

Editorial

Women with hereditary breast cancer predispositions should avoid using their smartphones, tablets, and laptops at night

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ABSTRACT

Breast cancer is the most common malignancy among women, both in the developed and developing countries. Women with mutations in the BRCA1 and BRCA2 genes have an increased risk of breast and ovarian cancers. Recent studies show that short-wavelength visible light disturb the secretion of melatonin and causes circadian rhythm disruption. We have previously studied the health effects of exposure to different levels of radiofrequency electromagnetic fields (RF-EMFs) such as mobile phones, mobile base stations, mobile phone jammers, laptop computers, and radars. Moreover, over the past several years, we investigated the health effects of exposure to the short wavelength visible light in the blue region emitted from digital screens. The reduction of melatonin secretion after exposure to blue light emitted from smartphone's screen has been reported to be associated with the negative impact of smartphone use at night on sleep. We have shown that both the blue light and RF-EMFs generated by mobile phones are linked to the disruption of the circadian rhythm in people who use their phones at night. Therefore, if women with hereditary breast cancer predispositions use their smartphones, tablets and laptops at night, disrupted circadian rhythms (suppression of melatonin caused by exposure to blue light emitted from the digital screens), amplifies the risk of breast cancer. It can be concluded that women who carry mutated BRCA1 or BRCA2, or women with family history of breast cancer should avoid using their smartphones, tablets and laptops at night. Using sunglasses with amber lenses, or smartphone applications which decrease the users' exposure to blue light before sleep, at least to some extent, can decrease the risk of circadian rhythm disruption and breast cancer.

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Breast cancer as a main concern

Both in the developed and developing countries, breast cancer is the most common malignancy among women (1, 2). It's well documented that women with mutations in the BRCA1 and BRCA2 genes have an increased risk of breast and ovarian cancers. A study published in JAMA in 2017 shows that the cumulative risk of breast cancer to age 80 y was 72% (95% CI, 65%-79%) for BRCA1 and 69% (95% CI, 61%-77%) for BRCA2 carriers (3). Almost all living organisms have developed endogenous circadian rhythmicity as daily oscillations in their physiology, over the past 3 billion years (4). Datta *et al.* in 2014 reported that in both developed and developing countries, there is a rising trend of breast cancer that challenges the screening programs as a real threat (5).

Melatonin and other cancers

It is well documented that melatonin can effectively

been used for the prevention and treatment of several cancers (6). Although the underlying mechanism of the effect of melatonin on RKO cells migration inhibition is not fully known, substantial evidence indicates that melatonin can modulate the formation of microtubule and microfilament structure (7), and suppress the invasive and metastatic potential of gastric (8), ovarian (9), breast (10, 11), colon (12), liver (13) and lung (14) cancer cells through different signaling pathways. A recent study shows that melatonin prolongs its anti-metastatic effect by expression of kisspeptin (KISS1), which suppresses the metastasis (10).

Exposure to artificial light at night

Substantial evidence shows that exposure to artificial sources of light at night (in work, home and community settings) leads to disrupted circadian rhythms and increases the risk of breast cancer (15). Studies show that artificial light at night, even in

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rural areas, might be a risk factor for breast cancer (16). Interestingly, the adverse health effects of exposure to light at night are not limited to breast cancer risk and incidence. It has been revealed that metabolic, psychiatric and behavioral disorders can also be linked to exposure to light at night (17-22). A recent study even claims that chronic exposure of parents to light at night can lead to increased risk of depressive-like behavior in their offspring (23).

Due to the key role of circadian rhythms, the International Agency for Research on Cancer (IARC) that is an intergovernmental agency forming part of the World Health Organization (WHO) has classified shift work in group 2A of carcinogens (probable carcinogens to humans) (24). It is worth noting that factors such as night or rotating shifts have been reported to be associated with decreased sleep time and disrupted circadian rhythms (24, 25). A meta-analysis of 16 prospective cohort studies also showed that night shift work can be associated with increased morbidity and mortality of breast cancer (26). The adverse health effects of light pollution is not limited to females and some reports indicate that high incidence of prostate cancer can be linked to light pollution and urbanization (27).

The issue of blue light emission

Another issue that needs more attention is the effect of shorter wavelengths of light. Some studies show that short-wavelength visible light preferentially disturb the secretion of melatonin and causes circadian phase shifts (28). Over the past several years, my colleagues and I, have expanded our focus on studying the adverse health effects of exposure to different levels of radiofrequency electromagnetic fields (RF-EMFs) such as cellular phones (29-40), mobile base stations(41, 42), Wi-Fi routers (31, 34, 43-47). We have also studied the health effects of the exposure to the short wavelength visible light in the blue region emitted from digital screens (e.g. smartphone's displays) (48) which along with Internet and mobile phone activities associated with social networking (49) could disturb the normal pattern of sleep in humans. The reduction of melatonin secretion due to exposure to blue light from smartphone's screen is reported to be linked to the negative impact of smartphone use at night on sleep (50). Mortazavi *et al.* have shown both the blue light emitted from the screens of smartphones and RF-EMFs generated by these devices can be associated with the disruption of the circadian rhythm in people who use their smartphones at night (51). In this light, as shown in Figure 1, if women with hereditary breast cancer predispositions use their smartphones, tablets and laptops at night, disrupted circadian rhythms due to suppression of melatonin caused by exposure to blue light emitted from the digital screens, amplifies the risk of breast cancer. Therefore, women who

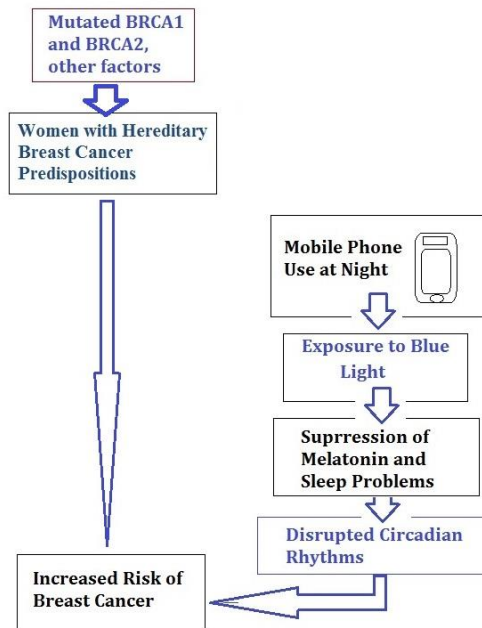


Figure 1. Mobile phone use at night can further increase the breast cancer risk in women with hereditary breast cancer predispositions. When these women use their smartphones, tablets and laptops at night, disrupted circadian rhythms due to suppression of melatonin caused by exposure to blue light emitted from the digital screens, amplifies the risk of breast cancer

carry mutated BRCA1 or BRCA2, or women with family history of breast cancer should avoid using their smartphones, tablets and laptops at night. Using sunglasses with amber lenses, or smartphone applications which decrease the users' exposure to blue light before sleep, at least to some extent, may decrease the risk of circadian rhythm disruption.

Conflict of interest

The authors declare that no conflict of interest exists.

References

- Jara L, Morales S, de Mayo T, Gonzalez-Hormazabal P, Carrasco V, Godoy R. Mutations in BRCA1, BRCA2 and other breast and ovarian cancer susceptibility genes in central and south American populations. *Biol Res* 2017;50:35.
- Ghoncheh M, Pournamdar Z, Salehiniya H. Incidence and mortality and epidemiology of breast cancer in the world. *Asian Pac J Cancer Prev* 2016;17(S3):43-46.
- Kuchenbaecker KB, Hopper JL, Barnes DR, Phillips KA, Mooij TM, Roos-Blom MJ, *et al.* Risks of breast, ovarian, and contralateral breast cancer for BRCA1 and BRCA2 mutation carriers. *JAMA* 2017;317:2402-2416.
- Stevens RG, Zhu Y. Electric light, particularly at night, disrupts human circadian rhythmicity: is that a problem? *Philos Trans R Soc Lond B Biol Sci* 2015;370.
- Datta K, Roy A, Nanda D, Das I, Guha S, Ghosh D, *et al.* Association of breast cancer with sleep pattern-a pilot case control study in a regional cancer centre in South Asia. *Asian Pac J Cancer Prev* 2014;15:8641-8645.

6. Li Y, Li S, Zhou Y, Meng X, Zhang J-J, Xu D-P, *et al.* Melatonin for the prevention and treatment of cancer. *Oncotarget*. 2017; 8:39896-39921.
7. Liu Z, Zou D, Yang X, Xue X, Zuo L, Zhou Q, *et al.* Melatonin inhibits colon cancer RKO cell migration by downregulating Rho-associated protein kinase expression via the p38/MAPK signaling pathway. *Mol Med Rep* 2017;16:9383-9392.
8. Asghari MH, Moloudizargari M, Ghobadi E, Fallah M, Abdollahi M. Melatonin as a multifunctional anti-cancer molecule: Implications in gastric cancer. *Life Sci* 2017; 185:38-45.
9. Chuffa LGA, Reiter RJ, Lupi LA. Melatonin as a promising agent to treat ovarian cancer: molecular mechanisms. *Carcinogenesis* 2017; 38:945-952.
10. Kim T-H, Cho S-G. Melatonin-induced KiSS1 expression inhibits triple-negative breast cancer cell invasiveness. *Oncol Lett* 2017; 14:2511-2516.
11. Mao L, Yuan L, Slakey LM, Jones FE, Burow ME, Hill SM. Inhibition of breast cancer cell invasion by melatonin is mediated through regulation of the p38 mitogen-activated protein kinase signaling pathway. *Breast Cancer Res* 2010;12:R107.
12. Zou DB, Wei X, Hu RL, Yang XP, Zuo L, Zhang SM, *et al.* Melatonin inhibits the migration of colon cancer RKO cells by down-regulating myosin light chain kinase expression through cross-talk with p38 MAPK. *Asian Pac J Cancer Prev* 2015; 16:5835-5842.
13. Ordonez R, Carbajo-Pescador S, Prieto-Dominguez N, Garcia-Palomo A, Gonzalez-Gallego J, Mauriz JL. Inhibition of matrix metalloproteinase-9 and nuclear factor kappa B contribute to melatonin prevention of motility and invasiveness in HepG2 liver cancer cells. *J Pineal Res.* 2014; 56:20-30.
14. Zhou Q, Gui S, Zhou Q, Wang Y. Melatonin inhibits the migration of human lung adenocarcinoma A549 cell lines involving JNK/MAPK pathway. *PLoS One.* 2014; 9:e101132.
15. Smolensky MH, Sackett-Lundeen LL, Portaluppi F. Nocturnal light pollution and underexposure to daytime sunlight: Complementary mechanisms of circadian disruption and related diseases. *Chronobiol Int* 2015; 32:1029-1048.
16. Kim YJ, Lee E, Lee HS, Kim M, Park MS. High prevalence of breast cancer in light polluted areas in urban and rural regions of South Korea: An ecologic study on the treatment prevalence of female cancers based on National Health Insurance data. *Chronobiol Int.* 2015;32:657-667.
17. Bedrosian TA, Nelson RJ. Timing of light exposure affects mood and brain circuits. *Transl Psychiatry* 2017; 7:e1017.
18. Bedrosian TA, Nelson RJ. Influence of the modern light environment on mood. *Mol Psychiatry* 2013;18:751-757.
19. Blask DE, Brainard GC, Dauchy RT, Hanifin JP, Davidson LK, Krause JA, *et al.* Melatonin-depleted blood from premenopausal women exposed to light at night stimulates growth of human breast cancer xenografts in nude rats. *Cancer Res* 2005;65:11174-11184.
20. Fonken LK, Workman JL, Walton JC, Weil ZM, Morris JS, Haim A, *et al.* Light at night increases body mass by shifting the time of food intake. *Proceedings of the National Academy of Sciences of the United States of America.* 2010; 107:18664-18669.
21. Davies TW, Smyth T. Why artificial light at night should be a focus for global change research in the 21st century. *Chronobiology international. Glob Chang Biol* 2017 [Epub ahead of print]
22. Wyse CA, Selman C, Page MM, Coogan AN, Hazlerigg DG. Circadian desynchrony and metabolic dysfunction; did light pollution make us fat? *Med Hypotheses.* 2011; 77:1139-1144.
23. Cisse YM, Russart KLG, Nelson RJ. Depressive-like behavior is elevated among offspring of parents exposed to dim light at night prior to mating. *Psychoneuroendocrinology* 2017; 83:182-186.
24. Touitou Y, Reinberg A, Touitou D. Association between light at night, melatonin secretion, sleep deprivation, and the internal clock: Health impacts and mechanisms of circadian disruption. *Life Sci* 2017;173:94-106.
25. Ball LJ, Palesh O, Kriegsfeld LJ. The pathophysiologic role of disrupted circadian and neuroendocrine rhythms in breast carcinogenesis. *Endocr Rev* 2016; 37:450-466.
26. Lin X, Chen W, Wei F, Ying M, Wei W, Xie X. Night-shift work increases morbidity of breast cancer and all-cause mortality: a meta-analysis of 16 prospective cohort studies. *Sleep Med* 2015; 16:1381-1387.
27. Kim KY, Lee E, Kim YJ, Kim J. The association between artificial light at night and prostate cancer in Gwangju City and South Jeolla Province of South Korea. *Chronobiol Int* 2017; 34:203-211.
28. Cho Y, Ryu SH, Lee BR, Kim KH, Lee E, Choi J. Effects of artificial light at night on human health: A literature review of observational and experimental studies applied to exposure assessment. *Chronobiol Int.* 2015; 32:1294-1310.
29. Mortazavi SM, Rahimi S, Talebi A, Soleimani A, Rafati A. Survey of the effects of exposure to 900 MHz radiofrequency radiation emitted by a GSM mobile phone on the pattern of muscle contractions in an animal model. *J Biomed Phys Eng* 2015; 5:121-132.
30. Mortazavi SAR, Mortazavi G, Mortazavi SMJ. Comments on "Radiofrequency electromagnetic fields and some cancers of unknown etiology: An ecological study". *Sci Total Environ* 2017; 609:1.
31. Zarei S, Mortazavi SM, Mehdizadeh AR, Jalalipour M, Borzou S, Taeb S, *et al.* A challenging issue in the etiology of speech problems: The effect of maternal exposure to electromagnetic fields on speech problems in the offspring. *J Biomed Phys Eng* 2015; 5:151-154.
32. Mokarram P, Sheikhi M, Mortazavi SMJ, Saeb S, Shokrpour N. Effect of exposure to 900 MHz GSM mobile phone radiofrequency radiation on estrogen receptor methylation status in colon cells of male sprague dawley rats. *J Biomed Phys Eng* 2017; 7:79-86.
33. Eghlidospour M, Ghanbari A, Mortazavi SMJ, Azari H. Effects of radiofrequency exposure emitted from a GSM mobile phone on proliferation, differentiation, and apoptosis of neural stem cells. *Anat Cell Biol* 2017; 50:115-123.
34. Taheri M, Mortazavi SM, Moradi M, Mansouri S, Hatam GR, Nouri F. Evaluation of the effect of radiofrequency radiation emitted from Wi-Fi router and mobile phone simulator on the antibacterial susceptibility of pathogenic bacteria *listeria monocytogenes* and *Escherichia coli*. *Dose Response* 2017; 15:1559325816688527.
35. Mortazavi SAR, Mortazavi SMJ, Paknahad M. The role of electromagnetic fields in neurological disorders. *J Chem Neuroanat* 2016;77:78-79.
36. Mortazavi SM, Rouintan MS, Taeb S, Dehghan N, Ghaffarpanah AA, Sadeghi Z, *et al.* Human short-term exposure to electromagnetic fields emitted by mobile phones decreases computer-assisted visual reaction time. *Acta Neurol Belg* 2012; 112:171-175.

37. Mortazavi SM. Subjective Symptoms Related to GSM Radiation from Mobile Phone Base Stations: a cross-sectional study. *J Biomed Phys Eng* 2014; 4:39-40.
38. Mortazavi SM, Motamedifar M, Namdari G, Taheri M, Mortazavi AR, Shokrpour N. Non-linear adaptive phenomena which decrease the risk of infection after pre-exposure to radiofrequency radiation. *Dose Response* 2013; 12:233-245.
39. Mortazavi SM, Mahbudi A, Atefi M, Bagheri S, Bahaedini N, Besharati A. An old issue and a new look: electromagnetic hypersensitivity caused by radiations emitted by GSM mobile phones. *Technol Health Care* 2011; 19:435-443.
40. Mortazavi SM, Ahmadi J, Shariati M. Prevalence of subjective poor health symptoms associated with exposure to electromagnetic fields among university students. *Bioelectromagnetics* 2007; 28:326-330.
41. Mortazavi S. Safety issues of mobile phone base stations. *J Biomed Phys Eng* 2013; 3:1-2.
42. Parsaei H, Faraz M, Mortazavi S. A multilayer perceptron neural network-based model for predicting subjective health symptoms in people living in the vicinity of mobile phone base stations. *Ecopsychology*. 2017; 9:99-105.
43. Mortazavi G, Mortazavi SM. Increased mercury release from dental amalgam restorations after exposure to electromagnetic fields as a potential hazard for hypersensitive people and pregnant women. *Rev Environ Health* 2015; 30:287-292.
44. Mortazavi SA, Taeb S, Mortazavi SM, Zarei S, Haghani M, Habibzadeh P, *et al.* The fundamental reasons why laptop computers should not be used on your lap. *J Biomed Phys Eng* 2016; 6:279-284.
45. Paknahad M, Mortazavi SM, Shahidi S, Mortazavi G, Haghani M. Effect of radiofrequency radiation from Wi-Fi devices on mercury release from amalgam restorations. *J Environ Health Sci Eng* 2016;14:12.
46. Shekoohi-Shooli F, Mortazavi SM, Shojaei-Fard MB, Nematollahi S, Tayebi M. Evaluation of the protective role of vitamin c on the metabolic and enzymatic activities of the liver in the male rats after exposure to 2.45 GHz of Wi-Fi routers. *J Biomed Phys Eng*. 2016; 6:157-164.
47. Taheri M, Mortazavi SM, Moradi M, Mansouri S, Nouri F, Mortazavi SA, *et al.* *Klebsiella pneumonia*, a microorganism that approves the non-linear responses to antibiotics and window theory after exposure to Wi-Fi 2.4 GHz electromagnetic radiofrequency radiation. *J Biomed Phys Eng* 2015; 5:115-120.
48. Oh JH, Yoo H, Park HK, Do YR. Analysis of circadian properties and healthy levels of blue light from smartphones at night. *Sci Rep*. 2015;5:11325.
49. Bruni O, Sette S, Fontanesi L, Baiocco R, Laghi F, Baumgartner E. Technology use and sleep quality in preadolescence and adolescence. *J Clin Sleep Med*. 2015; 11:1433-1441.
50. Yoshimura M, Kitazawa M, Maeda Y, Mimura M, Tsubota K, Kishimoto T. Smartphone viewing distance and sleep: an experimental study utilizing motion capture technology. *Nat Sci Sleep* 2017; 9:59-65.
51. Mortazavi S, Mortazavi S, Habibzadeh P, Mortazavi G. Is it blue light or increased electromagnetic fields which affects the circadian rhythm in people who use smartphones at night. *Iran J Public Health* 2016; 45:405-406.