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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 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.

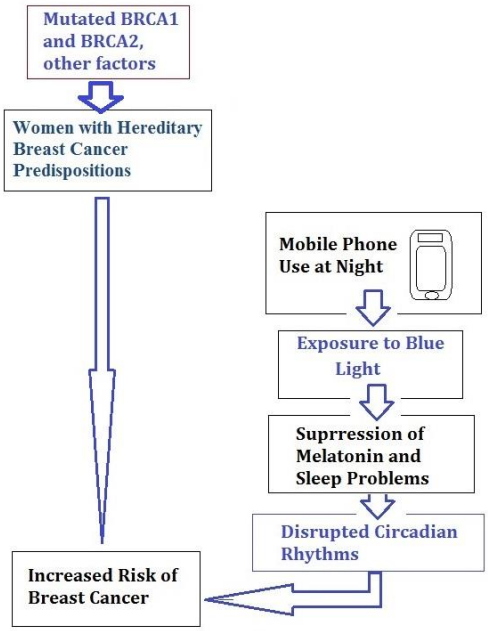

Figure 1. Mobile phone use at night can further increase the breast cancer risk in women with hereditary breast cancer predispositions. When these women use their smartphones, tablets and laptops at night, disrupted circadian rhythms due to suppression of melatonin caused by exposure to blue light emitted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

Conflict of interest

The authors declare that no conflict of interest exists.

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