Revisiting the 1999 Stanford-Linked Review of EMF and Breast Cancer in the Digital Era

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In 1999, Kheifets and Matkin reviewed more than 35 residential and occupational epidemiological studies concerning electromagnetic fields (EMF) and breast cancer [1]. Their remarkable pioneering review considered an existing hypothesis linking light at night and/or EMF exposure to melatonin suppression and breast carcinogenesis. It found no strong epidemiological support for an association, while recognising that limited statistical power, exposure misclassification and bias restricted firm conclusions. Reconsidering that review alongside selected studies from our group helps identify the questions that contemporary device-use research can address and the limitations that remain. This editorial is a focused perspective, rather than a comprehensive review of current evidence.

The review was co-authored by C. Chantal Matkin of Stanford University's Department of Epidemiology and Leeka I. Kheifets of the Electric Power Research Institute [1]. It examined the hypothesis advanced by Stevens in 1987 and highlighted unresolved questions about whether EMF exposure suppresses melatonin. Its call for better studies provides a historical context for contemporary research on digital devices. However, findings on residential and occupational fields, particularly power-frequency exposures, cannot be directly extrapolated to radiofrequency electromagnetic fields (RF-EMF) from mobile phones. These exposures require distinct assessment.

Digital screen use and light at night

Our 2022 machine-learning study included 603 women: 309 with breast cancer and 294 controls [2]. Using questionnaire-derived variables, three models classified existing case–control status with high performance under ten-fold cross-validation. The published analyses reported mean sensitivities of 97.2–99.6%, specificities of 96.4–98.4%, and accuracies of 97.1–99.0%. These are internal classification results, not estimates of prospective breast-cancer risk. They do not establish that screen exposure contributes independently to disease. External validation and careful assessment of predictor timing, information leakage and overfitting would be necessary before considering clinical use.

The 2024 retrospective case–control study [3] drew on a participant population substantially overlapping with that of the 2022 publication [2], but employed a different analytical approach. The earlier study evaluated classification performance using machine-learning models, whereas the later study investigated exposure–disease associations. These publications therefore represent related analyses of largely shared data rather than independent replications. The results were mixed. The reported comparisons of weekly screen use and daily screen use in dim light were not statistically significant. A statistically significant difference in cumulative exposure among heavy users was reported. Consequently, the cumulative-exposure result should not be presented as settled evidence without clarification of the relevant population, exposure definition and statistical analysis. The study does not establish a causal relationship between

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screen-emitted blue light and breast cancer.

Screen time is a behavioural measure, not a direct measure of biologically effective light exposure. Future studies should record the timing of use relative to sleep, screen brightness and spectrum, viewing conditions and other sources of light. They should assess circadian outcomes directly if melatonin or circadian disruption is proposed as a mediator. A measured effect on sleep or melatonin would still need to be linked prospectively to cancer outcomes; biological plausibility alone cannot establish that link.

Mobile phone use and radiofrequency exposure

The 2025 multicentre case–control study recruited 226 women in Iran and included controls, women referred for investigation and women with confirmed breast cancer [4]. The published multivariable analysis reported an adjusted odds ratio of 3.494 (95% confidence interval 1.020–11.97; P=0.046) for confirmed breast cancer among women reporting more than 60 minutes of daily mobile-phone calls, compared with those reporting 1–10 minutes per day. This is an imprecise association with self-reported call duration. In contrast to the broader interpretation presented in the original study's abstract, the reported adjusted comparisons across screen-time categories did not demonstrate statistically significant associations with confirmed breast cancer.

Call duration cannot isolate an RF-specific effect or quantify breast-tissue dose. Exposure assessment should incorporate handset position, hands-free use and transmission characteristics, alongside light exposure and correlated behaviours. Recall and selection bias, uncertain temporal ordering, residual confounding and model instability remain alternative explanations for associations. Adjustment alone does not eliminate these concerns. Internal inconsistencies in published group counts also require resolution before the quantitative findings can be treated as dependable evidence [4].

Priorities for the next studies

The enduring contribution of the Stanford-linked 1999 review is its emphasis on rigorous exposure assessment and adequate study design [1]. Research on digital devices should build on those principles without implying that the recent studies validate the original hypothesis. Light exposure, RF exposure and device-use behaviour should be measured separately, with prespecified analyses and clinically relevant exposure windows before diagnosis.

Prospective studies should combine objective device-use records with appropriate light and RF measurements, sufficient follow-up and careful assessment of established breast-cancer risk factors. Replication in independent populations is essential, particularly because the 2022 and 2024 publications largely share participants. Applying different methods to overlapping data can address different questions, but it does not provide independent confirmation. The present studies raise questions worth testing, but they do not establish that screen time or mobile-phone RF exposure causes breast cancer. Their most useful contribution is to inform more discriminating research, with conclusions proportionate to the quality and consistency of the evidence.

Conflict of Interest

SMJ. Mortazavi, as the Editorial Board Member, was not involved in the peer-review and decision-making processes for this manuscript.

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