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Artificial light at night as a source of environmental pollution - Melatonin suppression and breast cancer

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Background: The most dramatic environmental change that took place on our planet during the twenty century and is still going these days is the disappearance of dark nights by artificial light at night (ALAN). Throughout evolution humans as other organisms developed under light/dark cycles of 24h an important signal for the entrainment of our biological clock and expresses the rotation of our planet on its axis. In the first decades of electrical illumination incandescent bulbs were used and as those are considered inefficient in regards to energy saving, in the last five decades an increase in energetically efficient bulbs which emit short wavelength (SWL) illumination is noted. Under natural conditions SWL-lighting appears at day time and is efficient in suppressing pineal melatonin production. The objectives of our study were: 1) to test the following nexus – ALAN, melatonin suppression, epigenetic modifications and breast cancer (BC) cells proliferation in an animal model. 2) To assess melatonin suppression in response to different illumination types in regards to wavelength.

Materials and Methods: Female BALB/c mice acclimated to short day (8L:16D) were inoculated with 4T1 mice BC-cells subcutaneously so tumor size could be calculated with time. Mice were interfered at the middle of the dark period with white LED or Carbon lighting at the same intensity and for the same duration. At the end of the experiments about four weeks, urine was collected for measuring the amount of the melatonin metabolite 6-sulfatoxymelatonin (6-SMT). The tumor was removed and DNA was extracted for measuring global DNA methylation (GDM) levels.

Results: The nexus was revealed and we can further show that SWL-illumination and in particularly LED suppresses melatonin production. This suppression results in hypo-methylation which presumably increases BC-cell proliferation.

Conclusions: The aggressive penetration of the LED-technology into our indoor and outdoor illumination by the name of energy saving should be reconsidered and very carefully calculated. No doubt as SWL-illumination suppresses melatonin production such illumination sources cannot be used for ALAN. As incubation period of BC in humans is between 10-15 years and our results show the involvement of epigenetic modifications which are reversible, efforts should be made to discover what is the threshold from which the direction is not reversible? We assume that this can be a breakthrough in BC-prevention.

Biography:

Abraham Haim is a full (Emeritus) professor from the University of Haifa. After many years of studying the response mainly of rodents to changes in photoperiod as an initial signal for seasonal acclimatization, he became interested in the reproductive and metabolic responses to light interference what is known today as light pollution. So this became his main topic of research where among others we developed an animal model to test the relations between breast cancer development and exposure to different illuminations. He is the Head of Israeli Center for Interdisciplinary Research in Chronobiology and the Vice president of the Israeli Lighting Society, vice chair of LONNE one of EU, COST programs. Together with colleagues and students he has published over 180 scientific papers in pre-reviewed journals. Together with Prof. Portnov, he has published a book entitled: Light Pollution as a New Risk factor for Human Breast and Prostate Cancer, published by Springer, 2013.