

# Abstract

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## Relationship between low ultraviolet B irradiance and higher breast cancer risk in 107 countries.

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**BACKGROUND:** Epidemiological data show an inverse relationship between vitamin D levels and breast cancer incidence. This study investigates the relationship of modeled and measured serum 25-hydroxyvitamin D [25(OH)D] levels with age-standardized incidence rates of breast cancer in 107 countries.

**OBJECTIVE AND METHODS:** The hypothesis being tested is that breast cancer incidence is inversely related to geographically-dependent cutaneous sunlight exposure. A multiple regression approach was used to examine the contributions of ultraviolet B (UVB) irradiance to age-standardized incidence rates of breast cancer in the 107 countries with data on these covariates—total column ozone thickness, per capita intake of alcohol and energy from animal and vegetable sources, cigarettes, proportion of female population overweight, and total fertility.

**RESULTS:** Age-standardized incidence rates were substantially higher at latitudes distant from the equator ( $R^2 = 0.43$ ,  $p < 0.0001$ ). The dose-response gradient between modeled serum 25(OH)D levels and incidence rates of breast cancer followed a standard inverse dose-response curve. Increasing increments in serum 25(OH)D in the range above 22 ng/mL were associated with incrementally lower incidence rates of breast cancer. According to multiple regression, UVB irradiance adjusted for cloud cover was inversely associated with incidence rates ( $p = 0.04$ ) after controlling for covariates. Intake of energy from animal sources was also positively associated with incidence rates ( $p < 0.01$ ). The overall coefficient of determination,  $R^2$ , was 0.81 ( $p < 0.0001$ ).

**CONCLUSION:** There was a protective effect of UVB irradiance on risk of breast cancer that was independent of fertility rate, proportion of the population overweight, alcohol intake, animal energy intake, and other covariates.