investigate the impact of sun-protective behaviours on all-cause mortality.

Data from 3 survey cycles (2003–2006, 2009–2012, and 2015–2018) were extracted and analysed, encompassing health information from 59,988 individuals. After excluding participants with missing key variables or non-response to dermatology questionnaires, the final analytical sample consisted of 12,065 individuals aged 20–59 years. Baseline characteristics of the participants are summarized in Table SI (including detailed definitions of the variables).

The Cox regression model (with specific adjusted confounders listed in Table SII) revealed significant heterogeneity in the association between sun protection behaviours and all-cause mortality. This paradoxical association persisted in the fully adjusted model (shade: HR=0.66, 95% CI: 0.50–0.86, $p=0.002$; sunscreen use: HR=1.42, 95% CI: 1.02–1.99, $p=0.038$). In the subsequent subgroup analysis, we observed that participants with rare shading behaviour consistently exhibited a lower risk of mortality across various age groups, particularly in the younger cohort (HR=0.38, 95% CI: 0.19–0.75, $p=0.005$), compared with the 40–60 age

group (HR=0.73, 95% CI: 0.55–0.98, $p=0.038$). Regarding racial differences, non-Hispanic Black participants with rare shading behaviour had a significantly reduced mortality risk (HR=0.46, 95% CI: 0.26–0.81, $p=0.007$). In contrast, non-Hispanic White participants using sunscreen moderately (HR=1.64, 95% CI: 1.02–2.63, $p=0.039$) or rarely (HR=1.62, 95% CI: 1.06–2.48, $p=0.026$) showed higher mortality risk. The results for the other subgroups are presented in Table SII.

To our knowledge, this is the world's first large prospective cohort study using NHANES data to examine the relationship between sun protection behaviours and all-cause mortality. In summary, our study demonstrates that rarely seeking shade is associated with a reduced risk of mortality, whereas rare use of sunscreen is linked to an increased risk. Non-Hispanic Black individuals might benefit from more sun, whereas White individuals especially need sunscreen. Future research should further explore to refine public health guidelines.

Our study has several limitations. Self-reported sun protection behaviours may suffer from recall or social desirability bias, and unmeasured factors (e.g., genetics, lifestyle, vitamin D supplementation, or UV exposure) could confound the results. Using broad categories for these behaviours might mask dose-response effects. Additionally, a single serum 25-hydroxyvitamin D measurement may not reflect long-term status and we did not assess regional/seasonal UV differences or account for sunscreen formulations and SPF ratings.

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The authors have no conflicts of interest to declare.

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