American Journal of Epidemiology

Vol. 186, No. 10

Letters to the Editor

RE: "MODELED AND PERCEIVED EXPOSURE TO RADIOFREQUENCY ELECTROMAGNETIC FIELDS FROM MOBILE-PHONE BASE STATIONS AND THE DEVELOPMENT OF SYMPTOMS OVER TIME IN A GENERAL POPULATION COHORT"

In Martens et al. (1), the authors assessed associations between modeled and perceived exposure to radiofrequency electromagnetic fields (RF-EMF) generated by mobile-phone base stations and the development of nonspecific symptoms and sleep disturbances over time. The authors modeled far-field RF-EMF exposure from mobile-phone base stations and performed cross-sectional and longitudinal analyses. They reported that, in contrast with modeled exposure, perceived exposure to RF-EMF emitted by mobile-phone base stations can be considered to be a predictor of nonspecific symptoms and sleep disturbances. Based on these findings, they concluded that exposure to RF-EMF from mobile-phone base stations could not be linked to the development of nonspecific symptoms and sleep disturbances in the general public.

The paper authored by Martens et al. (1) has some omissions. The first comes from passing over the key point that mobile phones are the main source of our exposure to RF-EMF. Because the distance to the RF-EMF source is the cardinal determinant of exposure, the level of exposure we receive from mobile phones can be much higher than exposures from mobile-phone base stations. For example, the strengths of the electric and magnetic fields at a distance of 2.2 cm from a 2-W Global System for Mobile Communications (GSM) mobile-phone handset are 400 V/m and 0.8 A/m, respectively. Interestingly, even at the very short distance of 50 m from a 50-W base station, these fields are only 0.6 V/m and 1.6 mA/m, respectively. Another omission—again following from the wide use of mobile phones, tablets, and laptops—is the effect of blue light on sleep patterns. Martens et al. do not address substantial evidence showing that it is not only online and mobile-phone activities related to social networking themselves but also that exposure to a smartphone's short-wavelength visible light in the blue region can disturb the normal sleep pattern (2, 3).

Furthermore, Martens et al. (1) have limited their study to RF-EMF exposures while the possible effect of exposure to extremely low-frequency electromagnetic fields (ELF-EMF) on the development of symptoms is entirely omitted. Moving to the issue of predicting nonspecific symptoms and sleep disturbances, neural network–based models can solve current problems. We have recently introduced a multilayer perceptron neural network–based model that might be used for predicting the health symptoms (especially headache and sleep disturbance) in people living in the vicinity of mobile-phone base stations (4).

ACKNOWLEDGMENTS

Conflict of interest: none declared.

REFERENCES

1. Martens AL, Slottje P, Timmermans DRM, et al. Modeled and perceived exposure to radiofrequency electromagnetic fields from mobile-phone base stations and the development of symptoms over time in a general population cohort. *Am J Epidemiol*. 2017;186(2):210–219.
2. Oh JH, Yoo H, Park HK, et al. Analysis of circadian properties and healthy levels of blue light from smartphones at night. *Sci Rep*. 2015;5:11325.
3. Mortazavi SM, Mortazavi SA, Habibzadeh P, et al. 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(3):405–406.
4. 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(2):99–105.

S. M. J. Mortazavi (e-mail: S.M.Javad.Mortazavi@fccc.edu)
Department of Diagnostic Imaging, Fox Chase Cancer Center, Philadelphia, PA

DOI: 10.1093/aje/kwx315; Advance Access publication: October 5, 2017

THE AUTHORS REPLY

In a letter to the editor, Mortazavi (1) described 3 issues that could potentially have influenced the results of a study we published recently in the *Journal* (2). We described the results from our longitudinal study on the potential health effects of modeled and perceived exposure to radiofrequency electromagnetic fields (RF-EMF) emitted by mobile-phone base stations. We concluded that perceived but not modeled exposure to RF-EMF from mobile-phone base stations was related to the development of nonspecific symptoms and sleep disturbances in the general public. The first issue described by Mortazavi

is that the contribution of RF-EMF from mobile-phone base stations to total RF-EMF exposure is greatly exceeded by the subject's own mobile-phone use. Although this is true, it is important to note that the contributions of RF-EMF from mobile phones (uplink) and mobile-phone base stations (downlink) are variable depending on the organ of interest (e.g., whole body or brain), anthropometrics, and the behavior of the subject. For example, for whole-body exposure in children, exposure from downlink will be dominant, while in adults, exposure from uplink will be more important. In recent studies among adolescents and adults, it has been estimated that, of the total personal RF-EMF exposure, 50%–70% comes from mobile phones and 20%–50% from base stations (3). In our study, we did not address total RF-EMF exposure but rather focused on whether modeled or perceived exposure from base stations is related to the development of symptoms. This focus on base stations stems from the fact that perception of exposure for base stations is different from that for mobile phones (4). Statistically, and commonly in environmental epidemiology, it is not problematic to independently estimate effects of different exposures or different sources of the same exposure if they are not strongly correlated. In our study, mobile-phone use was not related to either perceived or modeled base-station exposure. Perceived and modeled base station exposures were also not correlated with each other.

Mortazavi also comments that we did not incorporate measures of blue light emitted from mobile phones and that we did not take into consideration exposure to extremely low-frequency electromagnetic fields (ELF-EMF). The fact that we did not include all possible exposures is not unique to our study. Incorporating these exposures would be important if there were an expectation that these exposures were strongly correlated to our exposures of interest and health endpoints. As with RF-EMF from mobile phones, there is no reason to assume that blue light emissions from mobile phones are related to RF-EMF exposure from base stations. Similarly, given the different spatial distribution and density of base stations and powerlines, it is also reasonable to assume that there is no strong correlation between far-field ELF-EMF and RF-EMF exposures from base stations. Blue light and RF-EMF from mobile phones and environmental ELF-EMF might be of interest with regards to symptom reporting, but they are not likely to have confounded the reported results in our study.

ACKNOWLEDGMENTS

Conflict of interest: none declared.

REFERENCES

1. Mortazavi SMJ. Re: "Modeled and perceived exposure to radiofrequency electromagnetic fields from mobile-phone base stations and the development of symptoms over time in a general population cohort." *Am J Epidemiol*. 2017;189(10):1217.
2. Martens AL, Slottje P, Timmermans DRM, et al. Modeled and perceived exposure to radiofrequency electromagnetic fields from mobile-phone base stations and the development of symptoms over time in a general population cohort. *Am J Epidemiol*. 2017;186(2):210–219.
3. Roser K, Schoeni A, Struchen B, et al. Personal radiofrequency electromagnetic field exposure measurements in Swiss adolescents. *Environ Int*. 2017;99:303–314.
4. Freudenstein F, Correia LM, Oliveira C, et al. Exposure knowledge and perception of wireless communication technologies. *Int J Environ Res Public Health*. 2015;12(11):14177–14191.

Astrid L. Martens[1,2], Pauline Slottje[1,3], Danielle R. M. Timmermans[2,4], Hans Kromhout[1], Marije Reedijk[1,6], Tjabe Smid[2,7], and Roel C. H. Vermeulen[1,5,6] (e-mail: R.C.H. Vermeulen@uu.nl)

[1] *Institute for Risk Assessment Sciences, Division Environmental Epidemiology, Utrecht University, Utrecht, the Netherlands*
[2] *Department of Public and Occupational Health, EMGO Institute for Health and Care Research, VU University Medical Center, Amsterdam, the Netherlands*
[3] *Department of General Practice and Elderly Care, EMGO Institute for Health and Care Research, VU University Medical Center, Amsterdam, the Netherlands*
[4] *National Institute for Public Health and the Environment, Bilthoven, the Netherlands*
[5] *Imperial College, Department of Epidemiology and Public Health, London, United Kingdom*
[6] *Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, Utrecht, the Netherlands*
[7] *KLM Health Services, Schiphol, the Netherlands*

DOI: 10.1093/aje/kwx316; Advance Access publication: October 5, 2017