



Log in | Register



International Journal of Radiation Biology >

78

Latest Articles

229 0

Views CrossRef citations to date Altmetric

Reviews

Possible health effects on the human brain by various generations of mobile telecommunication: a review based estimation of 5G impact

Hiie Hinrikus 🔀 📵, Tarmo Koppel 📵, Jaanus Lass 📵, Hans Orru 📵, Priit Roosipuu 🕩 & Maie Bachmann 🗈

Received 27 Oct 2021, Accepted 27 Dec 2021, Accepted author version posted online: 07 Jan 2022, Published online: 31 Jan 2022

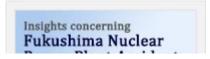
66 Download citation

https://doi.org/10.1080/09553002.2022.2026516

Sample our









Full Article Figures & data References **66** Citations **Metrics**

Reprints & Permissions Get access

Abstract

Purpose

The deployment of new 5G NR technology has significantly raised public concerns in possible negative effects on human health by radiofrequency electromagnetic fields (RF EMF). The current review is aimed to clarify the differences between possible health effects caused by the various generations of telecommunication technology, especially discussing and projecting possible health effects by 5G. The review of experimental studies on the human brain over the last fifteen years and the discussion on physical mechanisms and factors determining the dependence of the RF EMF effects on frequency and signal structure have been performed to discover and explain the possible distinctions between health effects by different telecommunication generations.

Conclusions

The human experimental studies on RF EMF effects on the human brain by 2G, 3G and 4G at frequencies from 450 to 2500 MHz were available for analyses. The search for publications indicated no human experimental studies by 5G nor at the RF EMF

frequencies higher than 2500 MHz. The results of the current review demonstrate no consistent relationship between the character of RF EMF effects and parameters of

At the RF EMF frequencies lower than 10 GHz, the impact of 5G NR FR1 should have no principal differences compared to the previous generations. The radio frequencies used in 5G are even higher and the penetration depths of the fields are smaller; therefore, the effect is rather lower than at previous generations. At the RF EMF frequencies higher than 10 GHz, the mechanism of the effects might differ and the impact of 5G NR FR2 becomes unpredictable. Existing knowledge about the mechanism of RF EMF effects at millimeter waves lacks sufficient experimental data and theoretical models for reliable conclusions. The insufficient knowledge about the possible health effects at millimeter waves and the lack of in vivo experimental studies on 5G NR underline an urgent need for the theoretical and experimental investigations of health effects by 5G NR, especially by 5G NR FR2.

Previous article	V	/iew latest articles	Next article >
Q Keywords: RF EMF exposure underlying mechanisms	health effects	frequency dependence	signal structure

Disclosure statement

The authors report no conflict of interest.

Additional information

Funding

This research has been initiated by the Ministry of Social Affairs and funded by the Ministry of Economic Affairs and Communications of the Republic of Estonia, Project 5GEMF1.

Hiie Hinrikus

Hiie Hinrikus, PhD, DSc, is a Professor Emeritus of Radiophysics at the Department of Health Technologies, Tallinn University of Technology, Tallinn, Estonia.

Tarmo Koppel

Tarmo Koppel, PhD, is a Lecturer at the Department of Business Administration, School of Business and Governance, Tallinn University of Technology, Tallinn, Estonia.

Jaanus Lass

Jaanus Lass, PhD, is a Senior Research Fellow at the Department of Health Technologies, Tallinn University of Technology, Tallinn, Estonia.

Hans Orru

Hans Orru, PhD, is a Professor of Environmental Health at the Institute of Family Medicine and Public Health, University of Tartu, Tartu, Estonia.

Priit Roosipuu

Priit Roosipuu, MSc, is a Telecom Solutions Developer at the Thomas Johann Seebeck Department of Electronics, School of Information Technologies, Tallinn University of Technology, Tallinn, Estonia.

Maie Bachmann

Maie Bachmann, PhD, is a Professor of Biosignals Processing at the



Related research (1)

People also read

Recommended articles

Cited by

Threshold of radiofrequency electromagnetic field effect on human brain >

Hiie Hinrikus et al.

International Journal of Radiation Biology

Published online: 23 Aug 2021

Health effects of WiFi radiation: a review based on systematic quality evaluation >

Stefan Dongus et al.

Critical Reviews in Environmental Science and Technology

Published online: 24 Jul 2021



N-acetyl-cysteine reduces the risk for mechanical ventilation and mortality in patients with COVID-19 pneumonia: a two-center retrospective cohort study

Stelios F. Assimakopoulos et al.

Infectious Diseases

Published online: 29 Jun 2021

View more

Home ► All Journals ► International Journal of Radiation Biology ► List of Issues ► Latest Articles

Possible health effects on the human bra

open access

Authors Overview

R&D professionals Open journals

Editors Open Select

Librarians Dove Medical Press

Societies F1000Research

Opportunities Help and information

Reprints and e-prints Help and contact

Advertising solutions Newsroom

Accelerated publication All journals

Corporate access solutions Books

Keep up to date

Register to receive personalised research and resources by email



Sign me up











Copyright © 2022 Informa UK Limited Privacy policy Cookies Terms & conditions

), Tayfor & Francis Shoup Zacina na wates

Accessibility

Registered in England & Wales No. 3099067 5 Howick Place | London | SW1P 1WG