

[Online]. Available: <https://www.fda.gov/media/135043/download>

[6] G. C. Van Rhoon, T. Samaras, P. S. Yarmolenko, M. W. Dewhirst, E. Neufeld, and N. Kuster, "CEM43°C thermal dose thresholds: A potential guide for magnetic resonance radiofrequency exposure levels?" *Eur. Radiol.*, vol. 23, no. 8, pp. 2215–2227, 2013, doi: 10.1007/s00330-013-2825-y.

[7] K. R. Foster, M. C. Ziskin, and Q. Balzano Q, "Time-temperature thresholds and safety factors for thermal hazards from radiofrequency energy above 6 GHz," *Health Phys.*, vol. 121, no. 3, pp. 234–247, Sep. 2021, doi: 10.1097/HP.0000000000001447.

[8] D. G. Greenhalgh, M. B. Lawless, B. B. Chew, W. A. Crone, M. E. Fein, and T. L. Palmieri,

"Temperature threshold for burn injury: An oximeter safety study," *J Burn Care Rehabil.*, vol. 25, no. 5, pp. 411–415, Sep. 2004, doi: 10.1097/01.bcr.0000138295.63830.90.

[9] K. R. Foster, D. C. Garrett, and M. C. Ziskin, "Can the microwave auditory effect be 'weaponized'?" *Front. Public Health*, vol. 9, p. 788,613, Dec. 2021, doi: 10.3389/fpubh.2021.788613.

Response to the Letter by Foster, Chou, and Croft

■ James C. Lin

I appreciate the letter from Foster, Chou, and Croft expressing their concerns about my recent article on health safety guidelines for RF exposures [1]. The letter is understandable, given its authors strong convictions that there is nothing but heat to worry about with RF exposure. In the interest of clarity, I will respond to the writers' three points in their order of presentation.

It is correct, as it should be, that the scientific literature does not support the view that a whole-body temperature rise of 1 °C is carcinogenic. Regrettably, as my article said, for some reason, the entities putting out the guidelines and standards forcefully criticized the NTP findings of malignant tumors in RF-exposed rats as confounded by the 1 °C body temperature rise instead of being caused by the RF exposure, which was the independent variable in arguably the best and largest NTP animal study including chemicals to date. It is paradoxical that the same entities that profess not to hold a position that a "whole-body temperature rise of 1 °C is carcinogenic" proclaim that the NTP findings of malignant tumors are "confounded by a 1 °C temperature rise." Furthermore, these same entities proceed to use phrases such as "substantial limitations" to declare their

reasons in barring any "conclusions being drawn concerning RF EMFs and carcinogenesis" to justify their guidelines and recommendations.

The letter complains that the thermal damage threshold discussion in my article oversimplifies and distorts a complex issue by referring to the hyperthermic temperature of 42°C. It is appropriate to recall that the topic under discussion is the recommendations for RF protection guidelines and safety standards based on thermal effects for short-term exposures that specify a 1 °C temperature rise in 6–30 min (see [1, Table 1]). So, the purpose of the statement "it is not useful to refer to a threshold for thermal injury without specifying the exposure level and duration" is obscure, if not pointless. However, I am glad to see recognition of the fact that biological damage and injury generally occur "in the range of 42–45 °C."

In the context of addressing inaccuracies and misstatements, it should be noted that the microwave auditory effect [2] associated with TA wave generation in the head by high-power microwave pulses is not produced by "transient heating." The microwave auditory effect at the threshold hearing level occurs because of the miniscule but rapid (in microseconds) rise of temperature (10⁻⁶ °C) in the brain from the absorption of high-power, pulsed microwave radiation in the microsecond pulsewidth range. The miniscule theoretical temperature rise is not measurable with any available sensor or felt as heat by anyone.

Generating a traditional tissue-injuring level of sound pressure would require an estimated peak power density of 14 (3–50) GW/m²/pulse [3], [4]. The corresponding theoretical temperature rise at this level would be about or less than 1 °C, which is a temperature considered "safe" by the recommended exposure guidelines or standards. The letter writers may have missed the point—the tissue-injuring level of a power density of 14 GW/m²/pulse producing a theoretical temperature rise of less than 1 °C is "unsafe." The reason being, as mentioned in my article, "Such high-power, microwave-pulse-generated, acoustic pressure waves can be initiated in the brain and then reverberated inside the head to potentially, if not surely, cause serious injury to white and gray brain matters, along with other neural elements." Actually, in this case, both the 1 °C temperature rise recommended by the guidelines and standards and the acoustic pressure waves generated inside the head are unsafe.

References

- [1] J. C. Lin, "Health safety guidelines and 5G wireless radiation," *IEEE Microw. Mag.*, vol. 23, no. 1, pp. 10–17, Jan. 2022, doi: 10.1109/MMM.2021.3117307.
- [2] J. C. Lin, "Sonic health attacks by pulsed microwaves in Havana revisited [Health Matters]," *IEEE Microw. Mag.*, vol. 22, no. 3, pp. 71–73, Mar. 2021, doi: 10.1109/MMM.2020.3044125.
- [3] J. C. Lin, "The microwave auditory effect," *IEEE J. Electromagn., RF, Microw. Med. Biol.*, early access, 2021, doi: 10.1109/JERM.2021.3062826.
- [4] J. C. Lin, *Auditory Effects of Microwave Radiation*. New York, NY, USA: Springer-Verlag, 2021



James C. Lin (lin@uic.edu) is with the University of Illinois, Chicago, 60607, USA.

Digital Object Identifier 10.1109/MMM.2022.3147174
Date of current version: 2 March 2022