

# Light at Night and Breast Cancer Risk in California Teachers

## Investigators

Reynolds Peggy,  
(peggy.reynolds@ucsf.edu)  
University of California, San  
Francisco

## Research Program

California Breast Cancer Research Program

## Research Priority

Etiology and Prevention

## Award Type

Innovative, Developmental, and Exploratory Award (IDEA)

## Application ID

16IB-0071

## Award Amount

\$197,333

## Start Date

7/1/2010

## Abstract

While it has long been noted that women living in industrialized areas are more likely to get breast cancer than their rural-dwelling counterparts, reasons for the urban excess of breast cancer remain enigmatic. One provocative hypothesis that has emerged is that increased exposure to night time lighting associated with industrialization results in circadian disruption that through a variety of potential mechanisms could increase the risk of breast cancer. While there is convincing laboratory evidence that circadian disruption mediated by light-at-night exposures promotes mammary carcinogenesis in rodents, the degree to which light-at-night plays a role in the development of breast cancer in humans is not known. Direct assessment of light-at-night exposures and breast cancer risk among human populations has been hampered by limitations in ways to assess exposure. This proposal capitalizes on newly-available satellite data on night-time illumination, on a well-developed urinary biomarker of melatonin (the primary hormonal modulator of circadian rhythms in mammals), and on existing survey data on indoor indicators of light-at-night exposures, to evaluate and develop methods to explore the relationship between these exposures and breast cancer risk among members of the California Teachers Study (CTS), a large, geographically diverse cohort of women for whom extensive

information on known breast cancer risk factors is available. This project will analyze approximately 125,000 CTS cohort members who live in California. Ambient light-at-night values will be based on satellite imagery data obtained from the U.S. Defense Meteorological Satellite Program's Operational Linescan System and assigned to CTS participants based on where they live. Through extensive exploratory data analyses we will identify the best strategy for using the satellite data to assign a value of night-time luminance to each individual in the cohort for the period of the study. Indicators of indoor light-at-night will be derived from prior CTS survey questions on sleep habits and use of night-time lighting in the home. Next, statistical models will be used to estimate the risk of breast cancer, taking into account other known breast cancer risk factors. These analyses will be based on the 4,800 cases of invasive breast cancer we anticipate will be diagnosed among CTS participants from 1995 - 2008. Finally, laboratory assays for urinary concentrations of 6-sulfatoxymelatonin, the primary metabolite of melatonin, will be conducted on approximately 300 stored CTS urine specimens and multivariable statistical models will be used to identify important predictors of those levels in participating women. This study would provide critical preliminary information regarding the role of night time lighting in the etiology of breast cancer. Given that light-at-night exposures are prevalent and potentially modifiable through relatively simple policy and behavioral interventions, it offers tremendous potential to identify new avenues for breast cancer prevention.

## **Progress Report Abstract**

The purpose of this project was to conduct methodological and exploratory analyses to evaluate the degree to which satellite imagery data and survey data can be used to assign indicators of indoor and outdoor levels of light-at-night (LAN) and to explore the breast cancer risk associated with these exposures among participants of the California Teachers Study (CTS). Because the effects of LAN are thought to be mediated by melatonin, a hormone that inhibits the growth of cancer cells, and whose production is strongly influenced by light (with levels peaking in the darkness of night), we also conducted analyses in a small subset of the CTS to evaluate how indoor and outdoor LAN exposures and other sociodemographic and host factors may affect levels of sulfatoxymelatonin (6-SMT), the primary by-product of melatonin found in urine. To estimate outdoor levels of LAN, we initially downloaded annual satellite imagery data from the U.S. Defense Meteorological Satellite Program's Operational Linescan System and linked the luminance values to the residential location of CTS members' homes. Initial assessments of these data, however, showed that nearly all women living in suburban or urban neighborhoods had the same value of LAN, precluding our ability to distinguish effects related to LAN from the well-established elevated rates of breast cancer in urban areas. Consequently, we obtained an alternate source of satellite imagery data that provided greater variability in LAN values across urban landscapes and used these for our analyses aimed at evaluating breast cancer risk and predicting urinary 6-SMT. Assays for 6-SMT were conducted on urine specimens collected from 303 CTS members. Indicators of indoor LAN were derived from CTS survey questions on sleep habits and use of nighttime lighting in the home. Overall, very few of the factors we evaluated predicted 6-SMT levels. Lower 6-SMT levels were significantly associated with older age, shorter nights, and residential locations in lower socioeconomic status (SES) neighborhoods. Use of a bright light while sleeping was reported only infrequently and for short periods of time and showed no relationship to 6-SMT or breast cancer risk. While there was a very modest decrease

in melatonin associated with increases in outdoor LAN, this relationship was not statistically significant ( $p=0.7$ ). Our breast cancer risk analysis, which was based on approximately 4,800 breast cancer cases diagnosed among approximately 107,000 CTS participants, suggested that women living in the areas with very high levels of outdoor LAN had about a 10% increased risk of breast cancer compared to women who lived in areas with the lowest levels of indoor LAN. Worthwhile future analyses would include the incorporation of information on genetic susceptibility and an exploration of other factors common to lower socioeconomic neighborhoods that could potentially cause circadian disruption, both independently, and in conjunction with LAN exposures. Publications: Sleep duration and cancer risk in women

## Publications

Title	Authors	Year
Light at night and breast cancer risk among California teachers.	Hurley S, Goldberg D, Nelson D, Hertz A, Horn-Ross PL, Bernstein L, Reynolds P.	2014
Sleep duration and cancer risk in women	Hurley, S., Goldberg, D., Bernstein, L. et al.	2015
A cross-sectional analysis of light at night, neighborhood sociodemographics and urinary 6-sulfatoxymelatonin concentrations: implications for the conduct of health studies	Hurley, S., Nelson, D.O., Garcia, E. et al.	2013