

La Protección Radiológica de los Campos Electromagnéticos (CEM)

Guía Informativa para la aplicación de los 3 Principios Fundamentales de Radioprotección por parte de organismos y Autoridades Regulatorias (Revisión Nº 9 de noviembre 2021)

Comisión Iberoamericana de Protección Radiológica de Campos Electromagnéticos (CIPRACEM)
Federación de Radioprotección de América Latina y el Caribe (FRALC)
Asociación Internacional de Protección Radiológica (IRPA)

Resumen

Esta Guía Informativa producida por la CIPRACEM es un documento de consulta “NO PRESCRIPTIVO” elaborado solo para ayudar a las autoridades competentes en la comprensión y en la aplicación práctica de los “Principios de ICNIRP-2020” y del ICRP-103 del 2007 que son las 2 Normas Internacionales producidas y aceptadas por el organismo responsable creado por el IRPA y por la comunidad internacional.

Estos Principios del ICNIRP-2020 fueron revisados y aprobados por representantes designados por:

- La Asociación Internacional de Protección Radiológica (IRPA),
- La Comisión Internacional de Protección Radiológica (ICRP),
- El Comité Científico de la Naciones Unidas sobre efectos de las Radiaciones atómicas (UNSCEAR),
- La Organización Internacional del Trabajo (OIT) y
- La Organización Mundial de la Salud (OMS),

Por lo tanto, es un documento de amplio consenso, respaldado por la comunidad internacional, que debe ser cumplido por todos los países a fin de asegurar la protección de la población y el medio ambiente.

Los “Principios del ICNIRP 2020” establecen un marco coherente de Protección Radiológica para Todo el espectro de las Radiaciones Ionizantes y No Ionizantes”

Se establecen y aplican los 3 Principios básicos de la Radioprotección enunciados en el ICRP-1 03 del 2007

- 1- **Principio de Justificación:** No deben realizarse exposiciones que no estén debidamente justificadas.
- 2- **Principio de Optimización** de la protección: La probabilidad de una exposición, el número de personas expuestas y la magnitud de las dosis individuales serán mantenidas **tan bajas como sea posible lograr** (principio ALARA)
- 3- **Principio de aplicación de Límites de Dosis:** La dosis total a todo individuo no debería exceder los límites apropiados especificados por la Autoridad competente a fin de prevenir los efectos dañinos para la salud.

Una cuestión importante que destacan los “Principios del ICNIRP 2020” es el **concepto de Dosis**; y, como tal, es el producto de la intensidad de la exposición y la duración de la exposición. Las dosis se deben medir y controlar.

Dado que los Principios del ICRP no han sido aplicados inicialmente a las radiaciones no ionizantes, no existe aun experiencia ni especialistas calificados, razón por la cual esta Guía fue diseñada por la CIPRACEM para proveer información y soporte a todas las autoridades en la aplicación de los Principios del ICRP basados en la experiencia adquirida durante muchos años en la regulación de las Radiaciones Ionizantes.

Algunos Objetivos y Recomendaciones a considerar por las autoridades competentes

1. Se tomarán medidas para que ningún trabajador ni miembro del público reciba dosis que puedan producir Efectos Deterministas y que los Efectos Estocásticos tengan una probabilidad de ocurrencia inferior al 1% /año a fin de bajar la frecuencia de cánceres, en particular los cerebrales, a los valores existentes al comienzo del uso de teléfonos celulares, **sin que las medidas afecten las comunicaciones ni el acceso libre a internet**.
2. Las comunicaciones serán reguladas para cumplir los Acuerdos Internacionales sobre el Cambio Climático...
3. Estarán vedadas las prácticas y/o el uso de dispositivos electrónicos que generen radiaciones sin obtenerse un beneficio neto o que puedan ser remplazados por dispositivos cableados que no emitan radiaciones.
4. Se evitará que los equipos de transmisión inalámbrica estén conectados y activos cuando no son utilizados por lo que deberán ser todos de apagado automático.
5. Se evitará que en lugares públicos coexistan más de dos o tres señales de wifi salvo que se demuestre fehacientemente que resultan imprescindibles para la conectividad.
6. Las antenas base para redes celulares de comunicación inalámbrica no operarán si la conectividad puede ser realizada y mantenida satisfactoriamente por las señales de wifi existentes en un lugar determinado.
7. Los celulares que dispongan de un sistema de geo-localización deberán ser remplazados a la brevedad por un sistema de localización manual operado por el usuario cuando deba cambiar su ubicación geográfica.
8. El límite de dosis para trabajadores y para el público debe ser establecido para evitar la ocurrencia de efectos deterministas y reducir la probabilidad de efectos estocásticos, en particular tumores cerebrales, al 1% /año.
9. Se deberá llevar registro de las dosis que recibe la población y una estadística de la frecuencia de las enfermedades relacionadas con la exposición a los CEM como es el caso de los tumores cerebrales y cánceres de tiroides de colon y recto de acuerdo a las edades, para verificar la eficacia del sistema de control establecido.

La CIPRACEM considera que es factible mantener las comunicaciones inalámbricas con valores de dosis a la población que sean 100 o 1000 veces inferiores a las actuales.

Abstract

This Informative Guide produced by CIPRACEM is a “NON-PRESCRIPTIVE” consultation document prepared only to help competent authorities in the understanding and practical application of the “Principles of ICNIRP-2020” and the ICRP-103 of 2007, which are the 2 International Standards produced and accepted by the responsible body created by IRPA and by the international community.

These ICNIRP-2020 Principles were reviewed and approved by representatives appointed by:

- **The International Radiation Protection Association (IRPA),**
- **The International Commission on Radiological Protection (ICRP),**
- **The United Nations Scientific Committee on Atomic Radiation Effects (UNSCEAR),**
- **The International Labor Organization (ILO) and**
- **The World Health Organization (WHO),**

Therefore, it is a document of broad consensus, endorsed by the international community, which must be complied with by all countries in order to ensure the protection of the population and the environment.

The ICNIRP 2020 Principles propose to establish "a coherent Radiological Protection framework for the entire spectrum of Ionizing and Non-Ionizing Radiations"

The 3 Basic Principles of Radioprotection set forth in ICRP-103 of 2007 are established and applied

1- Principle of Justification: Exposures that are not duly justified should not be made.

2- Principle of Optimization of protection: The probability of an exposure, the number of people exposed and the magnitude of individual doses will be kept as low as possible to achieve (ALARA principle)

3- Principle of application of Dose Limits: The total dose to every individual should not exceed the appropriate limits specified by the competent Authority in order to prevent harmful effects on health. .

An important issue highlighted by the “ICNIRP 2020 Principles” is the **concept of Dose**; and, as such, it is the product of the intensity of the exposure and the duration of the exposure. Doses must be measured and controlled.

Since the ICRP Principles have not been initially applied to non-ionizing radiation, there is still no experience or qualified specialists, which is why this Guide was designed by CIPRACEM to provide information and support to all authorities in the application of the ICRP principles based on the experience acquired over many years in the regulation of Ionizing Radiations.

Some Objectives and Recommendations to be considered by the competent regulatory authorities

1. The necessary measures will be taken so that no worker or any person in the public receives doses that can produce Deterministic Effects and that Stochastic Effects have a probability of occurrence of less than 1 % / year in order to reduce the frequency of cancers, in particular the brain, to the values existing at the beginning of the use of cell phones, without the measures affecting communications or free access to the Internet.
2. Communications will be regulated to comply with the International Agreements on Climate Change ...
3. The practices and / or the use of electronic devices that generate electromagnetic fields without obtaining a net benefit and / or mean an unnecessary energy expenditure, or that can be replaced by wired devices that do not emit radiation, will be prohibited:
4. Wireless transmission equipment will be prevented from being connected and active when not in use, so they should all be turned off automatically.
5. It will be avoided that more than three Wi-Fi signals coexist in public places unless it is reliably demonstrated that they are essential for connectivity.
6. The base antennas for cellular networks of wireless communication will not operate if the connectivity can be carried out and maintained satisfactorily by the existing Wi-Fi signals in a certain place.
7. Cell phones that have a geo-location system must be replaced as soon as possible by a manual location system operated by the user when they need to change their geographic location.
8. The dose limit for workers and the public should be established to avoid the occurrence of deterministic effects and reduce the probability of stochastic effects, in particular brain tumors, to 1 % / year.
9. A record must be kept of the doses received by the population and a statistic of the frequency of diseases related to exposure to EMF, such as brain tumors and thyroid cancers of the colon and rectum, according to age, to verify the effectiveness of the established control system.

The current practice of setting Power Density limits is very useful but it is not enough if all the unjustified exposures, which are many, are not also avoided. CIPRACEM considers that it is feasible to maintain wireless communications with dose values to the population that are 100 or 1000 times lower than the current ones...!! (And this also implies reducing deaths and diseases in those same proportions...!! and maintaining the benefits)

Protección de la población de las Radiaciones No Ionizantes (RNI)

CONTENIDO

Integrantes del grupo de redacción y revisión de la Guía Informativa CIPRACEM	4
Antecedentes Históricos	5
Los Principios del ICNIRP 2020	6
Guía Informativa para aplicar los Principios de Radioprotección	7
• Propósito de la Guía Informativa:	
• Los Objetivos de la Radioprotección	
• Efectos de las radiaciones: Determinísticos, Estocásticos:	
1º Aplicación del Principio de Justificación	8
• Ejemplos de Aplicación en Radiodiagnóstico médico	
• Ejemplos de Aplicación para la protección de los CEM.	
• Antenas redundantes	
• Geolocalización	
• Dosis colectivas	
2º Aplicación del Principio de Optimización:	9
• En Radiaciones Ionizantes:	
• En Radiaciones No Ionizantes	
• Variables a considerar en los CEM	
3º Aplicación del Principio de Límites de Dosis:	11
• Evitar efectos deterministas	
• Disminuir los riesgos de efectos estocásticos	
• Disminuir los riesgos No radiológicos.	
4º - Las Medidas para proteger el medio ambiente	13
5º - La aplicación del Criterio Conservativo	13
6º - Efectos científicamente comprobados (criterios de Bradford Hill)	14
<u>Propuesta de Recomendaciones a considerar</u>	15
• Requisitos básicos del ICRP	
• El Principio de Justificación	
• El Principio de Optimización	
• El Principio de Límites de Dosis	
• Requisitos de los Acuerdos Internacionales sobre el Cambio Climático	
APÉNDICE 1: Información Biológica y Epidemiológica	19
• El crecimiento de la frecuencia de los tumores cerebrales	
• La disminución de las defensas naturales del organismo	
• El poder co-cancerígeno de los CEM	
• Daños a la vida animal y el medio ambiente	
APÉNDICE 2: Aspectos no radiológicos de los campos electromagnéticos	22
• Impacto de las comunicaciones inalámbricas en el cambio climático	
• Usos del 5G con objetivos militares	
Trabajos Básicos de Referencia y Normas Internacionales	24
Bibliografía Temática	26

**Integrantes del grupo de redacción y revisión de la Guía Informativa CIPRACEM
(Lista provisoria con algunos revisores invitados...)**

Argentina: (Sociedad Argentina de Radioprotección - SAR)

Abel González
Rodolfo Touzet
Esteban Rossi
Guillermo Defays
Jorge Ferrari (†) (in memorial)

Brasil: (Sociedad Brasileira de Protección Radiológica - SBPR)

Altair Souza de Assis
José Antônio Simas Bulcão
Alfredo Lopes Ferreira Filho
Josilto Oliveira de Aquino
Claudio Enrique Fernandez Rodriguez

Chile: (Sociedad Chilena de Protección Radiológica – SOCHIPRA)

Enrique Viveros Pereira
Carina Vaca Zeller

Colombia: (Sociedad Colombiana de Protección Radiológica – ACPR)

Carolina Viloria
Pablo Giraldo

Cuba: (Sociedad Cubana de Física / Sección Protección Radiológica - SCF/PR)

Ruben Ferro
Juan Cardenas Herrera

Ecuador; (Asociación Ecuatoriana de Radioprotección – AERP)

Juan Miguel Olalla Pilco
Franklin Alexander Urquiza Bonilla
Washington Javier Carrasco Tustón
Álvaro David Ruiz Hidalgo
Edwin Armando Baldeón López

Mexico: (Sociedad Mexicana de Seguridad Radiológica – SMSR)

Richard Harr

Perú: (Sociedad Peruana de Radioprotección – SPR)

Bedher Omar Vega

Venezuela: Sociedad Venezolana de Protección Radiológica – SOVEPRA)

Omar Arias Curatolo
Laszlo Sajo

Uruguay: (Sociedad Uruguaya de Radioprotección - AUR)

Alvaro Luongo
Juan Carlos Hermida
Ariel Duran

* Julio Carmona de “Ecologistas en Acción” (España) ha tenido la gran gentileza de traducir y revisar la [versión en inglés](#) y CIPRACEM se lo agradece de corazón.

Protección de la población de las Radiaciones No Ionizantes (RNI)

Antecedentes Históricos de la Radioprotección de Radiaciones No Ionizantes

Control de las RNI de 1964 a 1992: En 1964 se crea la Asociación Internacional de Protección Radiológica (IRPA) con el propósito de asegurar la protección de las personas y el medio ambiente contra los peligros causados por las Radiaciones Ionizantes y No Ionizantes. En 1974 el IRPA crea la Comisión de Protección de las Radiaciones No Ionizantes (CNIRP), con el fin de establecer criterios específicos para proteger debidamente al público y al medio ambiente de las radiaciones no ionizantes.

Creación del ICNIRP por el IRPA: Posteriormente en 1992, el CNIRP se convierte en la Comisión Internacional de Protección de las Radiaciones No Ionizantes (ICNIRP) con un Estatuto que establece que se “mantendría una relación estrecha con el Comité Ejecutivo del IRPA” y presentará previamente sus recomendaciones para que el Ejecutivo del IRPA y todas las Sociedades Asociadas lo revisen antes de proceder a su publicación, y el plazo previo para comentarios sería de 90 días, pero “estos requisitos de revisión previa en la práctica no fueron cumplidos por el ICNIRP” de forma tal que las recomendaciones realizadas “sin el proceso de revisión establecido” tienen comprometida su calidad científica y al no cumplir con el estatuto de creación del ICNIRP hacen dudosa su validez formal. Por otra parte, el ICNIRP no mantuvo una relación estrecha con la Comisión Internacional de Protección Radiológica (ICRP) como había sido previsto en su constitución y *no aplicó los principios básicos de Protección Radiológica recomendados por el ICRP*. Esta conducta determinó diferencias importantes entre el ICRP y el ICNIRP

Corrección de las desviaciones del ICNIRP: Para corregir las desviaciones del ICNIRP del cumplimiento del Estatuto de su creación se realizaron varias gestiones y en el año 2008 para el Congreso IRPA-12 de Buenos Aires se programa una reunión ICNIRP-ICRP para consensuar los Principios de Radioprotección utilizados, pero el ICNIRP decide no concurrir a la Argentina. Luego en el Congreso IRPA-13 de Glasgow del 2012 se declara que era urgente que el ICNIRP aplicara los criterios fundamentales de Protección Radiológica de la ICRP, pero este objetivo no se cumple. En el 2018 se crea dentro del IRPA un “grupo de trabajo” que requiere al ICNIRP cumplir con los principios del ICRP-2007. La CIPRACEM emite un informe crítico sobre las desviaciones del ICNIRP al estatuto de creación. Con motivo del Congreso IRPA-15 en Seul, Corea, se reiteran varios reclamos del IRPA para que se cumplan fielmente los principios del ICRP-2007 y el IRPA y el ICRP participan en la revisión de los Principios del ICNIRP durante su elaboración.

Aceptación por el ICNIRP del ICRP-2007: El ICNIRP finalmente, acepta el reclamo del IRPA y emite los Principios del ICNIRP (ICNIRP STATEMENT, Principles for Non-ionizing Radiation Protection, publicado en la revista Health Physics 118 (5); 477-482; 2020) donde finalmente se propone cumplir con los mismos Principios de Radioprotección que aplica la Comisión Internacional de Protección Radiológica (ICRP) y adopta como documento de referencia la publicación ICRP-103 del año 2007. Los Principios del ICNIRP-2020 marcan un antes y un después en la Radioprotección de las Radiaciones No Ionizantes.

Estos **Principios del ICNIRP-2020** fueron revisados y aprobados por representantes designados por la Asociación Internacional de Protección Radiológica (IRPA) Sigurður Magnús Magnússon, por la Comisión Internacional de Protección Radiológica (ICRP) Jacques Lochard, por el Comité Científico de la Naciones Unidas sobre efectos de las Radiaciones atómicas (UNSCEAR) Ferid Shannoun, por la Organización Internacional del Trabajo (OIT) Shengli Niu y por la Organización Mundial de la Salud (OMS) Emilie van Deventer, razón por la cual se puede considerar como un documento de razonable consenso que cuenta con el aval y el respaldo de la comunidad internacional y debiera ser considerado por todos los países.

Aplicación de los Principios del ICNIRP-2020 en la región Latinoamericana: Las comunicaciones internacionales abarcan los países y las regiones, en nuestro caso Latinoamérica, y resulta muy importante contar con un documento de consenso a fin de poder establecer criterios comunes y standards de aplicación en todos nuestros países y esta es la función que desea facilitar la Comisión Latinoamericana de Protección de las Campos Electromagnéticos y las Radiaciones No Ionizantes (CIPRACEM) designada por la Federación de Radioprotección de América Latina y el Caribe (FRALC)

Los Principios del ICNIRP 2020

Se crea un “marco único” para todo el espectro de radiaciones

Se establece “**un marco coherente de Protección Radiológica para Todo el espectro de Radiaciones Ionizantes y No Ionizantes**” y se aplican los 3 Principios básicos de la Comisión Internacional de Protección Radiológica (ICRP-2007) y los valores éticos subyacentes, lo cual incluye:

1- Principio de Justificación: Cualquier decisión que altera la situación de exposición a la radiación debería occasionar más beneficio que daño. No deben realizarse exposiciones que no estén debidamente justificadas. (El beneficio debe siempre superar el daño)

2- Principio de Optimización de la protección: La probabilidad de una exposición, el número de personas expuestas y la magnitud de sus dosis individuales deberían ser mantenidas tan bajas como sea razonablemente alcanzable, teniendo en cuenta los factores económicos y sociales.

3- Principio de aplicación de Límites de Dosis: La dosis total a todo individuo no debería exceder los límites apropiados especificados por la Autoridad competente.

Se toma como documento de referencia el ICRP-2007 que el ICNIRP declara formalmente aceptar e incluye en forma taxativa tres conceptos fundamentales que son destacados: El concepto de dosis, El criterio Conservativo y el concepto de “Efectos científicamente comprobados”

El concepto de Dosis: Una cuestión muy importante que destaca el ICNIRP en sus Principios 2020 es el concepto de Dosis; normalmente se asume un determinado riesgo de daño y, como tal, **es el producto de la intensidad de la exposición y la duración de la exposición**, por lo que se puede obtener un efecto similar o un riesgo similar para un efecto mediante una exposición corta a alta intensidad o una larga exposición a baja intensidad (reciprocidad). De esta forma los Límites de Dosis o SA (Gy) que se establecen para proteger los individuos deben ser controlados considerando el producto entre los niveles de exposición y los tiempos involucrados.

4- El Criterio Conservativo: Para la estimación de los Límites de Dosis, ICNIRP generalmente “asume las situaciones más desfavorables” y “toma en consideración las incertidumbres en la evidencia científica” siempre en beneficio de las personas que se deben proteger (esto es equivalente al criterio Conservativo utilizado por el ICRP en todas sus recomendaciones)

5- Efectos científicamente comprobados (criterios de Bradford Hill):

ICNIRP establece sus pautas de exposición únicamente sobre la base de “efectos científicamente comprobados”. Con este objetivo para los estudios epidemiológicos, debe haber una descripción adecuada del grupo de población investigado, la exposición debe estar bien definida y debe haber una identificación y control adecuado de los factores de confusión para la minimización del sesgo. Para lograr “efectos científicamente comprobados” es fundamental **la aplicación de los 9 Criterios formulados por Sir Bradford Hill** (1965) que son imprescindibles para determinar la “Causalidad”.

En síntesis, la propuesta de establecer un Marco coherente de protección contra las radiaciones en TODO EL ESPECTRO de las radiaciones ionizantes y no ionizantes, está plenamente justificado y fundamentado, porque los riesgos son los mismos, en toda la extensión del espectro. La Agencia Internacional de Investigación del Cancer (IARC) ha categorizado a todas las radiaciones, ionizantes y no ionizantes, como agentes cancerígenos y por lo tanto existe siempre un riesgo de cáncer, mayor o menor, de acuerdo a la magnitud de las dosis de radiación recibidas.

Las radiaciones no ionizantes tienen incluso un poder cancerígeno mil veces superior al de las ionizantes, considerando los límites de dosis establecidos, y además pueden afectar el aparato reproductivo, el sistema inmune y el medio ambiente. Por esta razón la aplicación de los criterios de radioprotección debe ser realizada de la misma forma que se utilizan para la protección de las radiaciones ionizantes (ICRP-2007) pero podrían ser aun más restrictivos y severos.

Guía Informativa para aplicar los Principios de Radioprotección

requeridos en los Principios ICNIRP-2020 y en el ICRP-2007

Propósito de esta Guía Informativa:

- 1) Debido a que los principios de Radioprotección del ICRP no se han aplicado a las radiaciones no ionizantes y no hay aun suficientes especialistas con experiencia para aplicar estos principios a todas las prácticas, surge la necesidad de desarrollar una metodología y esta Guía Informativa fue diseñada por la CIPRACEM para dar soporte en la realización de las actividades regulatorias.
- 2) Se debe considerar además que el público en general desconoce los riesgos a los que está expuesto y conviene realizar tareas de capacitación para que la población pueda cooperar en la aplicación de las medidas de protección, razón por lo que esta Guía contiene información técnica sobre los fundamentos de los principios de radioprotección y su aplicación práctica a fin de capacitar debidamente a los funcionarios públicos y a la población en general.

Objetivos de la Radioprotección

El objetivo fundamental de la Radioprotección es contribuir a un nivel adecuado de protección de las personas y del medio ambiente, de los efectos perjudiciales de la exposición a la radiación sin limitar indebidamente todos los beneficios que pueden estar asociadas al uso de radiaciones.

El sistema de radioprotección de las personas se debe diseñar para que no ocurran efectos Determinísticos y para que el aumento de la probabilidad de efectos Estocásticos sea de un valor porcentual suficientemente bajo para que sea aceptado por la sociedad.

En el caso de la protección del medio ambiente se debe busca evitar la muerte temprana, la morbilidad o la capacidad de reproducción de los animales y las plantas, en particular para aquellas especies que son más útiles al hombre y el objetivo es prevenir o reducir la frecuencia de los efectos deletéreos de la radiación hasta un nivel lo suficientemente bajo para que los efectos tengan un impacto despreciable y no afecten el mantenimiento de la diversidad biológica.

Efectos de las radiaciones:

Efectos determinísticos:

Es el daño en poblaciones de células, caracterizado por una dosis umbral y un aumento en la severidad de la reacción a medida que aumenta la dosis. También denominados reacciones tisulares. El caso típico es el enrojecimiento de la piel por la exposición al sol o la producción de aberraciones cromosómicas o el cambio en la permeabilidad de una membrana. Siempre hay un umbral de exposición a partir del cual aparecen esos efectos y cuando mayor es la exposición mayor es la magnitud de dichos efectos.

Efectos estocásticos:

Son las enfermedades y los efectos heredables para los que la probabilidad de que ocurra un efecto, pero no su severidad, es considerada como una función de la dosis, sin umbral.

El caso típico es el cáncer cuya probabilidad de ocurrencia aumenta en la medida que aumente la exposición a las radiaciones. No es posible, en general, determinar si un cáncer es originado por la exposición a la radiación o su origen es natural, pero se observa que cuanto mayores son las dosis, mayor es el aumento de la frecuencia observada.

Conviene dar un ejemplo práctico para entender estos efectos:

En el caso de los campos electromagnéticos, se observó que, a partir de la intensificación del uso de los teléfonos celulares, la frecuencia de los tumores cerebrales, que era aproximadamente de dos casos nuevos por cada 100.000 habitantes y por año, aumentó por ejemplo en Brasil, por un factor 5 a una nueva frecuencia de 10 casos nuevos por cada 100.000 habitantes por año. O sea que actualmente, en promedio, de cada 5 casos de tumores cerebrales, 4 de ellos son debidos al uso de los teléfonos celulares y se observa que esta frecuencia sigue aumentando a razón de un 10 por ciento por cada año que pasa debido a las dosis recibidas por la población por los CEM. Esta información epidemiológica es coherente con el aumento de frecuencia observada en estudios de casos (Interphone, CERENAT y otros) así como en los estudios con animales (NTP, Instituto Ramazzini).

1º Aplicación del Principio de Justificación:

Este principio establece que antes de autorizar una práctica se debe determinar que las dosis que reciben las personas expuestas están justificadas y que no se recibe una mayor dosis que las que son estrictamente necesarias para cumplir con los objetivos de dicha práctica.

Habiendo muy poca experiencia de aplicación del Principio de Justificación a los campos electromagnéticos se van a presentar algunos ejemplos de aplicación en los usos médicos de las radiaciones ionizantes:

Ejemplo de Aplicación en Radiodiagnóstico médico: En radiodiagnóstico se utilizan fuentes radioactivas y equipos de rayos X para obtener imágenes anatómicas del cuerpo humano. Esto determina que los pacientes sometidos a estos estudios reciban dosis de radiación que podrían originar efectos determinísticos o estocásticos.

Para el radiodiagnóstico de una afección pulmonar un médico prescribe una radiografía de tórax para conocer el estado de los pulmones, lo que implica una exposición del paciente con una dosis baja de radiación.

Una tomografía computada permitiría obtener una imagen diagnóstica de mayor calidad que una radiografía y con mayor información anatómica para el diagnóstico médico pero la dosis sería 100 o 200 veces mayor y “*el aumento de riesgo es superior al beneficio extra obtenido*” por lo que se considera que una tomografía NO ESTA JUSTIFICADA y no debe por lo tanto ser realizada.

No está tampoco justificado hacer varias radiografías en lugar de una sola, ni tampoco realizar varias tomografías pues esas prácticas estarían muy injustificadas porque “*aumentarían innecesariamente la probabilidad de que ese paciente contraiga un cáncer*”.

O sea que se realizan solamente aquellos estudios que están justificados y se eligen aquellos que representan una menor dosis de radiación para evitar la ocurrencia de efectos determinísticos y para no aumentar innecesariamente la frecuencia de cáncer.

Ejemplo de Aplicación para la protección de los campos electromagnéticos.

Para una comunicación inalámbrica se requiere un transmisor y un receptor. El transmisor es habitualmente una antena base o una antena de wifi y el receptor es un celular o una laptop. ¡¡Para que el receptor reciba la señal y se comunique no es necesaria la presencia de varias señales dado que con una única señal es suficiente para que la comunicación se realice...!!

Antenas redundantes: Actualmente en cualquier punto de una ciudad llegan en forma simultánea las señales de docenas de antenas de wifi y además las señales de 4 o 5 antenas base de diferentes compañías telefónicas, y se requiere solo una de esas señales para realizar una comunicación. ¡¡En este caso para lograr el objetivo de comunicarse las señales son muy redundantes y las dosis que reciben los usuarios pueden ser 10 o 100 veces mayores que lo que se requiere para comunicarse...!! Esto es debido a que hay varias compañías que trabajan en forma independiente.!!

Esta situación sería equivalente en el ejemplo anterior del radiodiagnóstico, a que a un paciente que necesita solamente una placa de tórax se le haga varias placas de tórax y además varias tomografías para que participen todas las empresas, que trabajan en forma independiente. Y además al paciente se le realizan varias radiografías con distintos equipos de Rayos X porque esto sería el equivalente a la presencia de las diferentes señales de wifi en un punto dado.

Se da este ejemplo para señalar que el usuario recibe una dosis de radiación mucho mayor que la que recibiría con una sola señal de wifi, la cual sería suficiente para establecer la comunicación.

La aplicación del principio de Justificación consiste en usar una sola fuente emisora y que esa fuente emisora sea la que produce las dosis más bajas en los usuarios y que permitan mantener la conectividad necesaria. La redundancia no está justificada pues aumenta las dosis recibidas.

Geolocalización continua: Por otra parte, el celular dispone de un sistema de geolocalización destinado a que el sistema de comunicación tenga información sobre la ubicación del usuario, y que funcione en forma continua, aunque el usuario no cambie su ubicación. Si el objeto es la localización no está justificado que se irradie el usuario si no cambia de ubicación o si la localización se puede realizar sin irradiarlo y/o solo cuando el usuario modifica su localización.

Debido a esta función el teléfono celular emite radiaciones en forma continua lo que contribuye a aumentar las dosis que recibe el usuario y comparando con las radiaciones ionizantes puede ser equivalente a que la persona sea obligada a llevar una fuente radioactiva en su bolsillo en forma continua para ser localizado.

Estos ejemplos permiten entender el objetivo del Principio de Justificación y como se aplica para evitar los riesgos injustificados, sean radiaciones ionizantes o no ionizantes.

Dosis colectivas: Para lograr el objetivo de la comunicación no es necesario exponer a toda la población a múltiples fuentes emisoras de campos electromagnéticos, otorgando a las empresas proveedoras una independencia que les permita establecer los sistemas y dispositivos a utilizar sin considerar el cumplimiento de los Principios de Radioprotección tal como se establece en los Principios del ICNIRP-2020 y en el ICRP-2007. Cuando las personas expuestas son muchas los cuidados deben ser aun mayores pues aumenta la Dosis Colectiva y el riesgo de cáncer es mayor.

Por otra parte hay que destacar que en el ejemplo dado del paciente que se somete a una prueba de radiodiagnóstico las dosis de radiación son recibidos solamente por el paciente que realiza el estudio de rayos X mientras que en el caso de las comunicaciones inalámbricas las antenas pueden irradiar a cientos o miles de personas en forma simultánea, muchas de las cuales no reciben los beneficios y/o lo hacen en forma involuntaria y pueden tener además problemas particulares de salud o una mayor sensibilidad a las radiaciones.

2º Aplicación del Principio de optimización:

Este Principio determina que una vez que un riesgo está justificado, se deben tomar todas las medidas necesarias para lograr que ese riesgo sea tan bajo como sea razonablemente lograble (**Principio ALARA**).

En Radiaciones Ionizantes: Volviendo al caso anterior del Radiodiagnóstico médico: ¡¡Cuando el médico prescribe una radiografía se trata de obtener esa radiografía con la menor dosis posible...!! Porque cuanto menor sea la dosis menor será el riesgo y menor será el daño del paciente. Por lo tanto, antes de tomar una placa de RX se hace un estudio previo para saber cuál es la mejor distancia de la fuente emisora al paciente y la relación existente con la posición del detector de radiación o de la placa radiográfica que se va a utilizar a fin de que la dosis sea la menor posible.

En Radiaciones No Ionizantes: Con los Campos Electromagnéticos (CEM), se debe hacer el mismo tipo de estudios pero además de las dosis (SA) recibidas por las personas expresadas en Gy (J/kg), hay otras variables que juegan un papel importante en la producción del daño biológico a un tejido; este es el caso por ejemplo de la frecuencia, del carácter pulsado de la radiación, de su polarización, de la forma de modulación y muchas otras variables que debemos considerar en la optimización porque los efectos sobre la salud dependen de todas estas variables.

Por lo tanto, para lograr que “el riesgo sea tan bajo como sea posible lograr” además de controlar las dosis, también se debe controlar debidamente el resto de las variables de la exposición pues las mismas contribuyen de alguna manera a la magnitud del daño o de la enfermedad producida.

Ejemplo de variables que inciden en los efectos de los CEM:

- **Frecuencias:** hay algunos trabajos relevantes como el realizado por Hans Geesink y Dirk Meijer, un metanálisis sobre más de 700 trabajos realizados durante 50 años, donde se concluye que existen “frecuencias saludables” y “frecuencia no saludables” para los seres humanos y los animales. Se debe tratar por lo tanto de usar para las comunicaciones inalámbricas las frecuencias consideradas como saludables.
- **Pulsado:** Ha sido demostrado en muchos estudios (REFLEX Project, por ejemplo) que el pulsado es una variable muy importante que determina que ocurran efectos o que no ocurran y por lo tanto se debe evitar, en la medida de lo posible, el uso de las emisiones pulsadas.
- **Polarización:** También se ha observado que los tejidos vivos tienen una mayor sensibilidad a los campos polarizados que a los que no lo están y esta variable debe también ser considerada.
- **Ventanas de potencia:** ¡¡Hay trabajos que sugieren la existencia de “ventanas de potencia” dado que se observan algunos efectos biológicos a determinados valores de SAR o densidad de potencia que no se observan a valores de exposición superiores o inferiores...!!

- **Intermitencia:** También es muy importante el hecho de que la exposición sea permanente o intermitente. Esto también es observado en el caso de las radiaciones ionizantes donde los efectos biológicos son de mucha menor magnitud cuando las dosis son fraccionadas en el tiempo y esta característica es aprovechada justamente para proteger algunos tejidos u órganos en Radioterapia.

En el caso de los campos electromagnéticos se observa también en personas y en animales, que si la exposición se interrumpe en general se produce la recuperación de los tejidos y los efectos observados van desapareciendo con el correr del tiempo, en particular se puede lograr una recuperación del estrés oxidativo celular que permita al organismo eliminar las especies oxidantes y los radicales libres que han sido generados mediante los mecanismos naturales del organismo.

Esta observación sobre los beneficios de la intermitencia permite suponer que una interrupción temporal de la exposición a los campos electromagnéticos podría ser beneficiosa para el organismo. Esto se puede lograr con interrupciones programadas de los equipos emisores.

- **Coherencia y, decoherencia:** También se debe considerar que dentro de las células se generan campos electromagnéticos endógenos (CEME) debido a la vibración de macromoléculas dipolares y/o componentes del microesqueleto como es el caso de los microtúbulos. Estos campos electromagnéticos generados dentro de las células pueden ser afectados positivamente o negativamente por los campos electromagnéticos externos de acuerdo a que exista coherencia o decoherencia entre los mismos. De esta situación tan particular surge el concepto de “homeostasis electromagnética”, es decir, la capacidad del cuerpo humano para mantener un equilibrio de interacciones electromagnéticas altamente complejas dentro de las células, a pesar de un entorno ruidoso electromagnético externo (De Ninno y Pernolato, 2016).

- **Conjunto de variables:** Este escenario de características complejas de la exposición a los campos electromagnéticos pareciera exigir que en el Proceso de Optimización se debieran considerar, además de las dosis, a todos los factores que pueden afectar los efectos biológicos y la salud de las personas y los animales, algunos de los cuales podrían ser los siguientes:

Relacionados con la fuente emisora

- dosis recibida y/o densidad de potencia
- duración total de la exposición
- tasa de dosis o SAR
- frecuencia de onda y longitud de onda
- modo de Polarización (lineal, circular) / no polarización.
- campos continuos o pulsados (tipo de pulso, ancho, etc.)
- modulaciones de onda/ forma de modulación
- exposición intermitente o continua y tiempo transcurrido posterior a la exposición
- características de campo cercano / campo lejano
- campos parásitos presentes “o fondo ambiental”

Relacionados con el receptor de las dosis

- coherencia y/o decoherencia entre los CEM externos y los CEM endógenos
- tipo de células o tejido utilizado y su genotipo
- el género y la edad en el caso de animales de laboratorio.
- densidad de las células en un medio (separación entre las células)

En síntesis, para aplicar el Principio de Optimización en el caso de los CEM es muy importante “**que las dosis sean tan bajas como sea posible lograr**”, pero además resulta conveniente considerar el resto de las variables en juego pues está demostrado en seres humanos y en animales que es posible disminuir la magnitud de los daños y las enfermedades variando algunos de esos parámetros. **El objetivo integral debería ser: “lograr que las dosis sean tan bajas y tan poco dañinas para la salud como sea posible lograr”**

3º Aplicación del Principio de Límites de Dosis:

El límite de dosis para los trabajadores y para el público debe ser establecido de forma de evitar los efectos deterministas y reducir los riesgos de efectos estocásticos a un valor porcentual lo suficientemente bajo para que sea aceptado por la sociedad.

1) Evitar efectos deterministas

Aplicación de límites de dosis a las Radiaciones Ionizantes:

En el caso de las radiaciones ionizantes los límites de dosis anuales de los trabajadores (20 mSv) están, como mínimo, 10 veces por debajo de las dosis que podría causar, por ejemplo, la aparición de aberraciones cromosómicas o cualquier otro efecto determinístico, por lo que un trabajador no puede en ningún caso tener efectos determinísticos, salvo que ocurra un accidente radiológico. O sea que no se conoce ningún efecto medible en animales, en personas o en estudios in vitro que ocurra a valores de 20 mSv aunque sea recibido en un período corto de tiempo. En el caso de los límites de dosis anuales para el público (1mSv/año) los valores a los cuales se observan efectos deterministas son 100 o 200 veces superiores a estos límites.

Aplicación de límites de dosis a las Radiaciones No Ionizantes:

Se debe señalar que en la exposición a los campos electromagnéticos hay efectos determinísticos que ocurren a valores de tasa de dosis que se encuentran hasta 100 veces por debajo de los límites recomendados y utilizados actualmente. Por ejemplo 1) La **co-carinogénesis** en animales de laboratorio ocurre a un SAR ≤ 0.04 W/kg, muy por debajo de los valores límite, 2) La **apertura de los canales de calcio** y la inhibición de la Calcineurina que afecta seriamente al sistema inmune del organismo, ocurre a valores 100 veces inferiores a los límites, 3) La **pérdida de la permeabilidad de la membrana hemato-encefálica** ocurre en animales a valores 100 veces inferiores a los límites. 4) **Las aberraciones cromosómicas son detectadas en linfocitos de sangre periférica** de personas que residen en las cercanías de una antena base con valores de exposición 10 veces por debajo de los límites, 5) Se ha observado la **muerte del 90% de los huevos de renacuajos** dentro del área cercana de una antena base, 6) Se ha observado **aberraciones cromosómicas (dicéntricos) en células fetales humanas** expuestas 3 horas diarias a CEM producidos por teléfonos celulares. 7) Se ha observado una **triplicación en la frecuencia de abortos en mujeres embarazadas sanas** que fueron expuestas a CEM de niveles 100 veces inferiores a los límites establecidos (2 mG). 8) Se ha observado con CEM de baja frecuencia la **duplicación de las leucemias infantiles** a valores 100 veces por debajo de los límites establecidos. 9) Se han observado efectos determinísticos (**mayor mortalidad**) en **larvas de abejas expuestas** al campo generado por un teléfono celular. 10) Hay estudios de **infertilidad y pérdida de motilidad de los espermatozoides** en animales y personas a valores de exposición por debajo de los límites establecidos. 11) Se han observado **efectos genotóxicos significativos con CEM-RF** en gusanos expuestos a valores 10 veces por debajo de los límites establecidos y el efecto se duplica cuando el campo es modulado. 12) Se han observado **daños en el ADN en trabajadores expuestos a CEM-ELF** con valores medios en los lugares de trabajo 100 veces inferiores a los límites establecidos. 13) Por exposición de solo 3 horas a teléfonos celulares, se han observado **aberraciones cromosómicas (micronucleos) en dosímetros biológicos** (Allium cepa test) **de mucha mayor intensidad** que los producidos por la exposición a 30 KBq de Plutonio-239

En síntesis, **el poder cancerígeno de las radiaciones no ionizantes es al menos 1000 veces mayor que las ionizantes pues se observan efectos determinísticos a valores inferiores a los límites recomendados por el ICNIRP mientras que en las ionizantes es necesario aumentar las dosis 100 veces por encima de los límites para observar dichos efectos.** Toda esta información observada indica que para evitar los efectos determinísticos es necesario que las dosis sean lo suficientemente bajas como para que ninguno de estos efectos pueda ocurrir por lo que **las dosis deben ser disminuidas a valores que se estima que deben estar como mínimo 100 veces por debajo de los límites actuales de densidad de potencia** y se debe añadir además un factor de seguridad para cubrir los errores estadísticos.

Esto corresponde tanto a CEM de baja frecuencia (ELF) como a CEM de radiofrecuencia (RF)

Si no se establecen límites de dosis adecuados no se cumple con el objetivo de los Principios del ICNIRP-2020 de “establecer un Marco coherente de protección contra las radiaciones en TODO EL ESPECTRO de las radiaciones ionizantes y no ionizantes”, ni tampoco se cumple con los criterios del ICRP-2007 que es el documento de referencia. Si no se cumple con los límites de dosis habría grandes diferencias entre los límites de protección para las radiaciones ionizantes y no ionizantes.

2) Disminuir los riesgos de efectos estocásticos

Además de evitar los efectos Deterministas los Principios del ICNIRP-2020 así como el ICRP-2007 recomiendan **reducir los riesgos de efectos Estocásticos a un valor porcentual lo suficientemente bajo para que sea aceptado por la sociedad.**

Requisitos para las radiaciones Ionizantes:

En el caso de las radiaciones ionizantes, el valor límite de dosis establecido para los trabajadores (20 mSv) corresponde a un aumento de la probabilidad de contraer un cáncer del 0.1% /año, y en el caso del público (1mSv) la probabilidad es del 0.005 % /año.

Situación actual de las radiaciones No Ionizantes:

Actualmente si se toman los resultados de los estudios de casos, como por ejemplo el proyecto CERENAT, se observa que hubo un aumento del 200% en la frecuencia de tumores cerebrales (OR=3) para las dosis recibidas por el uso de 900 horas del celular en toda su vida, que asumiendo un período de 20 años corresponde a dosis recibidas por un uso de 45 horas/año que corresponde a un aumento de la frecuencia de tumores cerebrales de un 10% /año.

Estudios estadísticos muy recientes realizados en Europa (Van Wel et al) dan un valor promedio de uso del celular, en cercanía del cuerpo, de 30 horas/año, por lo que el valor de 45 horas/año es un dato razonable para utilizar en los cálculos estimativos.

Este valor es coherente con los datos epidemiológicos de varios países donde, de acuerdo a las estadísticas, la frecuencia de tumores cerebrales ha subido por factor 5 (OR=5) desde la década del 90, cuando empezó a hacerse popular el uso del celular, y la pendiente actual que se observa en varios países es aproximadamente del 10% /año, con una duplicación de los casos cada 8 años.

La información que se dispone de Argentina para los Neurinomas del acústico se observa que la frecuencia se ha cuadriplicado en 10 años lo que corresponde a un aumento del 15% /año.

Por lo tanto, partiendo de la base de que actualmente hay un aumento de la frecuencia del 10% /año, para lograr que el aumento de la probabilidad de contraer un cáncer sea equivalente a los valores recomendados por el ICRP del 0.1% /año **las dosis deberían disminuir como mínimo 100 veces** y como hemos visto anteriormente, esta acción es exactamente la misma que se requiere para evitar los efectos determinísticos.

Para cumplir los objetivos de los Principios ICNIRP-2020 de “establecer un marco coherente de Protección Radiológica para Todo el espectro de Radiaciones Ionizantes y No Ionizantes” resulta por lo tanto necesario disminuir las dosis que recibe actualmente la población expuesta a los campos electromagnéticos por un factor 100 a fin de que no ocurran efectos determinísticos y que la probabilidad de tumores cerebrales y otros sea del 0.1% /año.

En el Apéndice 1 y en la bibliografía adjunta se puede encontrar mayor información sobre los efectos determinísticos y estocásticos de los CEM en las personas y los animales.

3) Disminuir también los riesgos No radiológicos:

De acuerdo a los informes de los organismos especializados en el tema, las comunicaciones inalámbricas producen un fuerte impacto sobre el Cambio Climático debido al **gran consumo de energía con relación a la comunicación cableada lo que obliga a quemar combustibles fósiles y producir un volumen creciente de gases de efecto invernadero (GEI)**. Asimismo, el combustible de los cohetes destinados al envío de satélites para el despliegue 5G produce un daño irreparable a la Capa de Ozono que determina también un aumento de la temperatura del planeta.

En el Apéndice 2 se informa sobre este tema con un poco más de detalle.

¡Es muy importante destacar que bajar 100 veces las dosis para evitar los efectos determinísticos y bajar la frecuencia de tumores cerebrales a los valores anteriores al uso del celular, contribuye también al ahorro energético y a evitar el aumento de la emisión de gases efecto invernadero que producen daños al planeta...!

¡¡Pero el ahorro de energía es también ahorro de recursos y de dinero...!! razón por la cual “las mejoras en la protección de las personas y las mejoras en el cuidado del planeta no representan un gasto para la sociedad sino más bien un ahorro de sus recursos”

Este objetivo de bajar las dosis por factor 100 se puede lograr en el corto plazo y en una forma sustentable en el tiempo, si se aplican los principios de Radioprotección y muy en particular el principio de Justificación en forma inmediata. Como complemento se pueden bajar las dosis mediante un entrenamiento adecuado de la población para el uso inteligente del celular y el conjunto de medidas para reemplazar paulatinamente la comunicación inalámbrica por la cableada.

4 - Las Medidas para proteger el medio ambiente

No hay una definición universal única para la “protección del medio ambiente” pero el objetivo general puede ser prevenir o reducir la frecuencia de los efectos deletéreos de la radiación sobre los animales y las plantas hasta un nivel en el cual tendrían un impacto despreciable para el mantenimiento de la diversidad biológica, la conservación de las especies o la salud y el estado de los hábitats naturales, las comunidades y los ecosistemas.

Se propone el uso de Animales y Plantas de Referencia con el propósito de relacionar la exposición y las dosis a los efectos sobre los organismos vivos animales y vegetales.

También es posible la utilización de dosímetros biológicos vegetales que detectan genotoxicidad por exposición a los CEM por aberraciones cromosómicas (dicéntricos) como es el caso del Allium cepa test (ajo) y el Vicia faba root (porotos). Estos dosímetros biológicos vegetales son de bajo costo, fáciles de utilizar y sensibles tanto a las radiaciones ionizantes como a las no ionizantes lo que permite hacer estudios comparativos de genotoxicidad. Los laboratorios de dosimetría biológica de radiaciones ionizantes poseen el instrumental de medición necesario para evaluar las dosis.

5 - La aplicación del Criterio Conservativo:

En los casos en que, debido a la falta de información completa, no se puede establecer exactamente cuáles son los riesgos de una práctica, se asume siempre la hipótesis más desfavorable para las personas y o los animales. **En el caso de existir dos alternativas igualmente probables se asume siempre que es correcta la alternativa que implica un mayor daño a la salud**, y conviene en este caso dar algunos ejemplos concretos de la aplicación que ha hecho el ICRP de este criterio para el caso de las radiaciones ionizantes, dado que el ICRP-2007 es el documento de referencia adoptado por el ICNIRP al establecer sus Principios ICNIRP-2020:

La aplicación del Criterio Conservativo por parte del ICRP

Ejemplo a) La relación causa/efecto de las radiaciones ionizantes se ha establecido con valores de dosis muy altas, 100 o 1000 veces superiores a los valores límites establecidos para el público. Por lo tanto, se desconoce realmente cuales son los “Efectos a Bajas Dosis”. No hay ningún trabajo científico, ni con personas ni con animales ni tampoco en estudios in vitro donde se pueda observar algún efecto a bajas dosis. Es más, hay algunos estudios (K. Rothkamm and M. Löbrich) que demuestran que es imposible que haya inducción de cáncer a bajas dosis ya que no se produce la reparación enzimática del daño pasados muchos días. No obstante “como existe una posibilidad de que esto ocurra” **el ICRP asume que es científicamente verosímil** suponer que la incidencia de cáncer crecerá en proporción directa al aumento de la dosis equivalente en los órganos y tejidos pertinentes y asume que la relación causa/efecto se mantiene incluso a dosis extremadamente bajas, inferiores a 1 mGy y se aplica el denominado modelo “lineal sin umbral” (LNT en inglés)

Ejemplo b) No se han detectado Efectos Hereditarios de la radiación ni siquiera a dosis altas, en ninguno de los grupos de estudio evaluados, pero si se han detectado efectos hereditarios en ratones y moscas a altas dosis. Ante este escenario tanto la Comisión Internacional de Protección Radiológica (ICRP) como el Committee on the Biological Effects of Ionizing Radiations (BEIR) del National Research Council (NRC) de USA, han asumido que si hay efectos hereditarios en algunos seres vivos también puede haberlos en el hombre y aun a bajas dosis y por lo tanto se incluyen estos efectos como parte del detrimiento de las personas.

Ejemplo c) Cuando se debe asumir una dieta o una conducta de los pobladores cercanos a una instalación nuclear o radiactiva siempre se toma aquella dieta o conducta que resulta en las mayores dosis para el poblador, aunque la misma sea extremadamente improbable.

La aplicación del Criterio Conservativo a los CEM La aplicación del criterio conservativo es muy importante en el caso de las radiaciones no ionizantes para aquellos casos en que existan dudas porque la evidencia científica no es concluyente. Como recomienda el ICRP en estos casos se debe estar siempre del lado seguro cuando se trata de la protección de las personas, asumiendo aquella hipótesis que benefician a la gente.

Por lo tanto, si existen evidencias en estudios sobre animales se debe considerar que los mismos efectos pueden ocurrir en las personas

6 - Efectos científicamente comprobados (criterios de Sir Bradford Hill):

En los Principios del ICNIRP 2020 se establece que para tomar determinaciones y establecer requerimientos regulatorios es imprescindible que los “efectos estén científicamente comprobados”. Para lograr “efectos científicamente comprobados” es fundamental la aplicación de los 9 Criterios formulados por Sir Bradford Hill (1965) que son imprescindibles para determinar la “Causalidad”.

En síntesis, las desiciones no pueden ser tomadas sobre la base algunos trabajos sino “**sobre el conjunto de toda la información existente**” utilizando los **9 Criterios formulados por Sir Bradford Hill**.

Esta tarea ha sido realizada por dos prestigiosos expertos del IARC: los doctores Lennart Hardell y Christopher J. Portier, que han considerado la totalidad de la información científica que incluye trabajos in vitro, estudios de casos, estudios sobre animales, estudios estadísticos, etc y ambos han concluido que las pruebas de Causalidad de los campos electromagnéticos en los casos de tumores cerebrales como los gliomas y los Neurinomas del acústico son muy fuertes, razón por la cual **la causalidad está debidamente demostrada**.



PROPUESTA DE RECOMENDACIONES A CONSIDERAR

A fin de cumplir con los Principios establecidos por la Comisión Internacional de Protección de las Radiaciones No Ionizantes (ICNIRP) en la Norma “ICNIRP Statement Principles for Non-Ionizing Radiation Protection”, publicada en la revista Health Physics en el año 2020, las autoridades competentes de cada país establecerán las medidas necesarias para su efectivo cumplimiento, manteniendo la necesaria conectividad para las comunicaciones y el acceso libre a internet de todas las personas.

Requisitos básicos:

- 1 – Se recomienda tomar todas las medidas necesarias para que ningún trabajador ni ninguna persona del público reciba dosis que puedan producir efectos deterministas y que los efectos estocásticos tengan una probabilidad de ocurrencia inferior al 1% /año a fin de bajar la frecuencia de cánceres, en particular los cerebrales, a los valores existentes al comienzo del uso de teléfonos celulares, sin que las medidas afecten las comunicaciones y el acceso libre a internet de todas las personas que lo requieran.
- 2 - El uso de la comunicación inalámbrica será debidamente regulada de tal forma que permita al país cumplir con los objetivos del Acuerdo de París sobre el Cambio Climático el cual establece restricciones para la emisión de gases efecto invernadero (GEI) para limitar el aumento de temperatura del planeta a 1.5º C para lo cual se deberán tomar medidas efectivas para evitar todo uso que no esté debidamente justificado.

3 - Aplicación del Principio de Justificación: Estarán vedadas todas las prácticas o actividades y/o el uso de dispositivos electrónicos que generen campos electromagnéticos sin obtenerse un beneficio neto y/o signifiquen un gasto de energía innecesario, o que puedan ser remplazados por dispositivos cableados que no emitan radiaciones, como, por ejemplo:

- Se evitará que los equipos de transmisión inalámbrica estén conectados y activos cuando no son necesarios por lo que deberán ser de apagado automático cuando no son requeridos, en particular en los horarios nocturnos.
- Se evitará que en lugares públicos coexistan más de tres señales de wifi salvo que se demuestre fehacientemente que resultan imprescindibles para la conectividad.
- Las antenas base para redes celulares de comunicación inalámbrica no operarán si la conectividad puede ser realizada y mantenida satisfactoriamente por las señales de wifi existentes en un lugar determinado.
- Tampoco será permitido el uso de satélites en órbitas bajas si su objetivo son comunicaciones que pueden ser remplazadas con las antenas emisoras terrestres. En síntesis, no está permitida la redundancia de los emisores de campos electromagnéticos porque la misma vulnera el principio de Justificación establecido en las normas internacionales vigentes y en todos los casos se dará preferencia a las antenas emisoras que produzcan las menores dosis colectivas a la población expuesta.
- Como regla general, en todos aquellos casos en que se disponga de varias alternativas para la comunicación inalámbrica siempre se deberá utilizar aquella que produzca la menor dosis colectiva y el menor gasto energético con el fin de evitar un aumento de los riesgos para la salud y el aumento del consumo de energía.
- El uso de toda emisión de wifi será libre para todas las personas, sin requerir un código o password de autorización, lo cual no significa que deba ser gratuito.
- Los celulares [teléfonos móviles] que dispongan de un sistema de geo-localización que opere en forma continua deberán ser remplazados a la mayor brevedad por un sistema de localización basado en el GPS y/o un sistema de localización manual operado por el propio usuario cuando deba cambiar su ubicación geográfica (cambio de celda) y decida comunicarlo. En síntesis, no

estará permitida la emisión electromagnética automática y continua de ningún dispositivo electrónico, salvo la necesaria para la comunicación del propio usuario del mismo.

- Todos los dispositivos inalámbricos que permanezcan fijos en un lugar determinado deberán ser cableados para evitar la emisión de radiaciones, aumentar la velocidad de comunicación y disminuir el gasto de energía y el uso de baterías.
- La publicidad y las promociones comerciales no deberán realizarse en forma inalámbrica sino solamente en forma cableada. Se ha comprobado que más del 90% del tráfico inalámbrico, de acuerdo al horario, corresponde a la publicidad y las promociones comerciales, no solicitadas por los usuarios, lo que produce una gran congestión que dificulta la comunicación de los sistemas de emergencia, produce retardos, un mayor gasto de energía y recursos y un daño significativo al medio ambiente y a la salud de las personas, todo lo cual debe ser evitado. A mayor emisión de mensajes corresponde una mayor dosis colectiva de la población expuesta y de los animales y plantas que se encuentran en las inmediaciones.
- La comunicación de los dispositivos electrónicos con los centros de datos, denominados habitualmente “nubes”, para el back-up de los dispositivos, deberán realizarse únicamente en forma cableada que es de mayor velocidad, mayor capacidad de envío de información y de mucho menor consumo de energía. Para cumplir este requisito con los dispositivos electrónicos se deberá contar con facilidades de conexión de los mismos tanto en los domicilios particulares como en las empresas y en los lugares públicos para poder realizar periódicamente el back-up de los dispositivos electrónicos.

4 - Excepciones (Waivers): Cuando existan circunstancias especiales o condiciones en las cuales el operador o responsable de la práctica juzgue que la comunicación no puede ser realizada cumpliendo los requisitos establecidos podrá hacer un “Pedido de excepción a la autoridad competente” fundamentando las razones que dificultan la conectividad, formulando una propuesta alternativa y una estimación de las dosis colectivas que trae aparejada la aprobación de dicha excepción. La aplicación de las Recomendaciones establecidas no debe impedir ni dificultar la conectividad que debe ser mantenida evitando las consecuencias para la salud de las personas y del medio ambiente. Se tomarán los cuidados necesarios para asegurar la conectividad adecuada de los servicios de emergencias, policiales, médicos y de bomberos, entre otros.

5 - Medidas estructurales complementarias: A fin de facilitar y estimular todas aquellas formas de comunicación que son de menos riesgo para la salud de la población y de la biota:

- Se deberán desarrollar y optimizar las redes nacionales de banda ancha que cubran el país y se ramifiquen en todos los pueblos y ciudades facilitando las comunicaciones cableadas.
- Se realizarán, asimismo, en forma complementaria, los cableados Ethernet domiciliarios, industriales, comerciales y muy en especial en los colegios y universidades para evitar el uso del wifi en la enseñanza.
- En los lugares públicos, plazas y avenidas principales se instalarán conectores RJ-45 a fin de que aquellas personas que deseen comunicarse en forma cableada puedan hacerlo. Los conectores a internet pueden también incluir la alimentación de corriente continua para evitar el uso de baterías para lo cual se podrá disponer de conectores apropiados (Standard IEEE 802.3cg)
- Todos los teléfonos fijos deben disponer de pantallas táctiles, memorias múltiples, discado automático a partir de los contactos existentes, manejo por vos sin necesidad de usar el tubo, conexión a internet, gestión de reuniones tipo zoom o meet u otras aplicaciones y todos los avances necesarios para su uso normal dado que la comunicación cableada es más económica, no gasta baterías, es mucho más rápida, tiene mayor capacidad de transmisión de datos, menor tiempo de latencia y no provoca daños a la salud y el medio ambiente.
- Se desarrollarán medidas impositivas y de estímulo que promuevan y alienten el uso de la comunicación cableada y desalienten el uso de la comunicación inalámbrica a fin de fomentar las buenas prácticas y crear en la población una cultura de la Radioprotección, del ahorro de energía y del cuidado del medio ambiente, en particular en los jóvenes.

Nota: Se debe señalar que la política de las empresas telefónicas ha sido la de estimular la comunicación inalámbrica y desalentar el uso de la telefonía cableada razón por la cual no se ha realizado como corresponde la actualización de los teléfonos fijos. Esta política incorrecta fue señalada por el Consejo de Europa en la Resolución 1815/2011 y debiera ser fuertemente penalizada pues es una de las principales razones por las que se prefiere una forma de comunicación que provoca mayores daños a la salud y el medio ambiente además de producir un consumo mayor de energía y gasto de baterías.

De acuerdo a la opinión del National Institute for Science, Law & Public Policy Wash, DC, de los Estados Unidos “*La historia de la infraestructura de comunicaciones de los EE. UU. demuestra en forma fehaciente, que, de acuerdo a la experiencia, no es realista esperar que los monopolios, duopolios o triopolios privados, regulados o no regulados, realicen las inversiones a largo plazo necesarias para construir la carretera pública de información de fibra óptica de banda ancha duradera y sostenible que un país necesita. Las corporaciones buscarán invariablemente el camino más barato, rápido y rentable, lo que ha llevado al énfasis actual de la tecnología inalámbrica*”

Estas reflexiones basadas en la experiencia de esta prestigiosa institución de los Estado Unidos nos hacen suponer que es totalmente inaceptable que sean las empresas las que decidan las políticas de comunicación basadas en sus intereses comerciales y no las instituciones representativas de la sociedad en que vivimos. Se está promoviendo un sistema que es más costoso, más lento, con menor capacidad de transmisión de datos y que provoca enfermedades graves como es el caso de los tumores cerebrales que actualmente provocan en el mundo 1000 muertes diarias, sin mencionar la suma de otros trastornos graves para la salud y el medio ambiente que agobian a la humanidad.

Debiera ser la población y sus representantes las que tomen las decisiones sobre las políticas a seguir con el asesoramiento de los organismos técnicos especializados en comunicaciones, medicina, biología, epidemiología, medio ambiente, cuidado de animales y plantas, el cambio climático, etc.

6 - Aplicación del Principio de Optimización:

- Se utilizará la comunicación inalámbrica solo en aquellos casos en que no pueda ser reemplazada por la comunicación cableada.
- Cuando la comunicación inalámbrica sea la única alternativa posible se debe lograr que “las dosis sean tan bajas como sea razonablemente posible lograr” para lo cual la señal emitida por una antena debe tener la intensidad necesaria y la suficiente para la conexión con los dispositivos a los cuales está dirigida dicha señal.
- Pero además de las dosis también se debe controlar el conjunto de las variables que intervienen en la exposición pues las mismas pueden contribuir a la magnitud del daño o la magnitud del riesgo de contraer enfermedades en las personas o en otros seres vivos. Para cumplir este requisito se determinará en cada caso cuales son los parámetros de la emisión electromagnética que producen menos daños a la salud sin afectar la conectividad necesaria para cumplir con los objetivos de la emisión electromagnética considerada.

7 - Aplicación del Principio de Límite de Dosis:

- El límite de dosis para los trabajadores profesionalmente expuestos y para el público en general debe ser establecido de forma tal que evite la ocurrencia de todo tipo de efectos deterministas en personas o seres vivos y reduzca los riesgos de efectos estocásticos, en particular los tumores cerebrales, a una frecuencia límite de un 1% /año.
- Considerando los resultados de varios estudios de casos realizados y el incremento actual de la frecuencia de tumores cerebrales observado en varios países que han publicado sus estadísticas, se estima que los límites de dosis que se establezcan deben ser aproximadamente 100 veces inferiores a los valores actuales de dosis que recibe la población.

- Se deben desarrollar dosímetros personales para evaluar las dosis que reciben las personas, en particular aquellas de mayor exposición como son los trabajadores profesionalmente expuestos a los campos electromagnéticos. Se deberán determinar las dosis promedio en el cuerpo y las dosis en los tejidos u órganos de mayor exposición como por ejemplo las dosis en el lóbulo temporal del cerebro, en la tiroides, en el colon y el recto y en los órganos de reproducción.
- Para proteger la vida animal se deberán evaluar las dosis en los lugares de mayor exposición utilizando dosímetros físicos y biológicos, así como realizando estudios poblacionales de las especies que se consideren más sensibles como puede ser el caso de insectos polinizadores como las abejas y algunos anfibios como las ranas y realizar el monitoreo ambiental de los espacios que se reserven para proteger la vida silvestre.
- Se recomienda que los teléfonos celulares cuenten con aplicaciones destinadas a medir la intensidad de los campos electromagnéticos presentes y su integración temporal para poder estimar las dosis que puede recibir el portador del mismo. Estas aplicaciones dosimétricas pueden incluir señales de alarma para alertar al usuario sobre valores de dosis que se aproximen a los valores límites establecidos por la autoridad competente.

8 – Protección de personas de mayor sensibilidad:

- Se deberá establecer un valor de dosis en el que no se observe ningún tipo de efectos adversos (NOAEL) (no observed adverse effect level) a fin de proteger a las personas de mayor sensibilidad o mayor riesgo como es el caso de los niños, las mujeres embarazadas, los enfermos de cáncer y las personas hipersensibles.
- En los lugares públicos de mayor concurrencia se deberá disponer de lugares debidamente protegidos para que puedan permanecer las personas de mayor sensibilidad.
- Las autoridades deberán tomar medidas para asegurar la disponibilidad en el mercado de los materiales de protección de los campos electromagnéticos para las personas que los requieran para sus viviendas y para su protección personal.

9 - Uso de Indicadores para monitorear la eficacia de las medidas de control:

- Se recomienda llevar un registro de las dosis promedio que recibe la población en general a fin de evaluar la eficacia de las medidas tomadas para su control efectivo.
- Se deberá llevar una estadística de la frecuencia de las enfermedades relacionadas con la exposición a los campos electromagnéticos como es el caso de los tumores cerebrales (gliomas, glioblastomas, neurinoma del acústico), cánceres de tiroides, de colon y recto y de testículos. Las estadísticas deberán ser sectorizadas para cada grupo etario a fin de poder evaluar eventuales cambios en la edad a que se producen las distintas afecciones.
- Se deberá determinar la producción de gases de efecto invernadero (GEI) que son originados anualmente por la comunicación inalámbrica y se debe evaluar si dichos valores permiten cumplir con los objetivos establecidos en el Acuerdo Internacional sobre el Cambio Climático.
- Se deberá llevar una estadística de la población de las especies animales de mayor sensibilidad como es el caso de los insectos polinizadores, en particular las abejas y las aves migratorias.

10 - Las medidas de mayor urgencia:

Es necesario disminuir las dosis que recibe la población con relativa urgencia, fundamentalmente para bajar la frecuencia de tumores cerebrales que ocasiona miles de muertes diarias, para evitar todos los efectos estocásticos que son muchos y bajar la producción de GEI y para ello las medidas más eficaces, y por lo tanto las de mayor urgencia, son la eliminación de la geolocalización automática de los teléfonos celulares y anular las emisiones de las antenas base cuando la conectividad puede ser cubierta por las emisiones de wifi presentes. Se estima que estas dos medidas pueden bajar por factor 100 las dosis actuales.

APÉNDICE 1

Información Biológica y Epidemiológica producida por la exposición de los seres vivos los Campos Electromagnéticos. Se seleccionaron solo algunos casos que se consideran más relevantes y/o representativos.

1 - El crecimiento de la frecuencia de los tumores cerebrales:

Esto se vio en varios países que cuentan con estadísticas epidemiológicas desde antes del inicio del uso de los teléfonos celulares, como es el caso de Francia, Suecia, Australia, Inglaterra y Brasil donde la frecuencia de tumores se ha triplicado, cuadriplicado y quintuplicado y sigue creciendo en promedio un 10% cada año.

También en Argentina se ha observado un aumento de la frecuencia de los Neurinomas del acústico y en particular la de los más agresivos (grado 4) denominados gigantes, que se quintuplicaron en solo 10 años. Todo esto confirma los resultados de varios estudios de casos, las evidencia de ipsilateralidad, los estudios sobre animales realizados en los últimos años y los estudios in vitro donde se han comprobado en forma redundante los mecanismos de producción de cáncer.

Además, para confirmar la causalidad dos expertos del IARC (los Dres. C. Portier y L. Hardell) aplicaron los 9 criterios de Sir Bradford Hill obteniendo una muy fuerte evidencia de la causalidad atribuida a la exposición a los campos electromagnéticos (CEM).

Actualmente el aumento de la frecuencia es en promedio de un 10% cada año y esto está relacionado con un uso calculado del celular en proximidad de aproximadamente 45 horas/año.

Estos datos de aumento de la frecuencia de tumores cerebrales que son de alta morbilidad (glioma y glioblastoma multiforme) son muy coherentes con los resultados de varios estudios de casos, como por ejemplo el CERENAT, que da cuenta de la triplicación de la frecuencia (OR = 3) con un uso del celular de por vida de 900 horas.

Si se asume que este fenómeno ocurre también en los países que no tienen estadística de los mismos y se extrapolan los datos obtenidos en los países con estadísticas al total de los países, la suma de muertos por tumores cerebrales, y desde el inicio del uso de los celulares, se calcula en 4 millones de personas fallecidas. No se observa haberse llegado a un valor de equilibrio y la frecuencia sigue aumentando exponencialmente y se duplica cada 8 años por lo que si no se toman medidas ahora la situación irá empeorando con el transcurso del tiempo.

Correspondería entonces bajar el aumento de la frecuencia actual de tumores cerebrales de un 10% anual a un 1 por mil que es el valor recomendado por la Comisión Internacional de Protección Radiológica (ICRP) para los trabajadores con radiaciones ionizantes que tienen establecido un límite anual de dosis de 20 mSv lo que equivale justamente a un aumento de la frecuencia de cáncer de un 1 por mil. (Para los miembros del público el aumento de frecuencia es 20 veces inferior)

Lograr este descenso de la probabilidad de tumores cerebrales y por ende la tasa de mortalidad requiere tomar medidas para bajar las dosis promedio de la gente a valores 100 veces inferiores a las actuales lo que se puede lograr disminuyendo proporcionalmente el tiempo de uso del celular o disminuyendo la densidad de potencia producida por las antenas base y la densidad de potencia producida por el propio celular.

2 – La disminución de las defensas naturales del organismo por los efectos que producen los CEM al sistema inmune:

Hay un primer fenómeno sobre las defensas que se produce por la apertura de los canales de calcio localizados en la membrana celular lo que determina el ingreso descontrolado de iones calcio al interior de las células produciendo inicialmente la síntesis de óxido nítrico y luego un conjunto de reacciones que incluyen la producción de peroxinitrito y radicales libres que determinan finalmente

“la inhibición de la Calcineurina” que es una enzima esencial para la producción y diferenciación de las células T cuya función es proteger del ingreso de agentes externos al organismo como virus, bacterias, hongos y parásitos, lo determina un aumento de los riesgos inherentes a las infecciones y por ende mayor número de muertes por la imposibilidad de usar las defensas naturales. Esta situación en el caso de una pandemia es doblemente grave.

Asimismo, los CEM provocan un aumento de la permeabilidad de la membrana hemato-encefálica disminuyendo su función de protección al ingreso de toxinas, macromoléculas, virus y bacterias lo que expone a las neuronas a daños que han sido cuantificados en diversas experiencias con animales de laboratorio.

Se debe señalar que estos dos procesos de apertura de los canales de calcio y aumento de la permeabilidad de la membrana hemato-encefálica ocurren a valores de dosis 100 veces inferiores a los límites establecidos, razón por la cual es conveniente disminuir los límites actuales a valores 100 veces inferiores.

En relación con el sistema inmune y las infecciones se puede agregar que muy recientemente Taheri et al (2017) han demostrado que la exposición a la radiación de teléfonos móviles y de Wi-Fi determina que 2 bacterias, la Listeria monocytogenes y la Escherichia coli se hacen resistentes a diferentes antibióticos. Considerando que la listeriosis es una enfermedad mortal con síntomas de aborto, septicemia y meningitis, este es un hecho que debe ser tenido en cuenta.

3 – El poder co-cancerígeno de los CEM que aumenta la mortalidad del cáncer por el incremento del número y tamaño de los tumores existentes, y su metástasis:

A diferencia de las Radiaciones Ionizantes (RI) que actúan solamente en la etapa inicial de “Inducción” en el proceso de Cancerogénesis, los campos electromagnéticos y en particular los pulsados, además de inducir el inicio del proceso de cancerogénesis por daño de la molécula de ADN, actúan, en la etapa final de “Progresión” produciendo un aumento del número, tamaño y agresividad de los tumores pre-existentes hayan sido estos inducidos en forma natural o por agentes químicos o físicos. Este efecto particular determina que se deban tomar medidas de protección de los enfermos de cáncer que se encuentren en proceso de recuperación o tratamiento, razón por la cual los radioterapeutas y oncólogos deben estar debidamente informados y preparados para tomar las medidas de radioprotección correspondientes.

Este proceso ha sido comprobado, tanto en personas (INTEROCC) como en animales (Tillmann, Lerchl) y sea cual fuere el origen del tumor, de origen químico (Tillmann, Lerchl, Ramazzini) o de origen físico (Inst. Ramazzini), con CEM de baja frecuencia (INTEROCC, o con CEM de Radiofrecuencia (Tillmann, Lerchl) y se conocen también los mecanismos que lo originan a través de efectos epigenéticos que determinan el cambio en la expresión genes y oncogenes (REFLEX).

Cabe consignar aquí también, como se señala en los dos puntos anteriores, que los efectos co-cancerogénicos se producen a valores de exposición que están 100 veces por debajo de los valores límites de protección establecidos por el ICNIRP ($SAR \leq 0.04 \text{ W/kg}$), razón por la cual también aquí corresponde bajar las exposiciones al menos por un factor 100 para prevenirlos.

4 –Daños a la vida animal y en particular para algunas especies que están en peligro de extinción a causa de los campos electromagnéticos.

Los riesgos sobre la salud y de muerte, algunos de los cuales ya se han señalado para los seres humanos, son mucho mayores para el caso de algunas especies de animales y plantas que son más sensibles y determinan un aumento en la mortalidad y la reducción de las poblaciones afectando la biodiversidad.

En una revisión realizada sobre alrededor de 1000 estudios sobre diferentes animales plantas y vida silvestre en el 70% de los casos se encontró que había impacto sobre la vida animal a valores inferiores a los límites establecidos, tanto con bajas frecuencias como con radiofrecuencias.

El caso de mayor preocupación es el de las abejas; cuando los investigadores acercan a las colmenas de abejas la radiación de un teléfono celular, las abejas que ocupan la colmena eligen alejarse y nunca regresar. En esos casos la reina queda sola con sus ayudantes y finalmente la vida de la colmena termina. La exposición a un celular de los huevos y pupas en desarrollo de una colmena provoca la muerte de gran parte de las mismas. En todo el mundo se observan reducciones drásticas en las poblaciones de insectos polinizadores, en particular en Alemania, donde más del 75% de ellos ha desaparecido. En la India se observó la merma de la producción de frutas por la disminución de la polinización.

Se ha hecho un experimento con ranas cerca de una antena base que duró dos meses. Se colocaron cerca de la antena de red celular huevos de ranas desde la fase inicial hasta una fase avanzada del renacuajo antes de la metamorfosis. Las medidas de intensidad del campo eléctrico estuvieron entre 1,8 y 3,5 V/m, o sea muy por debajo de los límites del ICNIRP para esa frecuencia que son 61 V/m.

En el grupo de renacuajos expuestos ($n = 70$) se observó una baja coordinación de los movimientos, un crecimiento asincrónico, resultando en renacuajos muy grandes y muy pequeños, y una alta mortalidad (90%). Respecto al grupo control ($n = 70$) que fue mantenido exactamente en las mismas condiciones, pero dentro de una jaula de Faraday, la coordinación de movimientos fue normal, el desarrollo fue sincrónico y se obtuvo una mortalidad de solo el 4.2%.

En una granja de Suiza con vacas que estaban expuestas a una antena base de red celular se producían abortos espontáneos y algunos terneros nacían con cataratas nucleares. Cuando la antena dejó de funcionar todos los problemas desaparecieron. La antena se volvió a conectar y los mismos problemas volvieron a aparecer hasta que se decidió desconectarla en forma definitiva.

En Europa se ha notado en las grandes ciudades una disminución de la población de gorriones y algo semejante ocurre con las aves migratorias que no vuelven a los lugares donde habitualmente se apareaban y anidaban.

Las plantas y árboles son también sensibles a la proximidad de las antenas base observándose diferencias claras en las plantas del lado que se encuentra más cercano a la antena emisora.

Todos estos resultados y otros muchos que no se mencionan indican que la radiación emitida por las antenas base de red celular en una situación de la vida real puede afectar el desarrollo y puede causar un aumento en la mortalidad de distintas especies animales y plantas lo cual afecta sensiblemente la conservación de la biodiversidad.

Nota: Hay muchos otros efectos sobre la salud que se han observado sobre el Sistema reproductor masculino y femenino en personas y animales incluyendo los abortos espontáneos, sobre el sistema endocrino y las hormonas, sobre el Sistema de circulación sanguínea, sobre el Sistema nervioso con enfermedades neurológicas y psiquiátricas, y en ejemplares de diversas especies, como gusanos, hormigas, reptiles, murciélagos, aves, mamíferos, peces y microorganismos.

APÉNDICE 2

Aspectos no radiológicos de los campos electromagnéticos: el Cambio Climático, la Capa de Ozono y los Usos Militares.

1 - El fuerte impacto de las comunicaciones inalámbricas en el cambio climático:

De acuerdo a los informes de los organismos especializados en el tema como son: El Instituto Nacional de Ciencias y Políticas Públicas de los Estados Unidos (NISLAPP), La Agencia Federal del Medio Ambiente de Alemania (UBA) y El Centro de Investigaciones de Eficiencia Energética en Telecomunicaciones de Australia (CEET), la comunicación inalámbrica representa un tremendo derroche de energía con relación a la cableada dado que consume 10 veces más, lo que necesariamente obliga a quemar combustibles fósiles y producir un volumen creciente de gases de efecto invernadero (GEI) y el consiguiente aumento de la temperatura del planeta y el riesgo de desastres ambientales.

La transmisión con 4G produce 6 veces más emisiones de CO₂ en comparación con la fibra óptica o el cable. Del 2012 al 2015 se pasó de emitir 6 millones a 30 millones de toneladas de CO² o sea que se quintuplicó en 3 años y esto fue debido al uso excesivo de comunicación inalámbrica.

El Wifi aumenta poco el uso de energía, pero cuando ocurre el acceso a través de una torre de red celular, ¡¡el uso de energía se dispara...!! ¡¡El 4G consume 23 veces más que el Wifi...!!

Por otra parte, las redes de fibra óptica y cobre son muy superiores a las inalámbricas en Velocidad, Seguridad y Costo..., razón por la cual se está produciendo un daño al planeta y a la gente sin obtener beneficios a cambio.

Se debe analizar en los cambios tecnológicos cuales son las ventajas y las desventajas. El uso de la comunicación inalámbrica de acuerdo a la opinión de los organismos especializados implica básicamente:

- Costos mayores que los sistemas cableados.
- Menor Velocidad de transmisión y Mayor período de Latencia.
- Sensibilidad a los ciber-ataques y al robo de información.
- Menor eficiencia y un gasto de energía 10 veces superior al cableado.
- Mayor vulnerabilidad y menor resistencia a los eventos naturales.
- Mayor retraso y pérdida de datos por congestión y bloqueos.
- Necesidad de actualizaciones periódicas por obsolescencia.
- Dependencia de un sistema de baterías que además de ser más costoso, afectan el medio ambiente.
- Riesgos para la salud y en particular tumores Cerebrales, de Tiroides, en Colon y Recto, en Testículos, daños al Sistema Inmunológico, al de Reproducción, al Sistema Nervioso, al Sistema Sanguíneo y al Sistema Endocrino con un mayor riesgo para los niños y las mujeres embarazadas.
- Se estima que solo debido a los tumores cerebrales ya han ocurrido 4 millones de fallecimientos y la frecuencia sigue aumentando a una tasa de un 10% cada año
- Daños a diversas especies de animales, insectos, aves y plantas.
- Riesgo de calentamiento global por emisión de CO₂ y daño a la capa de ozono.

Asimismo, el combustible de los cohetes destinados al envío de decenas de miles de satélites para el despliegue 5G produce un daño irreparable a la Capa de Ozono que producirá también un aumento de la temperatura en diversas latitudes del planeta. Un modelo predice la pérdida de ozono de hasta un 4% en trópicos y subtrópicos, y un aumento de 3 grados Celsius en la temperatura de verano sobre el Polo Sur, un aumento de más de 1 grado Celsius en la temperatura antártica y la disminución del hielo antártico en un 5 %.

Los países firmantes del Acuerdo de París se han comprometido a tomar medidas para evitar el aumento de la temperatura del planeta a más de 1.5º C, razón por la cual deberá también tomarse medidas para disminuir el consumo energético, lo cual redundará también en una mayor protección de la salud de la gente y un ahorro de dinero para aumentar la investigación con fines pacíficos.

También aquí, como en otros puntos anteriores, bajar 100 veces las dosis aplicando los 3 Criterios de Protección Radiológica utilizados contribuye también al ahorro energético, a evitar los daños al planeta y mejorar la protección de la gente.

2 – Los usos del 5G con objetivos militares:

En el contexto del lanzamiento de 5G, existe el riesgo del uso de tecnologías ciberneticas y de inteligencia artificial, en los cielos y en el ciberespacio para el aumento de la letalidad de la guerra al permitir la comunicación casi en tiempo real y el uso de armas, drones y misiles hipersónicos para el dominio de la tierra y el espacio.

El uso del 5G por los militares puede determinar que tarde o temprano esa tecnología llegue también a los grupos terroristas que podrán realizar en todo el mundo ciberataques devastadores y a gran escala. Esta posibilidad es muy preocupante para la población y sería deseable que el 5G no sea utilizado para usos bélicos para lo cual la mejor garantía sería evitar su despliegue a nivel mundial.

Los satélites pueden ser usados para llevar cabezas nucleares y conducirlos a objetivos militares de forma tal que Nagasaki e Hiroshima pueden repetirse a nivel espacial.

La empresa SpaceX, entre otras empresas privadas, se está asociando con el ejército para proporcionarle una conexión satelital de doble uso para los militares a través de su programa de Internet de banda ancha Starlink. El resultado es que los clientes que se suscriben al servicio de Internet de Starlink están, al menos en parte, financiando el armamento del espacio. Este puede ser uno de los objetivos del 5G.

Conviene recordar que los usos militares de la energía nuclear provocaron grandes desastres ambientales, polución de los mares y del medio ambiente. Incluso el desastre de Chernóbil se origina en un reactor plutonígeno de usos militares que no tenía las protecciones y las medidas de seguridad de las centrales nucleares comerciales.

Bibliografía sobre los campos electromagnéticos (CEM) y los distintos efectos sobre la salud y el medio ambiente y sobre el impacto que produce la comunicación inalámbrica en el Cambio Climático y Referencias utilizadas para la aplicación de los Criterios de Radioprotección a los Campos Electromagnéticos.

Trabajos Básicos de Referencia: 9 Trabajos de Revisión sobre los CEM y 6 Referencias utilizadas para la aplicación de los Criterios de Radioprotección del ICRP – ICNIRP – IAEA – IRPA

1. “Risks to Health and Well-Being from Radio-Frequency Radiation Emitted by Cell Phones and Other Wireless”. Devices Anthony B. Miller¹, Margaret E. Sears², L. Lloyd Morgan³, Devra L. Davis³, Lennart Hardell⁴, Mark Oremus⁵ and Colin L. Soskolne^{6,7} (Edited by: Dariusz Leszczynski, University of Helsinki, Finland) **Frontiers in Public Health**. 1 Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada, 2 Ottawa Hospital ResearchInstitute, Prevent Cancer Now, Ottawa, ON, Canada, 3 Environmental Health Trust, Teton Village, WY, United States, 4 The Environmentand Cancer Research Foundation, Örebro, Sweden, 5 School of Public Health and Health Systems, University of Waterloo,Waterloo, ON, Canada, 6 School of Public Health, University of Alberta, Edmonton, AB, Canada, 7 Health Research Institute,University of Canberra, Canberra, ACT, Australia. **Frontiers in Public Health**, review article published online: 13 August 2019. Public full text online: <https://doi.org/10.3389/fpubh.2019.00223>.
2. “Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A)”. L. Lloyd Morgan¹, Anthony B. Miller², Annie Sasco³ and Devra Lee Davis¹ (1 Environmental Health Trust, Teton Village, WY 83025, USA; 2-Dalla Lana School ofPublic Health, University of Toronto, Toronto, ON M4N 3P7, Canada; 3- INSERM, ISPED, Centre INSERM U897-Epidémiologie-Biostatistique, F-33000 Bordeaux, France), **International journal of oncology May-2015. Volume 46 Issue 5. Rewied article published online on: February 25, 2015:** <https://doi.org/10.3892/ijo.2015.2908>
3. “Dependence of non-thermal biological effects of microwaves on physical and biological variables: implications for reproducibility and safety standards”. Igor Y Belyaev (Laboratory of Molecular Genetics, Cancer Research Institute, Bratislava, Slovak Republic.Laboratory of Radiobiology, General Physics Institute, Russian Academy of Science, Moscow, Russia. Department of Genetic and Cellular Toxicology, Stockholm University, Stockholm, Sweden). Published in **European Journal of Oncology - Library Vol. 5 (2010)**, ICEMS Monograph: “Non-Thermal effects and mechanisms of interaction between electromagnetic fields and living matter”. Public full text online: https://www.researchgate.net/publication/284970330_Dependence_of_non-thermal_biological_effects_of_microwaves_on_physical_and_biological_variables_Implications_for_reproducibility_and_safety_standards
4. “An integral predictive model that reveals a causal relation between exposures to non-thermal electromagnetic waves and healthy or unhealthy effects”. Hans J Geesink¹ and Dirk K F Meijer² (1 Previous Project Leader Nanotechnology, DSM-Research, The Netherlands. 2 Em, Professor of Pharmacology, University of Groningen, Groningen, The Netherlands). Project: Quantum Coherence in Animate and Non-animate Systems. April 2020. Public full text online: https://www.researchgate.net/publication/340488204_An_integral_predictive_model_that_reveals_a_causal_relation_between_exposures_to_n-on-thermal_electromagnetic_waves_and_healthy_or_unhealthy_effects
5. “Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation”. Michael Carlberg and Lennart Hardell, Department of Oncology, Faculty of Medicine and Health, Orebro University, 701 82 Örebro, Sweden **BioMed Research International**, Volume 2017, Article ID 9218486, 17 pages, <http://dx.doi.org/10.1155/2017/9218486>

6. “Expert Report” on brain tumor risk from exposure to radio frequency (RF) radiation used in cellphone technology. Exhibit C. Murray et al. v. Motorola, Inc. et al. Superior Court for the District of Columbia. March 1, 2021. Author: Christopher J. Portier, Ph. D. Director of the Environmental Toxicology Program (ETP) at NIEHS. Director of the National Center for Environmental Health (NCEH) Director of the Agency for Toxic Substances and Disease Registry (ATSDR). NCEH Chair from 2005 to 2010 of the Subcommittee on Toxics and Risk of the President’s National Science and Technology Council, Chair of EPA’S Science Advisory Panel from 1998 to 2003. Chair of the International Agency for Research on Cancer (IARC). Public full text online:
<https://drive.google.com/file/d/1we0YEJslnrmQkr2qzSFnQyqdsTqXbqSd/view>
7. “5G: Great risk for EU, U.S. and International Health, Compelling evidence for eight Distinct Types of great harm caused by Electromagnetic Field (EMF) exposures and the mechanism that causes them”. Martin L. Pall, PhD Professor Emeritus of Biochemistry and Basic Medical Sciences. Washington State University martin_pall@wsu.edu 503-232-3883. May 17, 2018. Public full text online: https://www.bibliotecapleyades.net/archivos_pdf/5g-emf-hazards.pdf
8. A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF) S. Cucurachi^a, W.L.M. Tamis^a, M.G. Vijver^a, W.J.G. Peijnenburga^b, J.F.B. Bolte^b, G.R. de Snoo^a (a - Institute of Environmental Sciences (CML), Leiden University, P.O. Box 9518, 2300 RA Leiden, The Netherlands. b - National Institute for Public Health and the Environment (RIVM), Bilthoven, The Netherlands). **Environment International**, Volume 51, January 2013, Pages 116-140. Received 18 June 2012, Accepted 24 October 2012, Available online 20 December 2012:
<https://www.sciencedirect.com/science/article/pii/S0160412012002334>
9. “Re-Inventing Wires: The Future of Landlines and Networks, National Institute for Science, Law & Public Policy”. Timothy Schoechle, PhD. National Institute for Science, Law & Public Policy (NISLAPP). Washington, DC. Public full text online: <https://electromagnetichealth.org/wp-content/uploads/2018/02/ReInventing-Wires-1-25-18.pdf>
10. “Protection against ionizing radiation vis-à-vis non-ionizing radiation: Unjustifiable different approaches; a potential derived ethical conflict”. Rodolfo E. Touzet ⁽¹⁾ and Abel J. González ⁽²⁾/ [(1) Comision Nacional de Energía Atómica, (2) Autoridad Regulatoria Nuclear, Buenos Aires, Argentina, Congress IRPA-15 Proceedings]. Conference: IRPA15 - 15th International Congress of the International Radiation Protection Association At: Seoul, Korea. January 2021. Public full text online:
https://www.researchgate.net/publication/351606909_Protection_against_ionizing_radiation_vis-a-vis_Protection_against_non-ionizing_radiation_Different_vis_Protection_against_non-ionizing_radiation_Different_approaches
11. International Commission on Non-Ionizing Radiation, ICNIRP Statement, Principles for Non-Ionizing Radiation Protection, Published in: HEALTH PHYSICS 118(5):477–482; 2020. Public full text online: <https://www.icnirp.org/cms/upload/publications/ICNIRPprinciples2020.pdf>
12. The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Public full text online: [https://www.icrp.org/docs/ICRP_Publication_103-Annals_of_the_ICRP_37\(2-4\)-Free_extract.pdf](https://www.icrp.org/docs/ICRP_Publication_103-Annals_of_the_ICRP_37(2-4)-Free_extract.pdf)
13. Normas de seguridad del OIEA para la protección de las personas y el medio ambiente. Protección radiológica y seguridad de las fuentes de radiación: Normas básicas internacionales de seguridad Patrocinada por AEN de la OECD, CE, FAO, OIEA, OIT, OMS, OPS, PNUMA Requisitos de Seguridad Generales, Parte 3 Nº GSR Part 3. https://www-pub.iaea.org/MTCD/publications/PDF/P1578_S_web.pdf
14. IRPA Guiding Principles for Radiation Protection Professionals on Stakeholder Engagement, Ref: IRPA 8/08. Public full text online:
[https://irpa.net/docs/IRPA%20Stakeholder%20Engagement%20Guiding%20Principles%20\(2008\).pdf](https://irpa.net/docs/IRPA%20Stakeholder%20Engagement%20Guiding%20Principles%20(2008).pdf)
15. IRPA Code of Ethics Document IRPA11/GA/4 (Rev.) Ref: IRPA 04/07. Public full text online:
<https://www.irpa.net/docs/IRPA%20Code%20of%20Ethics.pdf>

Bibliografía en forma temática (páginas 28-105)

INDICE DE SECCIONES

Sección 1 (» [pág. 28](#))

Efectos de los CEM sobre la salud de las personas, cancerogénesis, tumores cerebrales, estudios en animales, efectos sobre el aparato reproductor, esperamatogénesis y semen, efectos epigenéticos y apoptosis. (86)

Sección 2 (» [pág. 33](#))

Los CEM y la producción de tumores cerebrales y otros tipos de cáncer. Los CEM en la inducción de cáncer y en la promoción del cáncer. Glioma, Meningioma, Neurinoma del acústico. Estudios de casos, Interphone, CERENAT y datos epidemiológicos. El impacto de diferentes dispositivos emisores y de las antenas de la red celular. (30)

Sección 3 (» [pág. 34](#))

Dependencia de la producción de efectos biológicos de los parámetros físicos y las variables biológicas, y la gran importancia de su consideración para poder comparar trabajos científicos diferentes. Intensidad de exposición, duración total de la exposición, exposición intermitente o permanente, frecuencia de onda, modos de polarización, modos de pulsado, exposición intermitente o continua, campo cercano / campo lejano. Ventanas de frecuencia y Ventanas de densidad de potencia Tipo de célula, sexo, densidad de las células, células diferenciadas y no diferenciadas, jóvenes, adultas o viejas. Dosis y tasa de dosis, SA y SAR. (159)

Sección 4 (» [pág. 43](#))

Parámetros a considerar en la optimización de las prácticas. Frecuencias, ventanas de frecuencias, Campos electromagnéticos endógenos, Homeostasis electromagnética en los tejidos vivos. Efectos de los campos electromagnéticos externos sobre los endógenos. Frecuencias coherentes y decoherentes, Coherencia cuántica, patrones de frecuencia saludables y no saludables, modelos de Fröhlich y Davydov, frecuencias de 5G. (155)

Sección 5 (» [pág. 50](#))

Determinación de la Causalidad por L. Hardell. Aplicación de los 9 principios desarrollados por Sir Bradford Hill, Fuerza de la asociación, Consistencia de asociación, Especificidad, Temporalidad, Gradiente biológico, Plausibilidad biológica, Coherencia. Evidencia de casos humanos, Analogía. (72)

Sección 6 (» [pág. 55](#))

Determinación de la Causalidad por C. J. Portier. Aplicación de los 9 principios desarrollados por Sir Bradford Hill, Fuerza de la asociación, Consistencia de asociación, Especificidad, Temporalidad, Gradiente biológico, Plausibilidad biológica, Coherencia. Evidencia de casos humanos, Analogía. (434)

Sección 7 (» [pág. 77](#))

Información de base sobre la acción de los CEM y el 5G. Efectos genotóxicos produciendo roturas simples y dobles en las cadenas de ADN. Inicio del proceso de cancerogénesis

Sección 8 (» [pág. 78](#))

Daño a la fertilidad masculina y femenina, hormonas sexuales más bajas, libido más baja y niveles aumentados del aborto espontáneo.

Sección 9 (» [pág. 79](#))

Ataque de los CEM al sistema nervioso, incluido el cerebro, lo que lleva a efectos neurológicos y/neuropsiquiátricos y posiblemente muchos otros efectos. Autismo.

Sección 10 (» pág. 81)

Producción de niveles elevados de apoptosis (muerte celular programada), origen de enfermedades neurodegenerativas e infertilidad

Sección 11 (» pág. 81)

Producción de estrés oxidativo celular y daño por radicales libres.

Sección 12 (» pág. 82)

Ataque de los CEM al sistema endocrino y a las hormonas.

Sección 13 (» pág. 82)

Producción de un exceso de calcio intracelular por apertura de los canales de calcio.

Sección 14 (» pág. 83)

La sensibilidad biológica a la radiación pulsada y sus efectos.

Sección 15 (» pág. 84)

Inicio del proceso de cancerogénesis mediante diferentes mecanismos de producción de cáncer a nivel celular.

Sección 16 (» pág. 85)

Autismo

Sección 17 (» pág. 86)

Efecto de los Campos Electromagnéticos en el medio ambiente y la vida silvestre. Daño producido a diferentes animales, aves migratorias, insectos, en particular a los polinizadores y a las plantas.

Sección 18 (» pág. 95)

Efecto de los Campos Electromagnéticos y la comunicación inalámbrica sobre el Cambio Climático y la Capa de Ozono.

Sección 19 (» pág. 101)

Uso de celulares y riesgo de cáncer de tiroides, colon, recto, pulmón y cerebro

Sección 20 (» pág. 104)

Estimación de la absorción de la radiación de Campos Electromagnéticos por el cerebro en niños y en adultos.

Sección 21 (» pág. 104)

Efectos biológicos y “claramente deterministas” de los Campos Electromagnéticos en las cercanías de antenas base, dosimetría biológica y publicaciones más recientes.

Bibliografía en forma temática (páginas 28-105)

Sección 1

Efectos de los CEM sobre la salud de las personas, cancerogénesis, tumores cerebrales, estudios en animales, efectos sobre el aparato reproductor, esperamatogénesis y semen, efectos epigenéticos y apoptosis. (86)

Trabajo de revisión: Risks to Health and Well-Being from Radio-Frequency Radiation Emitted by Cell Phones and Other Wireless Devices. by Anthony B. Miller¹, Margaret E. Sears², L. Lloyd Morgan³, Devra L. Davis³, Lennart Hardell⁴, Mark Oremus⁵ and Colin L. Soskolne^{6,7} (Edited by: Dariusz Leszczynski, University of Helsinki, Finland) Frontiers in Public Health

- 1- Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada,
- 2- Ottawa Hospital Research Institute, Prevent Cancer Now, Ottawa, ON, Canada,
- 3 -Environmental Health Trust, Teton Village, WY, United States,
- 4 -The Environmentand Cancer Research Foundation, Örebro, Sweden,
- 5 -School of Public Health and Health Systems, University of Waterloo, Waterloo, ON, Canada,
- 6 -School of Public Health, University of Alberta, Edmonton, AB, Canada,
- 7 -Health Research Institute, University of Canberra, Canberra, ACT, Australia

1. Carlberg M, Hedendahl L, Koppel T, Hardell L. High ambient radiofrequency radiation in Stockholm city, Sweden. *Oncol Lett.* (2019) 17:1777–83. DOI: [10.3892/ol.2018.9789](https://doi.org/10.3892/ol.2018.9789)
2. Hardell, L., Carlberg, M., & Hedendahl, L.K. (2018). Radiofrequency radiation from nearby base stations gives high levels in an apartment in Stockholm, Sweden: A case report. *Oncology Letters*, 15, 7871-7883. DOI: [10.3892/ol.2018.8285](https://doi.org/10.3892/ol.2018.8285)
3. Halgamuge MN. Review: weak radiofrequency radiation exposure from mobile phone radiation on plants. *Electromagn Biol Med.* (2017) 36:213–35. DOI: [10.1080/15368378.2016.1220389](https://doi.org/10.1080/15368378.2016.1220389)
4. Odemer R, Odemer F. Effects of radiofrequency electromagnetic radiation (RF-EMF) on honey bee queen development and mating success. *Sci Total Environ.* (2019) 661:553–62. DOI: [10.1016/j.scitotenv.2019.01.154](https://doi.org/10.1016/j.scitotenv.2019.01.154)
5. Waldmann-Selsam C, Balmori-de la Plante A, Breunig H, Balmori A. Radiofrequency radiation injures trees around mobile phone base stations. *Sci Total Environ.* (2016) 572:554–69. DOI: [10.1016/j.scitotenv.2016.08.045](https://doi.org/10.1016/j.scitotenv.2016.08.045)
6. ICNIRP. Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). International commission onnon-ionizing radiation protection. *Health Phys.* (1998) 74:494–522.
7. IARC. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Non-ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields. Lyon: International Agency for Research on Cancer (2013). p. 102.
8. Miller AB, Morgan LL, Udasin I, Davis DL. Cancer epidemiology update, following the 2011 IARC evaluation of radiofrequency electromagnetic fields (Monograph 102). *Environ Res.* (2018) 167:673–83. DOI: [10.1016/j.envres.2018.06.043](https://doi.org/10.1016/j.envres.2018.06.043)
9. Hardell L, Carlberg M. Mobile phone and cordless phone use and the risk for glioma - analysis of pooled case-control studies in Sweden, 1997-2003 and 2007-2009. *Pathophysiology.* (2015) 22:1–13. DOI: [10.1016/j.pathophys.2014.10.001](https://doi.org/10.1016/j.pathophys.2014.10.001)
10. Hardell L, Carlberg M, Söderqvist F, Kjell HM. Pooled analysis of case control studies on acoustic neuroma diagnosed 1997-2003 and 2007-2009and use of mobile and cordless phones. *Int J Oncol.* (2013) 43:1036–44. DOI: [10.3892/ijo.2013.2025](https://doi.org/10.3892/ijo.2013.2025)
11. Hardell L, Carlberg M, Gee D. Chapter 21: Mobile phone use and brain tumour risk: early warnings, early actions? In: Late Lessons from Early Warnings, Part 2. European Environment Agency, Copenhagen. Denmark (2013). Available online at: <https://www.eea.europa.eu/publications/late-lessons-2/later-lessons-chapters/later-lessons-ii-chapter-21> (accessed August 25, 2018)
12. Karipidis K, Elwood M, Benke G, Sanagou M, Tjong L, Croft RJ. Mobile phone use and incidence of brain tumour histological types, grading or anatomical location: a population-based ecological study. *BMJ Open.* (2018) 8: e024489. DOI: [10.1136/bmjopen-2018-024489](https://doi.org/10.1136/bmjopen-2018-024489)

13. Nilsson J, Järås J, Henriksson R, Holgersson G, Bergström S, Estenberg J. No Evidence for Increased Brain Tumour Incidence in the Swedish National Cancer Register Between Years 1980-2012. *Anticancer Res.* (2019) 39:791–6. DOI: [10.21873/anticanres.13176](https://doi.org/10.21873/anticanres.13176)
14. Gittleman HR, Ostrom QT, Rouse CD, Dowling JA, de Blank PM, Kruchko CA, et al. Trends in central nervous system tumor incidence relative to other common cancers in adults, adolescents, and children in the United States, 2000 to 2010. *Cancer.* (2015) 121:102–12. DOI: [10.1002/cncr.29015](https://doi.org/10.1002/cncr.29015)
15. Ostrom QT, Gittleman H, de Blank PM, Finlay JL, Gurney JG, McKean-Cowdin R, et al. Adolescent and young adult primary brain and central nervous system tumors diagnosed in the United States in 2008–2012. *Neuro-Oncology.* (2016) 18 (suppl. 1):1–50. DOI: [10.1093/neuonc/nov297](https://doi.org/10.1093/neuonc/nov297)
16. Philips A, Henshaw DL, Lamburn G, O’Carroll MJ. Brain tumours: rise in glioblastoma multiforme incidence in England 1995–2015 suggests an adverse environmental or lifestyle factor. *J Public Health Environ.* (2018) 2018:7910754. DOI: [10.1155/2018/2170208](https://doi.org/10.1155/2018/2170208)
17. Central Brain Tumor Registry of the United States. Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States. Annual Reports. 2007–2017. (2017)
18. Ostrom QT, Gittleman H, Truitt G, Boscia A, Kruchko C, Barnholtz-Sloan JS. CBTRUS statistical report: primary brain and other central nervous system tumors diagnosed in the United States in 2011–2015. *Neuro-Oncology.* (2018) 20:1–86. DOI: [10.1093/neuonc/noy131](https://doi.org/10.1093/neuonc/noy131)
19. Röösli M, Lagorio S, Schoemaker MJ, Schüz J, Feychtig M. Brain and salivary gland tumors and mobile phone use: evaluating the evidence from various epidemiological study designs. *Annu Rev Public Health.* (2019) 40:221–38. DOI: [10.1146/annurev-publhealth-040218-044037](https://doi.org/10.1146/annurev-publhealth-040218-044037)
20. Söderqvist, Fredrik, Carlberg, Michael and Hardell, Lennart. "Review of four publications on the Danish cohort study on mobile phone subscribers and risk of brain tumors". *Reviews on Environmental Health*, vol. 27, no. 1, 2012, pp. 51-58. DOI: [10.1515/reveh-2012-0004](https://doi.org/10.1515/reveh-2012-0004)
21. Vrijheid M, Deltour I, Krewski D, Sanchez M, Cardis E. The effects of recall errors and of selection bias in epidemiologic studies of mobile phone use and cancer risk. *J Expo Sci Environ Epidemiol.* (2006) 16:371–84. DOI: [10.1038/sj.jes.7500509](https://doi.org/10.1038/sj.jes.7500509)
22. Goedhart G, van Wel L, Langer CE, de Llobet Viladoms P, Wiart J, Hours M, et al. Recall of mobile phone usage and laterality in young people: the multinational Mobi-Expo study. *Environ Res.* (2018) 165:150–7. DOI: [10.1016/j.envres.2018.04.018](https://doi.org/10.1016/j.envres.2018.04.018)
23. Brzozek C, Benke KK, Zeleke BM, Abramson MJ, Benke G. Radiofrequency Electromagnetic Radiation and Memory Performance: Sources of Uncertainty in Epidemiological Cohort Studies. *Int J Environ Res Public Health.* (2018) 15: E592. DOI: [10.3390/ijerph15040592](https://doi.org/10.3390/ijerph15040592)
24. Carlberg M, Hardell L. Decreased Survival of Glioma Patients with Astrocytoma Grade IV (Glioblastoma Multiforme) Associated with Long-Term Use of Mobile and Cordless Phones. *Int J Environ Res Public Health.* (2014) 11:10790–805. DOI: [10.3390/ijerph111010790](https://doi.org/10.3390/ijerph111010790)
25. Olsson A, Bouaoun L, Auvinen A, Feychtig M, Johansen C, Mathiesen T, et al. Survival of glioma patients in relation to mobile phone use in Denmark, Finland and Sweden. *J Neurooncol.* (2019) 141:139–49. DOI: [10.1007/s11060-018-03019-5](https://doi.org/10.1007/s11060-018-03019-5)
26. National Toxicology Program. NTP Technical Report on the Toxicology and Carcinogenesis Studies in Hsd: Sprague-Dawley SD Rats Exposed to Whole-Body Radio Frequency Radiation at a Frequency (900 MHz) and Modulations (GSM and CDMA) Used by Cell Phones. NTP TR 595. (2018). Available online at: https://ntp.niehs.nih.gov/ntp/about_ntp/trpanel/2018/march/tr595peerdraft.pdf (accessed August 25, 2018).
27. ICNIRP. ICNIRP Note on Recent Animal Carcinogenesis Studies. Munich (2018). Available online at: <https://www.icnirp.org/cms/upload/publications/ICNIRPnote2018.pdf> (accessed September 29, 2018).
28. Melnick RL. Commentary on the utility of the National Toxicology Program study on cell phone radiofrequency radiation data for assessing human health risks despite unfounded criticisms aimed at minimizing the findings of adverse health effects. *Environ Res.* (2019) 168:1–6. DOI: [10.1016/j.envres.2018.09.010](https://doi.org/10.1016/j.envres.2018.09.010)
29. Falcioni L, Bua L, Tibaldi E, Lauriola M, De Angelis L, Gnudi F, et al. Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission. *Environ Res.* (2018) 165:496–503. DOI: [10.1016/j.envres.2018.01.037](https://doi.org/10.1016/j.envres.2018.01.037)

31. Lerchl A, Klose M, Grote K, Wilhelm AF, Spathmann O, Fiedler T, et al. Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. *Biochem Biophys Res Commun.* (2015) 459:585–90. DOI: [10.1016/j.bbrc.2015.02.151](https://doi.org/10.1016/j.bbrc.2015.02.151)
32. Soffritti M, Giuliani L. The carcinogenic potential of non-ionizing radiations: The cases of S-50 Hz MF and 1.8 GHz GSM radiofrequency radiation. *Basic & Clinical Pharmacology & Toxicology* (2019). DOI: [10.1111/bcpt.13215](https://doi.org/10.1111/bcpt.13215)
33. West JG, Kapoor NS, Liao SY, Chen JW, Bailey L, Nagourney RA. Multifocal breast cancer in young women with prolonged contact between their breasts and their cellular phones. *Case Rep Med.* (2013) 2013:354682. DOI: [10.1155/2013/354682](https://doi.org/10.1155/2013/354682)
34. Akdag M, Dasdag S, Canturk F, Akdag MZ. Exposure to non-ionizing electromagnetic fields emitted from mobile phones induced DNA damage in human ear canal hair follicle cells. *Electromagn Biol Med.* (2018) 37:66–75. DOI: [10.1080/15368378.2018.1463246](https://doi.org/10.1080/15368378.2018.1463246)
35. Vijayalakmi, Prihoda TJ. Comprehensive review of quality of publications and meta-analysis of genetic damage in mammalian cells exposed to non ionizing radiofrequency fields. *Radiat Res.* (2019) 191:20–30. DOI: [10.1667/RR15117.1](https://doi.org/10.1667/RR15117.1)
36. Corvi R, Madia F. In vitro genotoxicity testing—can the performance be enhanced? *Food Chem Toxicol.* (2017) 106:600–8. DOI: [10.1016/j.fct.2016.08.024](https://doi.org/10.1016/j.fct.2016.08.024)
37. Huss A, Egger M, Hug K, Huwiler-Müntener K, Röösli M. Source of funding and results of studies of health effects of mobile phone use: systematic review of experimental studies. *Environ Health Perspect.* (2007) 115:1–4. DOI: [10.1289/ehp.9149](https://doi.org/10.1289/ehp.9149)
38. Redmayne M, Smith E, Abramson MJ. The relationship between adolescents' well-being and their wireless phone use: a cross-sectional study. *EnvironHealth.* (2013) 12:90. DOI: [10.1186/1476-069X-12-90](https://doi.org/10.1186/1476-069X-12-90)
39. Fernández C, de Salles AA, Sears ME, Morris RD, Davis DL. Absorption of wireless radiation in the child versus adult brain and eye from cell phone conversation or virtual reality. *Environ Res.* (2018) 167:694–9. DOI: [10.1016/j.envres.2018.05.013](https://doi.org/10.1016/j.envres.2018.05.013)
40. De-Sola Gutiérrez J, Rodríguez de Fonseca F, Rubio G. Cell-phone addiction: a review. *Front Psychiatry.* (2016) 7:175. DOI: [10.3389/fpsyg.2016.00175](https://doi.org/10.3389/fpsyg.2016.00175)
41. Divan HA, Kheifets L, Obel C, Olsen J. Prenatal and postnatal exposure to cell phone use and behavioral problems in children. *Epidemiology.* (2008) 19:523–9. DOI: [10.1097/EDE.0b013e318175dd47](https://doi.org/10.1097/EDE.0b013e318175dd47)
42. Sudan M, Olsen J, Arah OA, Obel C, Kheifets L. Prospective cohort analysis of cell phone use and emotional and behavioural difficulties in children. *J Epidemiol Community Health.* (2016) 70:1207–13. DOI: [10.1136/jech-2016-207419](https://doi.org/10.1136/jech-2016-207419)
43. Walsh JJ, Barnes JD, Cameron JD, Goldfield GS, Chaput JP, Gunnell KE, et al. Associations between 24 hour movement behaviours and global cognition in US children: a cross-sectional observational study. *Lancet Child Adolesc Health.* (2018) 2:783–91. DOI: [10.1016/S2352-4642\(18\)30278-5](https://doi.org/10.1016/S2352-4642(18)30278-5)
44. Foerster M, Thielens A, JosephW, EeftensM, RöösliM. A prospective cohort study of adolescents' memory performance and individual brain dose of microwave radiation from wireless communication. *Environ Health Perspect.* (2018) 126:077007. DOI: [10.1289/EHP2427](https://doi.org/10.1289/EHP2427)
45. Sage C, Burgio E. Electromagnetic fields, pulsed radiofrequency radiation, and epigenetics: how wireless technologies may affect childhood development. *Child Dev.* (2018) 89:129–36. DOI: [10.1111/cdev.12824](https://doi.org/10.1111/cdev.12824)
46. Choi KH, Ha M, Ha EH, Park H, Kim Y, Hong YC, et al. Neurodevelopment for the first three years following prenatal mobile phone use, radiofrequency radiation and lead exposure. *Environ Res.* (2017) 156:810–17. DOI: [10.1016/j.envres.2017.04.029](https://doi.org/10.1016/j.envres.2017.04.029)
47. Byun YH, Ha M, Kwon HJ, Hong YC, Leem JH, Sakong J, et al. Mobile phone use, blood lead levels, and attention deficit hyperactivity symptoms in children: a longitudinal study. *PLoS ONE.* (2013) 8: e59742. DOI: [10.1371/journal.pone.0059742](https://doi.org/10.1371/journal.pone.0059742)
48. Meo SA, Almahmoud M, Alsultan Q, Alotaibi N, Alnajashi I, Hajjar WM. Mobile phone base station tower settings adjacent to school buildings: impact on students' cognitive health. *Am J Mens Health.* (2018) 13:1557988318816914. DOI: [10.1177/1557988318816914](https://doi.org/10.1177/1557988318816914)
49. Pall ML. Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression. *J Chem Neuroanat.* (2016) 75:43–51. DOI: [10.1016/j.jchemneu.2015.08.001](https://doi.org/10.1016/j.jchemneu.2015.08.001)
50. Deniz OG, Suleyman K, Mustafa BS, Terzi M, Altun G, Yurt KK, et al. Effects of short- and long-term electromagnetic fields exposure on the human hippocampus. *J Microsc Ultrastruct.* (2017) 5:191–7. DOI: [10.1016/j.jmau.2017.07.001](https://doi.org/10.1016/j.jmau.2017.07.001)

51. Eghlidospour M, Amir G, Seyyed MJM, Hassan A. Effects of radiofrequency exposure emitted from a GSM mobile phone on proliferation, differentiation, and apoptosis of neural stem cells. *Anatomy Cell Biol.* (2017) 50:115–23. DOI: [10.5115/acb.2017.50.2.115](https://doi.org/10.5115/acb.2017.50.2.115)
52. Aldad TS, Gan G, Gao XB, Taylor HS. Fetal radiofrequency radiation exposure from 800-1900 MHz-Rated cellular telephones affects neurodevelopment and behavior in mice. *Sci Rep.* (2012) 2:312. DOI: [10.1038/srep00312](https://doi.org/10.1038/srep00312)
53. Huber R, Treyer V, Borbely AA, Schuderer J, Gottselig JM, Landolt HP, et al. Electromagnetic fields, such as those from mobile phones, alter regional cerebral blood flow and sleep and waking EEG. *J Sleep Res.* (2002) 11:289–95. DOI: [10.1046/j.1365-2869.2002.00314.x](https://doi.org/10.1046/j.1365-2869.2002.00314.x)
54. Huber R, Treyer V, Schuderer J, Berthold T, Buck A, Kuster N, et al. Exposure to pulse-modulated radio frequency electromagnetic fields affects regional cerebral blood flow. *Eur J Neurosci.* (2005) 21:1000–6. DOI: [10.1111/j.1460-9568.2005.03929.x](https://doi.org/10.1111/j.1460-9568.2005.03929.x)
55. Volkow ND, Tomasi D, Wang GJ, Vaska P, Fowler JS, Telang F, et al. Effects of cell phone radiofrequency signal exposure on brain glucose metabolism. *JAMA.* (2011) 305:808–13. DOI: [10.1001/jama.2011.186](https://doi.org/10.1001/jama.2011.186)
56. Kostoff RN, Lau CGY. Combined biological and health effects of electromagnetic fields and other agents in the published literature. *Technol Forecast Soc Change.* (2013) 80:1331–49. DOI: [10.1016/j.techfore.2012.12.006](https://doi.org/10.1016/j.techfore.2012.12.006)
57. Adams JA, Galloway TS, Mondal D, Esteves SC, Mathews F. Effect of mobile telephones on sperm 421 quality: a systematic review and meta-analysis. *Environ Int.* (2014) 70:106–12. DOI: [10.1016/j.envint.2014.04.015](https://doi.org/10.1016/j.envint.2014.04.015)
58. Houston BJ, Nixon B, King BV, De Iuliis GN, Aitken RJ. The effects of radiofrequency electromagnetic radiation on sperm function. *Reproduction.* (2016) 152: R263–76. DOI: [10.1530/REP-16-0126](https://doi.org/10.1530/REP-16-0126)
59. Kesari KK, Agarwal A, Henkel R. Radiations and male fertility. *Reprod Biol Endocrinol.* (2018) 16:118. DOI: [10.1186/s12958-018-0431-1](https://doi.org/10.1186/s12958-018-0431-1)
60. Rago R, Salacone P, Caponecchia L, Sebastianelli A, Marcucci I, Calogero AE, et al. The semen quality of the mobile phone users. *J Endocrinol Invest.* (2013) 36:970–4. DOI: [10.3275/8996](https://doi.org/10.3275/8996)
61. Zhang G, Yan H, Chen Q, Liu K, Ling X, Sun L, et al. Effects of cell phone use on semen parameters: results from the MARHCS cohort study in Chongqing, China. *Environ Int.* (2016) 91:116–21. DOI: [10.1016/j.envint.2016.02.028](https://doi.org/10.1016/j.envint.2016.02.028)
62. Gautam R, Singh KV, Nirala J, Murmu NN, Meena R, Rajamani P. Oxidative stress-mediated alterations on sperm parameters in male Wistar rats exposed to 3G mobile phone radiation. *Andrologia.* (2019) 51: e13201. DOI: [10.1111/and.13201](https://doi.org/10.1111/and.13201)
63. BioInitiative Working Group. A Rationale for Biologically-Based Exposure Standards for Low-Intensity Electromagnetic Radiation. BioInitiative. (2012) Available online at: <https://www.bioinitiative.org/> (accessed August 25, 2018).
64. Belyaev I. Dependence of non-thermal biological effects of microwaves on physical and biological variables: implications for reproducibility and safety standards. In: Giuliani L, Soffritti M, Editors. Non-Thermal Effects and Mechanisms of Interaction Between Electromagnetic Fields and Living Matter, Vol. 5. Bologna: Ramazzini Institute (2010). p. 187–218. Available online at: https://electromagnetichealth.org/wp-content/uploads/2010/11/ramazzini_library5_part2.pdf
65. Barnes F, Greenebaum B. Some effects of weak magnetic fields on biological systems: RF fields can change radical concentrations and cancer cell growthrates. In: IEEE Power Electronics Magazine 3, (March) (2016). p. 60–8. Available online at: <https://www.emfanalysis.com/wp-content/uploads/2016/04/IEEE-Biological-Effects-of-EMF.pdf>
66. Panagopoulos DJ, Johansson O, Carlo GL. Evaluation of specific absorption rate as a dosimetric quantity for electromagnetic fields bioeffects. *PLoS ONE.* (2013) 8:e62663. DOI: [10.1371/journal.pone.0062663](https://doi.org/10.1371/journal.pone.0062663)
67. Ying L, Héroux P. Extra-low-frequency magnetic fields alter cancer cells through metabolic restriction. *Electromagn Biol Med.* (2013) 33:264–75. DOI: [10.3109/15368378.2013.817334](https://doi.org/10.3109/15368378.2013.817334)
68. Belyaev I, Dean A, Eger H, Hubmann G, Jandrisovits R, Kern M, et al. EUROPAEMEMF guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses. *Rev Environ Health.* (2016) 31:363–97. DOI: [10.1515/reveh-2016-0011](https://doi.org/10.1515/reveh-2016-0011)
69. Heuser G, Heuser SA. Functional brain MRI in patients complaining of electrohypersensitivity after long term exposure to electromagnetic fields. *Rev Environ Health.* (2017) 32:291–9. DOI: [10.1515/reveh-2017-0014](https://doi.org/10.1515/reveh-2017-0014)
70. Belpomme D, Hardell L, Belyaev I, Burgio E, Carpenter DO. Thermal and non-thermal health effects of low intensity non-ionizing radiation: an international perspective. *Environ Pollut.* (2018) 242:643–58. DOI: [10.1016/j.envpol.2018.07.019](https://doi.org/10.1016/j.envpol.2018.07.019)

71. Anonymous. LTE Achieves 39% Market Share Worldwide. (2018). Available online at: <http://www.microwavejournal.com/articles/30603-lte-achieves> (accessed September 29, 2018).
72. Rappaport TS, Sun S, Mayzus R, Zhao H, Azar Y, Wang K, et al. Millimeter wave mobile communications for 5G cellular: it will work! *IEEE Access*. (2013) 1:335–49. DOI: [0.1109/ACCESS.2013.2260813](https://doi.org/10.1109/ACCESS.2013.2260813)
73. Beltzalel N, Ben Ishai P, Feldman Y. The human skin as a sub-THz receiver- Does 5G pose a danger to it or not? *Environ Res.* (2018) 163 :208–16. DOI : [10.1016/j.envres.2018.01.032](https://doi.org/10.1016/j.envres.2018.01.032)
74. Russell CL. 5G wireless telecommunications expansion: public health and environmental implications. *Environ Res.* (2018) 165: 484–95. DOI: [10.1016/j.envres.2018.01.016](https://doi.org/10.1016/j.envres.2018.01.016)
75. Federal Communication Commission. Radio Frequency Safety 13-39 Section112. 37. First Report and Order March 29, 2013 (2013). Available online at: https://apps.fcc.gov/edocs_public/attachmatch/FCC-13-39A1.pdf (accessed August 25, 2018).
76. Alster N. Captured Agency: How the Federal Communications Commissions Dominated by the Industries It Presumably Regulates. Cambridge, MA: Edmond J. Safra Center for Ethics Harvard University (2015). Available online at: https://ethics.harvard.edu/files/center-for-ethics/files/capturedagency_alster.pdf
77. Institute of Electrical and Electronic Engineers. (IEEE). C95.1-2005 - IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. (1991) Available online at: <https://ieeexplore.ieee.org/document/1626482/> (accessed August 25, 2018).
78. Environmental Health Trust. Database of Worldwide Policies on Cell Phones, Wireless and Health (2018) Available online at: <https://ehtrust.org/policy/international-policy-actions-on-wireless/> (accessed August 25, 2018)
79. Leach V, Weller S, Redmayne M. Database of bio-effects from non-ionizing radiation. A novel database of bio-effects from non-ionizing radiation. *Rev Environ Health.* (2018) 33:273–80. DOI: [10.1515/reveh-2018-0017](https://doi.org/10.1515/reveh-2018-0017)
80. EMF Portal of the RWTH Aachen University. (2018). Available online at: <https://www.emf-portal.org/en> (accessed October 10, 2018).
81. CDPH. CDPH Issues Guidelines on How to Reduce Exposure to Radio Frequency Energy from Cell Phones. (2017) Available online at: <https://www.cdpb.ca.gov/Programs/OPA/Pages/NR17-086.aspx> (accessed August 25, 2018).
82. Connecticut Department of Public Health. Cell Phones: Questions and Answers about Safety. (2015). Available online at: <https://portal.ct.gov/-/media/Departments-and-Agencies/DPH/dph/environmentalhealth/eoha/ToxicologyRiskAssessment/050815CellPhonesFINALpdf.pdf?la=en> (accessed August 25, 2018).
83. Massachusetts, United States of America. Legislative Update on Billson Wireless and Health. (2017) Available online at: <https://ehtrust.org/massachusetts-2017-bills-wireless-health/> (accessed August 25, 2018).
84. Worcester School Committee Precautionary Option on Radiofrequency Exposure. (2017). Available online at: http://wpsweb.com/sites/default/files/www/schoolsafety/radio_frequency.pdf (accessed August 25, 2018).
85. Samuel H. The Telegraph. France to Impose Total Ban on Mobile Phones in Schools. (2018). Available online at: <https://www.telegraph.co.uk/news/2017/12/11/france-impose-total-ban-mobile-phones-schools/> (accessed August 25, 2018).
86. Moskowitz JM. Berkeley Cell Phone “Right to Know” Ordinance. (2014). Available online at: <https://ehtrust.org/policy/the-berkeley-cellphone-right-to-know-ordinance> and Available online at: <https://www.saferemr.com/2014/11/berkeley-cell-phone-right-to-know.html> (accessed September 29, 2018).

Sección 2

Los CEM y la producción de tumores cerebrales y otros tipos de cáncer. Los CEM en la inducción de cáncer y en la promoción del cáncer. Glioma, Meningioma, Neurinoma del acústico. Estudios de casos, Interphone, CERENAT y datos epidemiológicos. El impacto de diferentes dispositivos emisores y de las antenas de la red celular. (30)

Trabajo de revisión: Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A) (Review) by L. Lloyd Morgan ¹, Anthony B. Miller ², Annie Sasco³ and Devra Lee Davis ¹

1- Environmental Health Trust, Teton Village, WY 83025, USA;

2-Dalla Lana School of Public Health, University of Toronto, Toronto, ON M4N 3P7, Canada;

3- INSERM, ISPED, Centre INSERM U897-Epidémiologie-Biostatistique, F-33000 Bordeaux, France.

International journal of oncology 46: 1865-1871, 2015. <https://doi.org/10.3892/ijo.2015.2908>

1. Auvinen A, Hietanen M, Luukkonen R and Koskela RS: Brain tumors and salivary gland cancers among cellular telephone users. Epidemiology 13: 356-359, 2002. https://journals.lww.com/epidem/Fulltext/2002/05000/Brain_Tumors_and_Salivary_Gland_Cancers_Among_18.aspx
2. Christensen HC, Schüz J, Kosteljanetz M, Poulsen HS, Boice JD Jr, McLaughlin JK and Johansen C: Cellular telephones and risk for brain tumors: A population-based, incident case-control study. Neurology 64: 1189-1195, 2005.
3. Inskip PD, Tarone RE, Hatch EE, Wilcosky TC, Shapiro WR, Selker RG, Fine HA, Black PM, Loeffler JS and Linet MS: Cellular-telephone use and brain tumors. N Engl J Med 344:79-86, 2001.
4. Muscat JE, Malkin MG, Thompson S, Shore RE, Stellman SD, McRee D, Neugut AI and Wynder EL: Hand held cellular telephone use and risk of brain cancer. JAMA 284: 3001-3007, 2000. Erratum in: JAMA 286: 1293, 2001.
5. INTER PHONE Study Group: Brain tumour risk in relation to mobile telephone use: Results of the INTER PHONE international case-control study. Int J Epidemiol 39: 675-694, 2010.
6. Coureau G, Bouvier G, Lebailly P, et al: Mobile phone use and brain tumours in the CERENAT case-control study. Occup Environ Med 71: 514-522, 2014.
7. Moon IS, Kim BG, Kim J, Lee JD and Lee WS: Association between vestibular schwannomas and mobile phone use. Tumour Biol 35: 581-587, 2014.
8. Hardell L, Carlberg M, Söderqvist F and Mild KH: Pooled analysis of case-control studies on acoustic neuroma diagnosed 1997-2003 and 2007-2009 and use of mobile and cordless phones. Int J Oncol 43: 1036-1044, 2013.
9. Carlberg M, Söderqvist F, Hansson Mild K and Hardell L: Meningioma patients diagnosed 2007-2009 and the association with use of mobile and cordless phones: A case-control study. Environ Health 12: 60, 2013.
10. Hardell L, Carlberg M and Hansson Mild K: Re-analysis of risk for glioma in relation to mobile telephone use: Comparison with the results of the Interphone international case-control study. Int J Epidemiol 40: 1126-1128, 2011.
11. INTER PHONE Study Group: Acoustic neuroma risk in relation to mobile telephone use: Results of the INTER PHONE international case-control study. Cancer Epidemiol 35: 453-464, 2011.
12. Hardell L, Carlberg M, Söderqvist F and Mild KH: Pooled analysis of case-control studies on acoustic neuroma diagnosed 1997-2003 and 2007-2009 and use of mobile and cordless phones. Int J Oncol 43: 1036-1044, 2013.
13. The World Bank: Mobile cellular subscriptions (per 100 people). <http://data.worldbank.org/indicator/IT.CEL.SETS>. Accessed September 19, 2014.
14. Cardis E, Deltour I, Mann S, Moissonnier M, Taki M, Varsier N, Wake K and Wiart J: Distribution of RF energy emitted by mobile phones in anatomical structures of the brain. Phys Med Biol 53: 2771-2783, 2008.
15. Hardell L and Carlberg M: Mobile phone and cordless phone use and the risk for glioma -. Analysis of pooled case-control studies in Sweden, 1997-2003 and 2007-2009. Pathophysiology: Oct 29, 2014 (Epub ahead of print).
16. Hardell L and Carlberg M: Re: Mobile phone use and brain tumours in the CERENAT case-control study. Occup Environ Med 72: 79, 2015.

17. Coureau G, Leffondre K, Gruber A, Bouvier G and Baldi I: Author's response: Re 'Mobile phone use and brain tumours in the CERENAT case-control study'. *Occup Environ Med* 72: 79-80, 2015.
18. Hardell L, Carlberg M and Hansson Mild K: Case-control study on cellular and cordless telephones and the risk for acoustic neuroma or meningioma in patients diagnosed 2000-2003. *Neuroepidemiology* 25: 120-128, 2005.
19. International Agency for Research on Cancer (IARC): Non ionizing radiation, part 2: radiofrequency electromagnetic fields. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 102. IARC, Lyon, 2013.
20. Morgan LL, Kundi M and Carlberg M: Re-evaluation of the Interphone Study: Application of a correction factor. In: Proceedings of the Bioelectromagnetics Society Annual Meeting. Seoul, Korea, pp1-7, 2010.
21. Hardell L and Carlberg M: Using the Hill viewpoints from 1965 for evaluating strengths of evidence of the risk for brain tumors associated with use of mobile and cordless phones. *Rev Environ Health* 28: 97-106, 2013.
22. Hardell L and Carlberg M: Mobile phones, cordless phones and the risk for brain tumours. *Int J Oncol* 35: 5-17, 2009.
23. Hardell L, Carlberg M and Hansson Mild K: Pooled analysis of two case-control studies on the use of cellular and cordless telephones and the risk of benign brain tumours diagnosed during 1997-2003. *Int J Oncol* 28: 509-518, 2006.
24. Aydin D, Feychting M, Schüz J, et al: Mobile phone use and brain tumors in children and adolescents: A multicenter case-control study. *J Natl Cancer Inst* 103: 1264-1276, 2011.
25. Deltour I, Auvinen A, Feychting M, Johansen C, Klaeboe L, Sankila R and Schüz J: Mobile phone use and incidence of glioma in the Nordic countries 1979-2008: Consistency check. *Epidemiology* 23: 301-307, 2012.
26. Little M P, Rajaraman P, Curtis R E, Devesa S S, Inskip P D, Check D P et al. Mobile phone use and glioma risk: comparison of epidemiological study results with incidence trends in the United States *BMJ* 2012; 344:e1147 DOI: [10.1136/bmj.e1147](https://doi.org/10.1136/bmj.e1147).
27. Zada G, Bond AE, Wang YP, Giannotta SL and Deapen D: Incidence trends in the anatomic location of primary malignant brain tumors in the United States: 1992-2006. *World Neurosurgery* 77: 518-524, 2012.
28. Dobes M, Khurana VG, Shadbolt B, Jain S, Smith SF, Smee R, Dexter M and Cook R: Increasing incidence of glioblastomamultiforme and meningioma, and decreasing incidence of Schwannoma (2000-2008): Findings of a multicenter Australian study. *Surg Neurol Int* 2: 176, 2011.
29. The Danish Cancer Society: The increase in new cases of aggressive brain cancer. <http://www.cancer.dk/Nyheder/nyhedsartikler/2012kv4/Kraftigstigningihjernesvulster.html>. Accessed September 22, 2014.
30. Schüz J, Jacobsen R, Olsen JH, Boice JD Jr, McLaughlin JK and Johansen C: Cellular telephone use and cancer risk: Update of a nationwide Danish cohort. *J Natl Cancer Inst* 98: 1707-1713, 2006.

Sección 3

Dependencia de la producción de efectos biológicos de los parámetros físicos y las variables biológicas, y la gran importancia de su consideración para poder comparar trabajos científicos diferentes. Intensidad de exposición, duración total de la exposición, exposición intermitente o permanente, frecuencia de onda, modos de polarización, modos de pulsado, exposición intermitente o continua, campo cercano / campo lejano. Ventanas de frecuencia y Ventanas de densidad de potencia Tipo de célula, sexo, densidad de las células, células diferenciadas y no diferenciadas, jóvenes, adultas o viejas. Dosis y tasa de dosis, SA y SAR. (159)

Trabajo de revisión: Dependence of non-thermal biological effects of microwaves on physical and biological variables: implications for reproducibility and safety standards. by Igor Y Belyaev

Laboratory of Molecular Genetics, Cancer Research Institute, Bratislava, Slovak Republic. Laboratory of Radiobiology, General Physics Institute, Russian Academy of Science, Moscow, Russia. Department of Genetic and Cellular Toxicology, Stockholm University, Stockholm, Sweden

1. Belyaev IY, Shcheglov VS, Alipov ED, et al. Non-thermal effects of extremely high frequency microwaves on chromatin conformation in cells in vitro: dependence on physical, physiological and genetic factors. *IEEE Transactions on Microwave Theory and Techniques* 2000; 48: 2172-9.
2. Pakhomov AG, Akyel Y, Pakhomova ON, et al. Current state and implications of research on biological effects of millimeter waves: a review of the literature. *Bioelectromagnetics* 1998; 19: 393-413.
3. Lai H. Biological effects of radiofrequency electromagnetic field. In: Wnek GE, Bowlin GL, eds. *Encyclopedia of Biomaterials and Biomedical Engineering*. New York, NY: Marcel Decker, 2005, 1-8.
4. Betskii OV, Devyatkov ND, Kislov VV. Low intensity millimeter waves in medicine and biology. *Crit Rev Biomed Eng* 2000; 28: 247-68.
5. Adey WR. Cell and molecular biology associated with radiation fields of mobile telephones. In Stone WR, Ueno S, eds. *Review of Radio Science*, 1996-1999. Oxford: Oxford University Press, 1999, 845-72.
6. Banik S, Bandyopadhyay S, Ganguly S. Bioeffects of microwave - a brief review. *Bioresour Technol* 2003; 87: 155-9.
7. Devyatkov ND, Golant MB, Betskij OV. Peculiarities of usage of millimeter waves in biology and medicine (in Russian). IRE RAN. 1994. Moscow.
8. Grundler W, Jentzsch V, Keilmann F, et al. Resonant cellular effects of low intensity microwaves. In: Frolich H, ed. *biological coherence and response to external stimuli*. Berlin: Springer-Verlag, 1988, 65-85.
9. Iskin VD. Biological effects of millimeter waves and correlation method of their detection (in Russian). Osnova, Kharkov, 1990.
10. Grigoriev YG. Bioeffects of modulated electromagnetic fields in the acute experiments (results of Russian researches). In: Annual of Russian National Committee on Non-Ionising Radiation Protection. Moscow: ALLANA, 2004, 16-73.
11. Grigoriev YG, Stepanov VS, Nikitina VN, et al. ISTC Report. Biological effects of radiofrequency electromagnetic fields and the radiation guidelines. Results of experiments performed in Russia/Soviet Union. Institute of Biophysics, Ministry of Health, Russian Federation. Moscow, 2003.
12. Grigoriev Y, Nikitina V, Rubtsova N, et al. The Russian National Committee on Non-Ionizing Radiation Protection (RNCNIRP) and the radiation guidelines. In Transparency Forum for Mobile Telephone Systems. http://www.ssi.se/ickejoniserandestrålning/mobiltele/transpar/PDF/Semi3_Forsiktigh_gransvar.pdf, Ed. <http://members.chello.se/igor.belyaev/guidelines.pdf>. Stockholm, 2005.
13. ICNIRP. ICNIRP Guidelines. Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). *Health Physics* 1998; 74: 494-522.
14. Cook CM, Saucier DM, Thomas AW, et al. Exposure to ELF magnetic and ELF-modulated radiofrequency fields: the time course of physiological and cognitive effects observed in recent studies (2001-2005). *Bioelectromagnetics* 2006; 27: 613-27.
15. Pakhomov AG, Murphy MB. Comprehensive review of the research on biological effects of pulsed radiofrequency radiation in Russia and the former Soviet Union. In: Lin JC, ed. *Advances in Electromagnetic Fields in Living System*, Vol. 3. New York: Kluwer Academic/Plenum Publishers, 2000, 265-90.
16. Sit'ko SP. The 1st All-Union Symposium with International Participation "Use of Millimeter Electromagnetic Radiation in Medicine". TRC Otklik. Kiev, Ukraine, USSR, 1989, 298.
17. Kundi M, Mild K, Hardell L, et al. Mobile telephones and cancer - a review of epidemiological evidence. *J Toxicol Environ Health B Crit Rev* 2004; 7: 351-84.
18. Lonn S, Ahlbom A, Hall P, et al. Mobile phone use and the risk of acoustic neuroma. *Epidemiology* 2004; 15: 653-9.
19. Hardell L, Eriksson M, Carlberg M, et al. Use of cellular or cordless telephones and the risk for non-Hodgkin's lymphoma. *Int Arch Occup Environ Health* 2005; DOI [10.1007/s00420-005-0003-5](https://doi.org/10.1007/s00420-005-0003-5).

20. Vilenskaya RL, Smolyanskaya AZ, Adamenko VG, et al. Induction of the lethal colicin synthesis in *E. coli* K12 C600 (E1) by means the millimeter radiation (in Russian). Bull Eksperim Biol Med 1972; 4: 52-4.
21. Devyatkov ND. Influence of electromagnetic radiation of millimeter range on biological objects (in Russian). Usp Fiz Nauk 1973; 116: 453-4.
22. Webb SJ. Factors affecting the induction of Lambda prophages by millimetre waves. Phys Letts 1979; 73A: 145-8.
23. Lukashevsky KV, Belyaev IY. Switching of prophage lambda genes in *Escherichia coli* by millimeter waves. Medical Science Research 1990; 18: 955-7.
24. Golant MB. Resonance effect of coherent millimeter-band electromagnetic waves on living organisms (in Russian). Biofizika 1989; 34: 1004-14.
25. Postow E, Swicord ML. Modulated fields and “window” effects. In: Polk C, Postow E, eds. CRC Handbook of Biological Effects of Electromagnetic Fields. Boca Raton, FL: CRC Press, 1986, 425- 60
26. Belyaev IY. Some biophysical aspects of the genetic effects of low intensity millimeter waves. Bioelectrochem Bioenerg 1992; 27: 11-8.
27. Hyland GJ. Physics and biology of mobile telephony. Lancet 2000; 356: 1833-6.
28. Blackman CF, Benane SG, Joines WT, et al. Calcium-ion efflux from brain tissue: power-density versus internal field-intensity dependencies at 50-MHz RF radiation. Bioelectromagnetics 1980; 1: 277-83.
29. Blackman CF, Benane SG, Elder JA, et al. Induction of calcium-ion efflux from brain tissue by radiofrequency radiation: effect of sample number and modulation frequency on the power-density window. Bioelectromagnetics 1980; 1: 35-43.
30. Joines WT, Blackman CF. Power density, field intensity, and carrier frequency determinants of RF-energy-induced calcium-ion efflux from brain tissue. Bioelectromagnetics 1980; 1: 271-5.
31. Adey WR, Bawin SM, Lawrence AF. Effects of weak amplitude-modulated microwave fields on calcium efflux from awake cat cerebral cortex. Bioelectromagnetics 1982; 3: 295-307.
32. Lin-Liu S, Adey WR. Low frequency amplitude modulated microwave fields change calcium efflux rates from synaptosomes. Bioelectromagnetics 1982; 3: 309-22.
33. Belyaev IY, Alipov YD, Shcheglov VS, et al. Resonance effect of microwaves on the genome conformational state of *E. coli* cells. Z Naturforsch [C] 1992; 47: 621-7.
34. Belyaev IY, Alipov YD, Shcheglov VS. Chromosome DNA as a target of resonant interaction between *Escherichia coli* cells and low-intensity millimeter waves. Electro- and Magnetobiology 1992; 11: 97-108.
35. Belyaev IY, Shcheglov VS, Alipov YD, et al. Resonance effect of millimeter waves in the power range from 10(-19) to 3 x 10(-3) W/cm² on *Escherichia coli* cells at different concentrations. Bioelectromagnetics 1996; 17: 312-21.
36. Belyaev IY, Harms-Ringdahl M. Effects of gamma rays in the 0.5-50-cGy range on the conformation of chromatin in mammalian cells. Radiat Res 1996; 145: 687-93.
37. Belyaev IY, Alipov YD, Harms-Ringdahl M. Effects of zero magnetic field on the conformation of chromatin in human cells. Biochim Biophys Acta 1997; 1336: 465-73.
38. Markova E, Hillert L, Malmgren L, et al. Microwaves from GSM Mobile Telephones Affect 53BP1 and gamma-H2AX Foci in Human Lymphocytes from Hypersensitive and Healthy Persons. Environ Health Perspect 2005; 113: 1172-7.
39. Belyaev IY, Hillert L, Protopopova M, et al. 915 MHz microwaves and 50 Hz magnetic field affect chromatin conformation and 53BP1 foci in human lymphocytes from hypersensitive and healthy persons. Bioelectromagnetics 2005; 26: 173-84.
40. Sarimov R, Malmgren LOG, Markova E, et al. Non-thermal GSM microwaves affect chromatin conformation in human lymphocytes similar to heat shock. IEEE Transactions on Plasma Science 2004; 32: 1600-8.

41. Shcheglov VS, Belyaev IY, Ushakov VL, et al. Power-dependent rearrangement in the spectrum of resonance effect of millimeter waves on the genome conformational state of *E. coli* cells. *Electro and Magnetobiology* 1997; 16: 69-82.
42. Grundler W. Intensity- and frequency-dependent effects of microwaves on cell growth rates. *Bioelectrochem Bioenerg* 1992; 27: 361-5.
43. Belyaev SY, Kravchenko VG. Resonance effect of low-intensity millimeter waves on the chromatin conformational state of rat thymocytes. *Z Naturforsch [C]* 1994; 49: 352-8.
44. Frohlich H. Long-range coherence and energy storage in biological systems. *Int J Quantum Chem* 1968; 2: 641-52.
45. Gapeev AB, Safranova VG, Chemeris NK, et al. Inhibition of the production of reactive oxygen species in mouse peritoneal neutrophils by millimeter wave radiation in the near and far field zones of the radiator. *Bioelectrochem Bioenerg* 1997; 43: 217-20.
46. Gapeev AB, Safranova VG, Chemeris NK, et al. Modification of the activity of murine peritoneal neutrophils upon exposure to millimeter waves at close and far distances from the emitter. *Biofizika* 1996; 41: 205-19.
47. Gapeev AB, Mikhailik EN, Chemeris NK. Anti-inflammatory effects of low-intensity extremely high-frequency electromagnetic radiation: frequency and power dependence. *Bioelectromagnetics* 2008; 29: 197-206.
48. Gapeev AB, Mikhailik EN, Chemeris NK. Features of anti-inflammatory effects of modulated extremely high-frequency electromagnetic radiation. *Bioelectromagnetics* 2009; 30(6): 454-61.
49. Belyaev IY, Markova E, Hillert L, et al. Microwaves from UMTS/GSM mobile phones induce longlasting inhibition of 53BP1/gamma-H2AX DNA repair foci in human lymphocytes. *Bioelectromagnetics* 2009; 30: 129-41.
50. Tkalec M, Malaric K, Pevalek-Kozlina B. Influence of 400, 900, and 1900 MHz electromagnetic fields on *Lemna minor* growth and peroxidase activity. *Bioelectromagnetics* 2005; 26: 185-93.
51. Tkalec M, Malaric K, Pevalek-Kozlina B. Exposure to radiofrequency radiation induces oxidative stress in duckweed *Lemna minor* L. *Sci Total Environ* 2007; 388: 78-89.
52. Tkalec M, Malaric K, Pavlica M, et al. Effects of radiofrequency electromagnetic fields on seed germination and root meristematic cells of *Allium cepa* L. *Mutation Research - Genetic Toxicology and Environmental Mutagenesis* 2009; 672: 76-81.
53. Remondini D, Nylund R, Reivinen J, et al. Gene expression changes in human cells after exposure to mobile phone microwaves. *Proteomics* 2006; 6: 4745-54.
54. Belyaev IY, Shcheglov VS, Alipov YD. Selection rules on helicity during discrete transitions of the genome conformational state in intact and X-rayed cells of *E. coli* in millimeter range of electromagnetic field. In: Allen MJ, et al., eds. *Charge and Field Effects in Biosystems*. Vol. 3. Basel, Switzerland: Birkhauser, 1992, 115-26.
55. Kolbun ND, Lobarev VE. Problems of bioinformational interaction in millimeter range (in Russian). *Kibernet Vychislitel'naya Tekhnika* 1988; 78: 94-9.
56. Belyaev IY, Shcheglov VS, Alipov YD, et al. Regularities of separate and combined effects of circularly polarized millimeter waves on *E. coli* cells at different phases of culture growth. *Bioelectrochem Bioenerg* 1993; 31: 49-63.
57. Belyaev IY, Alipov YD, Shcheglov VS, et al. Cooperative response of *Escherichia Coli* cells to the resonance effect of millimeter waves at super low intensity. *Electro- and Magnetobiology* 1994; 13: 53-66.
58. Shcheglov VS, Alipov ED, Belyaev IY. Cell-to-cell communication in response of *E. coli* cells at different phases of growth to low-intensity microwaves. *Biochim Biophys Acta* 2002; 1572: 101-6.
59. Oscar KJ, Hawkins TD. Microwave alteration of the blood-brain barrier system of rats. *Brain Res* 1977; 126: 281-93.
60. Persson BRR, Salford LG, Brun A. Blood-Brain Barrier permeability in rats exposed to electromagnetic fields used in wireless communication. *Wireless Networks* 1997; 3: 455-61.

61. Salford LG, Brun A, Sturesson K, et al. Permeability of the blood-brain barrier induced by 915 MHz electromagnetic radiation, continuous wave and modulated at 8, 16, 50, and 200 Hz. *Microscopy research and technique* 1994; 27: 535-42.
62. Eberhardt JL, Persson BR, Brun AE, et al. Blood-brain barrier permeability and nerve cell damage in rat brain 14 and 28 days after exposure to microwaves from GSM mobile phones. *Electromagn Biol Med* 2008; 27: 215-29.
63. Bozhanova TP, Bryukhova AK, Golant MB. About possibility to use coherent radiation of extremely high frequency for searching differences in the state of living cells. In: Devyatkov ND, ed. *Medical and biological aspects of millimeter wave radiation of low intensity*. Fryazino, USSR, IRE, Academy of Science, 1987, Vol. 280, 90-7.
64. Kwee S, Raskmark P. Changes in cell proliferation due to environmental non-ionizing radiation. 2. Microwave radiation. *Bioelectrochem Bioenerg* 1998; 44: 251-5.
65. Belyaev IY, Shcheglov VS, Alipov YD. Existence of selection rules on helicity during discrete transitions of the genome conformational state of *E. coli* cells exposed to low-level millimeter radiation. *Bioelectrochem Bioenerg* 1992; 27: 405-11.
66. Nikolova T, Czyz J, Rolletschek A, et al. Electromagnetic fields affect transcript levels of apoptosis related genes in embryonic stem cell-derived neural progenitor cells. *Faseb J* 2005; 19: 1686-8.
67. Markova E, Malmgren L, Belyaev I. GSM/UMTS microwaves inhibit 53BP1 DNA repair foci in human stem cells stronger than in differentiated cells: mechanistic link to possible cancer risk. *Environ Health Perspect* 2009 <http://www.ehponline.org/docs/2009/0900781/abstract.html>.
68. Litovitz TA, Krause D, Penafiel M, et al. The role of coherence time in the effect of microwaves on ornithine decarboxylase activity. *Bioelectromagnetics* 1993; 14: 395-403.
69. Diem E, Schwarz C, Adlkofer F, et al. Non-thermal DNA breakage by mobile-phone radiation (1800 MHz) in human fibroblasts and in transformed GFSH-R17 rat granulosa cells in vitro. *Mutat Res* 2005 ; 583 : 178-83.
70. Veyret B, Bouthet C, Deschaux P, et al. Antibody responses of mice exposed to low-power microwaves under combined, pulse-and-amplitude modulation. *Bioelectromagnetics* 1991; 12: 47-56.
71. Penafiel LM, Litovitz T, Krause D, et al. Role of modulation on the effect of microwaves on ornithine decarboxylase activity in L929 cells. *Bioelectromagnetics* 1997; 18: 132-41.
72. Litovitz TA, Penafiel LM, Farrel JM, et al. Bioeffects induced by exposure to microwaves are mitigated by superposition of ELF noise. *Bioelectromagnetics* 1997; 18: 422-30.
73. Byus CV, Lundak RL, Fletcher RM, et al. Alterations in protein kinase activity following exposure of cultured human lymphocytes to modulated microwave fields. *Bioelectromagnetics* 1984; 5: 341-51.
74. Byus CV, Kartun K, Pieper S, et al. Increased ornithine decarboxylase activity in cultured cells exposed to low energy modulated microwave fields and phorbol ester tumor promoters. *Cancer Res* 1988; 48: 4222-6.
75. d'Ambrosio G, Massa R, Scarfi MR, et al. Cytogenetic damage in human lymphocytes following GMSK phase modulated microwave exposure. *Bioelectromagnetics* 2002; 23: 7-13.
76. Huber R, Treyer V, Schuderer J, et al. Exposure to pulse-modulated radio frequency electromagnetic fields affects regional cerebral blood flow. *Eur J Neurosci* 2005; 21: 1000-6.
77. Huber R, Treyer V, Borbely AA, et al. Electromagnetic fields, such as those from mobile phones, alter regional cerebral blood flow and sleep and waking EEG. *J Sleep Res* 2002; 11: 289-95.
78. Markkanen A, Penttinen P, Naarala J, et al. Apoptosis induced by ultraviolet radiation is enhanced by amplitude modulated radiofrequency radiation in mutant yeast cells. *Bioelectromagnetics* 2004; 25: 127-33.
79. Gapeev AB, Iakushina VS, Chemeris NK, et al. Modulated extremely high frequency electromagnetic radiation of low intensity activates or inhibits respiratory burst in neutrophils depending on modulation frequency (in Russian). *Biofizika* 1997; 42: 1125-34.
80. Gapeev AB, Yakushina VS, Chemeris NK, et al. Modification of production of reactive oxygen species in mouse peritoneal neutrophils on exposure to low-intensity modulated millimeter wave radiation. *Bioelectrochemistry and Bioenergetics* 1998; 46: 267-72.

81. Lopez-Martin ME, Brogains J, Relova-Quinteiro JL, et al. The action of pulse-modulated GSM radiation increases regional changes in brain activity and c-Fos expression in cortical and subcortical areas in a rat model of picrotoxin-induced seizure proneness. *Journal of Neuroscience Research* 2009; 87: 1484-99.
82. Lukkonen J, Juutilainen J, Naarala J. Combined effects of 872 MHz radiofrequency radiation and ferrous chloride on reactive oxygen species production and DNA damage in human SH-SY5Y neuroblastoma cells. *Bioelectromagnetics* 2010; (Epub ahead of print).
83. Hinrikus H, Bachmann M, Lass J, et al. Effect of 7, 14 and 21 Hz modulated 450 MHz microwave radiation on human electroencephalographic rhythms. *Int J Radiat Biol* 2008; 84: 69-79.
84. Hoyto A, Luukkonen J, Juutilainen J, et al. Proliferation, oxidative stress and cell death in cells exposed to 872 MHz radiofrequency radiation and oxidants. *Radiat Res* 2008; 170: 235-43.
85. Franzellitti S, Valbonesi P, Contin A, et al. HSP70 expression in human trophoblast cells exposed to different 1.8 Ghz mobile phone signals. *Radiat Res* 2008; 170: 488-97.
86. Bailey J, Chrysostomou A, Hough JH, et al. Circular polarization in star- formation regions: implications for biomolecular homochirality. *Science* 1998; 281: 672-4.
87. Ushakov VL, Shcheglov VS, Belyaev IY, et al. Combined effects of circularly polarized microwaves and ethidium bromide on *E. coli* cells. *Electro- and Magnetobiology* 1999; 18: 233-42.
88. Ushakov VL, Alipov EA, Shcheglov VS, et al. Peculiarities of non-thermal effects of microwaves in the frequency range of 51-52 GHz on *E. coli* cells. *Radiat Biol Radioecol* 2006; 46: 729-34.
89. Belyaev IY, Eriksson S, Nygren J, et al. Effects of ethidium bromide on DNA loop organisation in human lymphocytes measured by anomalous viscosity time dependence and single cell gel electrophoresis. *Biochim Biophys Acta* 1999; 1428: 348-56.
90. Ushakov VL, Alipov ED, Shcheglov VS, et al. Peculiarities of non-thermal effects of microwaves in the frequency range of 51-52 GHz on *E. coli* cells. *Radiats Biol Radioecol* 2006; 46: 719-28.
91. Alipov YD, Belyaev IY, Kravchenko VG, et al. Experimental justification for generality of resonant response of prokaryotic and eukaryotic cells to MM waves of super-low intensity. *Physics of the Alive* 1993; 1: 72-80.
92. Belyaev IY, Alipov YD, Polunin VA, et al. Evidence for dependence of resonant frequency of millimeter wave interaction with *Escherichia coli* K12 cells on haploid genome length. *Electro- and Magnetobiology* 1993; 12: 39-49.
93. Shckorbatov YG, Pasiuga VN, Kolchigin NN, et al. The influence of differently polarised microwave radiation on chromatin in human cells. *Int J Radiat Biol* 2009; 85: 322-9.
94. Binhi VN, Alipov YD, Belyaev IY. Effect of static magnetic field on *E. coli* cells and individual rotations of ion-protein complexes. *Bioelectromagnetics* 2001; 22: 79-86.
95. Belyaev IY, Alipov ED, Harms-Ringdahl M. Effects of weak ELF on *E. coli* cells and human lymphocytes: role of genetic, physiological and physical parameters. In: Bersani F, ed. *Electricity and Magnetism in Biology and Medicine*. NY: Kluwer Academic, 1999, 481-4.
96. Belyaev IY, Alipov ED. Frequency-dependent effects of ELF magnetic field on chromatin conformation in *Escherichia coli* cells and human lymphocytes. *Biochim Biophys Acta* 2001; 1526: 269-76.
97. Matronchik AY, Belyaev IY. Model of slow nonuniform rotation of the charged DNA domain for effects of microwaves, static and alternating magnetic fields on conformation of nucleoid in living cells. In: Pokorný J, ed. *Frohlich Centenary International Symposium "Coherence and Electromagnetic Fields in Biological Systems (CEFBIOS-2005)"*: Institute of Radio Engineering and Electronics, Academy of Sciences of the Czech Republic. Prague, Czech Republic, 2005, 63-4.
98. Binhi VN. *Magnetobiology: Underlying Physical Problems*. San Diego: Academic Press, 2002.
99. Matronchik AI, Alipov ED, Beliaev II. A model of phase modulation of high frequency nucleoid oscillations in reactions of *E. coli* cells to weak static and low-frequency magnetic fields (in Russian). *Biofizika* 1996; 41: 642-9.

100. Chiabrera A, Bianco B, Caufman JJ, et al. Quantum dynamics of ions in molecular crevices under electromagnetic exposure. In: Brighton CT, Pollack SR, eds. Electromagnetics in Medicine and Biology. San Francisco: San Francisco Press, 1991, 21-6.
101. Chiabrera A, Bianco B, Moggia E, et al. Zeeman-Stark modeling of the RF EMF interaction with ligand binding. *Bioelectromagnetics* 2000; 21: 312-24.
102. Matronchik AY, Belyaev IY. Mechanism for combined action of microwaves and static magnetic field: slow non uniform rotation of charged nucleoid. *Electromagn Biol Med* 2008; 27: 340-54.
103. Panagopoulos DJ, Karabarounis A, Margaritis LH. Mechanism for action of electromagnetic fields on cells. *Biochem Biophys Res Commun* 2002; 298: 95-102.
104. Di Carlo A, White N, Guo F, et al. Chronic electromagnetic field exposure decreases HSP70 levels and lowers cytoprotection. *J Cell Biochem* 2002; 84: 447-54.
105. Lai H. Interaction of microwaves and a temporally incoherent magnetic field on spatial learning in the rat. *Physiology & behavior* 2004; 82: 785-9.
106. Lai H, Singh NP. Interaction of microwaves and a temporally incoherent magnetic field on single and double DNA strand breaks in rat brain cells. *Electromagnetic Biology and Medicine* 2005; 24: 23-9.
107. Yao K, Wu W, Yu Y, et al. Effect of superposed electromagnetic noise on DNA damage of lens epithelial cells induced by microwave radiation. *Invest Ophthalmol Vis Sci* 2008; 49: 2009-15.
108. Gapeev AB, Iakushina VS, Chemeris N K, et al. Dependence of EHF EMF effects on the value of the static magnetic field. *Doklady Akademii nauk / [Rossiiskaya akademii nauk]* 1999; 369: 404-7.
109. Belyaev IY. Biological effects of low dose ionizing radiation and weak electromagnetic fields. In Andreev SG, ed. 7th Workshop on Microdosimetry. Suzdal: MIFI Publisher, 1993, 128-46.
110. Alipov ED, Shcheglov VS, Sarimov RM, et al. Cell-density dependent effects of low-dose ionizing radiation on *E. coli* cells. *Radiats Biol Radioecol* 2003; 43: 167-71.
111. Belyaev IY, Alipov YD, Matronchik AY. Cell density dependent response of *E. coli* cells to weak ELF magnetic fields. *Bioelectromagnetics* 1998; 19: 300-9.
112. Belyaev IY, Alipov YD, Matronchik AY, et al. Cooperativity in *E. coli* cell response to resonance effect of weak extremely low frequency electromagnetic field. *Bioelectrochem Bioenerg* 1995; 37: 85-90.
113. Golant MB, Kuznetsov AP, Bozhanova TP. The mechanism of synchronizing yeast cell cultures with EHF-radiation (in Russian). *Biofizika* 1994; 39: 490-5.
114. Stagg RB, Thomas WJ, Jones RA, et al. DNA synthesis and cell proliferation in C6 glioma and primary glial cells exposed to a 836.55 MHz modulated radiofrequency field. *Bioelectromagnetics* 1997; 18: 230-6.
115. Repacholi MH, Basten A, Gebski V, et al. Lymphomas in E mu-Pim1 transgenic mice exposed to pulsed 900 MHz electromagnetic fields. *Radiat Res* 1997 ; 147 : 631-40.
116. Czyz J, Guan K, Zeng Q, et al. High frequency electromagnetic fields (GSM signals) affect gene expression levels in tumor suppressor p53-deficient embryonic stem cells. *Bioelectromagnetics* 2004; 25: 296-307.
117. Schwarz C, Kratochvil E, Pilger A, et al. Radiofrequency electromagnetic fields (UMTS, 1,950 MHz) induce genotoxic effects in vitro in human fibroblasts but not in lymphocytes. *Int Arch Occup Environ Health* 2008; 81: 755-67.
118. Hoyto A, Juutilainen J, Naarala J. Ornithine decarboxylase activity is affected in primary astrocytes but not in secondary cell lines exposed to 872 MHz RF radiation. *Int J Radiat Biol* 2007; 83: 367-74.
119. Nylund R, Leszczynski D. Mobile phone radiation causes changes in gene and protein expression in human endothelial cell lines and the response seems to be genome- and proteome-dependent. *Proteomics* 2006; 6: 4769-80.
120. Zhao TY, Zou SP, Knapp PE. Exposure to cell phone radiation up-regulates apoptosis genes in primary cultures of neurons and astrocytes. *Neurosci Lett* 2007; 412: 34-8.

121. Papageorgiou CC, Nanou ED, Tsiafakis VG, et al. Gender related differences on the EEG during a simulated mobile phone signal. *Neuroreport* 2004; 15: 2557-60.
122. Smythe JW, Costall B. Mobile phone use facilitates memory in male, but not female, subjects. *Neuroreport* 2003; 14: 243-6.
123. Nam KC, Kim SW, Kim SC, et al. Effects of RF exposure of teenagers and adults by CDMA cellular phones. *Bioelectromagnetics* 2006; 27: 509-14.
124. Hardell L, Mild KH, Carlberg M, et al. Cellular and cordless telephone use and the association with brain tumors in different age groups. *Arch Environ Health* 2004; 59: 132-7.
125. Hardell L, Carlberg M. Mobile phones, cordless phones and the risk for brain tumours. *Int J Oncol* 2009; 35: 5-17.
126. Hardell L, Carlberg M, Hansson Mild K. Epidemiological evidence for an association between use of wireless phones and tumor diseases. *Pathophysiology* 2009; 16 (2-3): 113-22.
127. Shckorbatov YG, Grigoryeva NN, Shakhbazov VG, et al. Microwave irradiation influences on the state of human cell nuclei. *Bioelectromagnetics* 1998; 19: 414-9.
128. Hinrikus H, Bachmann M, Lass J, et al. Effect of low frequency modulated microwave exposure on human EEG: individual sensitivity. *Bioelectromagnetics* 2008; 29: 527-38.
129. Zotti-Martelli L, Peccatori M, Maggini V, et al. Individual responsiveness to induction of micronuclei in human lymphocytes after exposure in vitro to 1800-MHz microwave radiation. *Mutat Res* 2005; 582: 42-52.
130. Sannino A, Sarti M, Reddy SB, et al. Induction of adaptive response in human blood lymphocytes exposed to radiofrequency radiation. *Radiat Res* 2009; 171: 735-42.
131. Lai H, Singh NP. Single- and double-strand DNA breaks in rat brain cells after acute exposure to radiofrequency electromagnetic radiation. *Int J Radiat Biol* 1996; 69: 513-21.
132. Lai H, Singh NP. Melatonin and a spin-trap compound block radiofrequency electromagnetic radiation- induced DNA strand breaks in rat brain cells. *Bioelectromagnetics* 1997; 18: 446-54.
133. Oktem F, Ozguner F, Mollaoglu H, et al. Oxidative damage in the kidney induced by 900-MHz emitted mobile phone: protection by melatonin. *Arch Med Res* 2005; 36: 350-5.
134. Ozguner F, Aydin G, Mollaoglu H, et al. Prevention of mobile phone induced skin tissue changes by melatonin in rat: an experimental study. *Toxicol Ind Health* 2004; 20: 133-9.
135. Ozguner F, Oktem F, Arman A, et al. Comparative analysis of the protective effects of melatonin and caffeic acid phenethyl ester (CAPE) on mobile phone-induced renal impairment in rat. *Mol Cell Biochem* 2005; 276: 31-7.
136. Ozguner F, Oktem F, Ayata A, et al. A novel antioxidant agent caffeic acid phenethyl ester prevents long-term mobile phone exposure-induced renal impairment in rat. Prognostic value of malondialdehyde, N-acetyl-beta-D-glucosaminidase and nitric oxide determination. *Mol Cell Biochem* 2005; 277: 73-80.
137. Ozguner F, Altinbas A, Ozaydin M, et al. Mobile phone-induced myocardial oxidative stress: protection by a novel antioxidant agent caffeic acid phenethyl ester. *Toxicol Ind Health* 2005; 21: 223-30.
138. Ozguner F, Bardak Y, Comlekci S. Protective effects of melatonin and caffeic acid phenethyl ester against retinal oxidative stress in long-term use of mobile phone: a comparative study. *Mol Cell Biochem* 2006; 282: 83-8.
139. Ayata A, Mollaoglu H, Yilmaz HR, et al. Oxidative stress-mediated skin damage in an experimental mobile phone model can be prevented by melatonin. *J Dermatol* 2004; 31: 878-83.
140. Ilhan A, Gurel A, Armutcu F, et al. Ginkgo biloba prevents mobile phone-induced oxidative stress in rat brain. *Clin Chim Acta* 2004; 340: 153-62.
141. Koju H, Mollaoglu H, Ozguner F, et al. Melatonin modulates 900 MHz microwave-induced lipid peroxidation changes in rat brain. *Toxicol Ind Health* 2006; 22: 211-6.

142. Sokolovic D, Djindjic B, Nikolic J, et al. Melatonin reduces oxidative stress induced by chronic exposure of microwave radiation from mobile phones in rat brain. *J Radiat Res (Tokio)* 2008; 49(6): 579-86.
143. Sevast'yanova LA. Specific influence of millimeter waves on biological objects. In: Devyatkov ND, ed. Nonthermal effects of millimeter waves radiation (in Russian). Moscow: Institute of Radioelectronics of USSR Academy of Science, 1981: 86-109.
144. Gos P, Eicher B, Kohli J, et al. Extremely high frequency electromagnetic fields at low power density do not affect the division of exponential phase *Saccharomyces cerevisiae* cells. *Bioelectromagnetics* 1997; 18: 142-55.
145. Frohlich H. Long-range coherence and energy storage in biological systems. *Int J Quantum Chem* 1968; 2: 641-52.
146. Kaiser F. Coherent oscillations - their role in the interaction of weak ELM-fields with cellular systems. *Neural Network World* 1995; 5: 751-62.
147. Scott A. Nonlinear science: emergence and dynamics of coherent structures. Oxford: Oxford University Press, 1999.
148. Bischof M. Introduction to integrative biophysics. In: Popp FA, Belousov LV, eds. *Integrative biophysics*. Dordrecht: Kluwer Academic Publishers, 2003, 1-115.
149. Arinichev AD, Belyaev IY, Samedov VV, et al. The physical model of determining the electromagnetic characteristic frequencies of living cells by DNA structure. In: 2nd International Scientific Meeting "Microwaves in Medicine". Rome, Italy: "La Sapienza" University of Rome, 1993, 305-7.
150. Hardell L, Hansson Mild K. Mobile phone use and acoustic neuromas. *Epidemiology* 2005; 16: 415; author reply 7-8.
151. Hardell L, Hansson Mild K, Carlberg M. Further aspects on cellular and cordless telephones and brain tumours. *Int J Oncol* 2003; 22: 399-407.
152. Hardell L, Hansson Mild K, Pahlson A, et al. Ionizing radiation, cellular telephones and the risk for brain tumours. *Eur J Cancer Prev* 2001; 10: 523-9.
153. Ahlbom A, Green A, Kheifets L, et al. Swerdlow. Epidemiology of health effects of radiofrequency exposure. *Environ Health Perspect* 2004; 112: 1741-54.
154. Pacini S, Ruggiero M, Sardi I, et al. Exposure to global system for mobile communication (GSM) cellular phone radiofrequency alters gene expression, proliferation, and morphology of human skin fibroblasts. *Oncol Res* 2002; 13: 19-24.
155. Nikolova T, Czyz J, Rolletschek A, et al. Electromagnetic fields affect transcript levels of apoptosis-related genes in embryonic stem cell-derived neural progenitor cells. *Faseb J* 2005; 19(12): 1686-8.
156. Ozguner M, Koyu A, Cesur G, et al. Biological and morphological effects on the reproductive organ of rats after exposure to electromagnetic field. *Saudi Med J* 2005; 26: 405-10.
157. Panagopoulos DJ, Karabarounis A, Margaritis LH. Effect of GSM 900-MHz mobile phone radiation on the reproductive capacity of *drosophila melanogaster*. *Electromagnetic Biology and Medicine* 2004; 23: 29 - 43.
158. Fejes I, Za Vaczki Z, Szollosi J, et al. Is there a relationship between cell phone use and semen quality? *Arch Androl* 2005; 51: 385-93.
159. Aitken RJ, Bennetts LE, Sawyer D, et al. Impact of radio frequency electromagnetic radiation on DNA integrity in the male germline. *Int J Androl* 2005; 28: 171-9.

Sección 4

Parámetros a considerar en la optimización de las prácticas. Frecuencias, ventanas de frecuencias, Campos electromagnéticos endógenos, Homeostasis electromagnética en los tejidos vivos. Efectos de los campos electromagnéticos externos sobre los endógenos. Frecuencias coherentes y decoherentes, Coherencia cuántica, patrones de frecuencia saludables y no saludables, modelos de Fröhlich y Davydov, frecuencias de 5G. (155)

Trabajo de revisión: An integral predictive model that reveals a causal relation between exposures to non-thermal electromagnetic waves and healthy or unhealthy effects, by Hans J Geesink¹ and Dirk K F Meijer²

1. Previous Project Leader Nanotechnology, DSM-Research, The Netherlands
2. Em, Professor of Pharmacology, University of Groningen, Groningen, The Netherlands

1. Agrawal, L., Sahu, S., Ghosh, S. Shiga, T., Fujita, D., Bandyopadhyay, A. Inventing atomic resolution scanning dielectric microscopy to see a single protein complex operation live at resonance in a neuron without touching or adulterating the cell, Journal of Integrative Neuroscience, Vol.15, No.4 (2016) 435-462 World Scientific Publishing Europe Ltd. DOI: [10.1142/S0219635216500333](https://doi.org/10.1142/S0219635216500333).
2. Ahlberg Gagnér V., Ida Lundholm, Maria-Jose Garcia-Bonete, Helena Rodilla, Ran Friedman, Vitali Zhaunerchyk, Gleb Bourenkov, Thomas Schneider, Jan Stake, Gergely Katona. Clustering of atomic displacement parameters in bovine trypsin reveals a distributed lattice of atoms with shared chemical properties. *Scientific Reports* | (2019) 9:19281 | DOI: [10.1038/s41598-019-55777-5](https://doi.org/10.1038/s41598-019-55777-5).
3. Ahmed, N.A.G., Calderwood, J.H., Fröhlich, H., Smith, C.W. (1975). Evidence for collective magnetic effects in an enzyme likelihood of room temperature superconductive regions. *Phys.Lett.A.* 53:129–130.
4. Amiot E. The Torii of Phases.In: Yust J, Wild J, Burgoyne J A (eds) Mathematics and Computation in Music.MCM 2013.Lecture Notes in Computer Science.2013;7937.
5. Bacon, D. "Decoherence, control, and symmetry in quantum computers". <https://arxiv.org/abs/quant-ph/0305025>. Impaired coherence contributes to the progressive, 2001.
6. Bardeen J, Cooper LN, Schrieffer JR. "Theory of superconductivity" *Phys.Rev.* 1957; vol.108, pp.1175–1204, <http://link.aps.org/doi/10.1103/PhysRev.108.1175>.
7. Barnes FS, Greenebaum B. The effects of weak magnetic fields on radical pairs. *Bioelectromagnetics*. 2015 Jan;36(1):45-54. DOI: [10.1002/bem.21883](https://doi.org/10.1002/bem.21883). Epub 2014 Nov 15. PMID: 25399679.
8. Baumgratz, T.; Cramer, M.; Plenio, M.B. (2014)."Quantifying Coherence". *Phys.Rev. Lett.* 113 (14): 140401. <https://arxiv.org/pdf/1311.0275.pdf>.
9. Bekard, I.B., K.J. Barnham, L.R. White and D.E. Dunstan, α -Helix unfolding in simple shear flow, *Soft Matter*, 2011, 7, 203.
10. Bekard, I.B., P. Asimakis, C.L. Teoh, T. Ryan, G.J. Howlett, J. Bertolini and D.E. Dunstan, Bovine serum albumin unfolds in Couette flow, *Soft Matter*, 2012, 8, 385.
11. Bekard I.B., Dave E. Dunstan. Electric field induced changes in protein conformation. *Soft Matter*, 2014, 10, 431.
12. Belyaev, I.Y., Alipov, Y.D.and Shcheglov, V.S. (1992) Chromosome DNA as a Target of Resonant Interaction between Escherichia-coli-cells and Low Intensity Millimeter Waves. *Electro- and Magnetobiology*, 11, 97-108. DOI: [10.3109/15368379209009820](https://doi.org/10.3109/15368379209009820)
13. Belyaev, I.Y., V.S. Shcheglov, Y.D. Alipov, Resonance effect of millimeter waves in the power range from 10-19 to 3×10^{-3} W/cm² on Escherichia coli cells at different concentrations. January 1996. *Bioelectromagnetics* 17(4):312-321. DOI: [10.1002/\(SICI\)1521-186X\(1996\)17:4<312::AID-BEM7>3.0.CO;2-6](https://doi.org/10.1002/(SICI)1521-186X(1996)17:4<312::AID-BEM7>3.0.CO;2-6)
14. Belyaev, I.Y. (2010) Dependence of Non-Thermal Biological Effects of Microwaves on Physical and Biological Variables: Implications for Reproducibility and Safety Standards.In: Giuliani, L. and Soffritti, M., Eds., European Journal of Oncology—Library Non-Thermal Effects and Mechanisms of Interaction between Electromagnetic Fields and Living Matter.
15. Belyaev, I.Y., 2015.Biophysical mechanisms for nonthermal microwave effects. In: Markov, M. (Ed.), Electromagnetic Fields in Biology and Medicine, vol.2015.CRC Press, Boca Raton, London, New York, pp.49e68.
16. Blank, M., Findl, E. (1970). Mechanistic Approaches to Interactions of Electric and Electromagnetic Fields with Living Systems. 1987.Springer Science+Business Media, LLC.ISBN: 978-1-4899-1970-0.

17. Blank, M. Protein and DNA Reactions Stimulated by Electromagnetic Fields. February2008. Electromagnetic Biology and Medicine 27(1): 3-23. DOI: [10.1080/15368370701878820](https://doi.org/10.1080/15368370701878820).
18. Bodewein, L. Schmiedchen K., Dechent D., Stunder D., Graefrath D., Winter L., Kraus T., Driessen S. Systematic review on the biological effects of electric, magnetic and electromagnetic fields in the intermediate frequency range (300 Hz to 1 MHz). Environmental Research Volume 171, April 2019, Pages247-259.
19. Buchachenko, A. (2015). Why magnetic and electromagnetic effects in biology are irreproducible and contradictory? Bioelectromagnetics.37:1–13. Wiley Periodicals, Inc.
20. Bugay, A.N. Interaction of terahertz radiation with DNA. Nano Systems: Physics, Chemistry, Mathematics, 2012, 3 (1), P.51–55. http://nanojournal.ifmo.ru/files/volume6/05_Bugay.pdf
21. Butikov, E.I. (2004). Parametric excitation of a linear oscillator. Eur.J.Phys.25:535–554.
22. Betskii, O.V., Lebedeva, N.N., 2004.Clinical Application of Bioelectromagnetic Medicine. Marcel Dekker, USA, N-Y, Ch. Low-intensity Millimeter Waves in Biology and Medicine, pp.741e760.
23. Blackman, C.F. (1984) Sub-Chapter 5.7.5 Biological Effects of Low Frequency Modulation of RF Radiation. In: Elder, J.A. and Cahill, D.F., Eds., Biological Effects of Radiofrequency Radiation.
24. Bock J, Fukuyo Y, Kang S, Phipps ML, Alexandrov LB, Rasmussen KØ, et al. (2010) Mammalian Stem Cells Reprogramming in Response to Terahertz Radiation. PLoS ONE 5(12): e15806. DOI: [10.1371/journal.pone.0015806](https://doi.org/10.1371/journal.pone.0015806)
25. Del Re B., Fernando Bersani, Gianfranco del Georgi. Effect of electromagnetic field exposure on the transcription of repetitive DNA elements in human cells, Electromagnetic Biology and Medicine Volume 38, 2019 - Issue 4.
26. Cea, T, Barone P, Castellani C, Benfatto L. Polarization dependence of the third-harmonic generation in multiband superconductors. Phys.Rev.2018; B 97, 094516.
27. Chukova YP. Doubts about Non thermal Effects of MM Radiation Have no Scientific Foundations, 9th International Fröhlich's Symposium IOP Publishing, Journal of Physics: Conference Series 329 (2011) 012032 DOI:[10.1088/1742-6596/329/1/012032](https://doi.org/10.1088/1742-6596/329/1/012032).
28. Devi-Prasad, K.V., and Prohofsky, E.W. (1984), “Low frequency mode prediction in A-DNA compared to experimental observations and significance for A to B conformational change,” Biopolymers, 20, 853–864.
29. Devyatkov, N D "Influence of Millimeter-band Electromagnetic Radiation on Biological Objects" Soviet Physics Uspekhi. 16 568–569 (1974)
30. Deruelle F. The different sources of electromagnetic fields: Dangers are not limited to physical. Journal Electromagnetic Biology and Medicine, Published online: 10 Mar2020
31. Cosic, I. (1997). The Resonant Recognition Model of Macromolecular Bioactivity Theory and Applications. Basel, Boston, Berlin: Birkhauser Verlag.ISBN: 978-3-0348-7477-9.
32. Cosic, I., Cosic, D., Lazar, K. (2015). Is it possible to predict electromagnetic resonances in proteins DNA and RNA? EPJ Nonlinear Biomedical Physics.3:5.
33. Cosic, I., Cosic, D., Lazar, K. (2016). Environmental light and its relationship with electromagnetic resonances of biomolecular interactions, as predicted by the resonant recognition model. Int. J. Environ. Res. Public Health.13:647
34. Cruz C., Anka M. F. Quantifying quantum coherence in a metal-silicate framework. arXiv: [1910.04199v3](https://arxiv.org/abs/1910.04199v3) [quant-ph] 5 Dec 2019.
35. https://www.researchgate.net/publication/336410736_Quantifying_quantum_coherence_in_a_metal-silicate_framework
36. D'Agostino, S., Chiara Della Monica, Eleonora Palizzi, Fabio Di Pietrantonio, Massimiliano Benetti, Domenico Cannatà, Marta Cavagnaro, Dariush Sardari, Pasquale Stano & Alfonsina Ramundo-Orlando. Extremely High Frequency Electromagnetic Fields Facilitate Electrical Signal Propagation by Increasing Transmembrane Potassium Efflux in an Artificial Axon Model. Scientific Reports | (2018) 8:9299 | DOI: [10.1038/s41598-018-27630-8](https://doi.org/10.1038/s41598-018-27630-8).
37. Dana K.D., María García Díaz, Mohamed Mejatty, Andreas Winter. Resource Theory of Coherence — Beyond States. [arXiv:1704.03710v4](https://arxiv.org/abs/1704.03710v4) [quant-ph] 20 Nov 2017.
38. Davydov, A.S. (1973). The theory of contraction of proteins under their excitation. J.Theor.Biol.38:559–569. DOI [10.1016/0022-5193\(73\)90256-7](https://doi.org/10.1016/0022-5193(73)90256-7). PMID 4266326.
39. Davydov, A.S. (1977). Solitons and energy transfer along protein molecules. J.Theor.Biol.66:379–387. DOI:

- [10.1016/0022-5193\(77\)90178-3](https://doi.org/10.1016/0022-5193(77)90178-3). PMID 886872.
40. Li D, Chen H, Ferber JR, Hirst AK, Odouli R. Association Between Maternal Exposure to Magnetic Field Nonionizing Radiation During Pregnancy and Risk of Attention-Deficit/Hyperactivity Disorder in Offspring in a Longitudinal Birth Cohort. *JAMA Netw Open*. 2020;3(3):e201417. DOI: [10.1001/jamanetworkopen.2020.1417](https://doi.org/10.1001/jamanetworkopen.2020.1417).
 41. Del Giudice, E., Doglia, S., Milani, M., Vitiello, G. (1983). Spontaneous symmetry breakdown and boson condensation in biology. *Physics Letters A*, Volume 95, Issue 9, 30 May 1983, Pages 508-510.
 42. Del Giudice, E., Doglia, S., Milani, M., Vitiello, G. (1985). Quantum field theoretical approach to the collective behaviour of biological systems. *Nuclear Physics B*. 251(C):375–400.
 43. Del Giudice E, Tedeschi A, 2009. Water and Autocatalysis in Living Matter, *Electromagnetic Biology and Medicine*, 28: 46–52.
 44. Del Giudice E, Spinetti P R, Tedeschi A, 2010. Water dynamics at the root of metamorphosis in living organisms. *Water* 2: 566–586.
 45. De Ninno A., Castellano AC. On the Effect of Weak Magnetic Field on Solutions of Glutamic Acid: The Function of Water, 2011 *J. Phys.: Conf.Ser.* 329 012025.
 46. De Ninno, Congiu Castellano and Del Giudice. The supramolecular structure of liquid water and quantum coherent processes in biology. *Journal of Physics: Conference Series* 442 (2013) 012031 DOI: [10.1088/1742-6596/442/1/012031](https://doi.org/10.1088/1742-6596/442/1/012031)
 47. De Ninno, A., Del Giudice, E., Gamberale, L., Congiu Castellano, A. (2014). The structure of liquid water emerging from the vibrational spectroscopy: Interpretation with QED theory. *Water* 6:13–25.
 48. De Ninno, A., Pagnolato, M. Electromagnetic homeostasis and the role of low-amplitude electromagnetic fields on life organization, *Electromagnetic Biology and Medicine*, 2016. DOI: [10.1080/15368378.2016.1194293](https://doi.org/10.1080/15368378.2016.1194293), 2016.
 49. De Ninno, A., De Francesco, M. ATR-FTIR study of the isosbestic point in water solution of electrolytes, *Chem Phys*. 513, (2018) 266 -272.
 50. Devyatkov, N.D. (1974) Influence of Millimetre Band Electromagnetic Radiation on Biological Objects. *Sov Phys Usp*, 16, 568-569. DOI: [10.1070/PU1974v01n04ABEH005308](https://doi.org/10.1070/PU1974v01n04ABEH005308)
 51. Devyatkov, N.D., Golant, M.V. and Betskii, O.V. (1991) Millimeter Waves and Their Role in Processes of Vital Activity (in Russian). *Radio and Svyaz*, Moscow.
 52. Devyatkov, N.D., Pletnyov, S.D., Chernov, Z.S., Faikin, V.V., et al. (1994) Effect of Low-energy and High-peak-power Nanosecond Pulses of Microwave Radiation on Malignant Tumors. DANSSSR,336. (In Russian). https://www.researchgate.net/publication/12013799_Effect_of_Low-energy_and_High-peak-power_Nanosecond_Pulses_of_Microwave_Radiation_on_Malignant_Tumors
 53. Dubey, Swati & Paliwal, Ayushi & Ghosh, Sanjay. (2016). Frohlich Interaction in Compound Semiconductors: A Comparative Study. *Advanced Materials Research*. 1141. 44-50. 10.4028/ www.scientific.net/AMR.1141.44. https://www.researchgate.net/publication/307085517_Frohlich_Interaction_in_Compound_Semiconductors_A_Comparative_Study
 54. Durdik, M., Pavol Kosik, Eva Markova, Alexandra Somsedikova, Beata Gajdosechova, Ekaterina Nikitina, Eva Horvathova, Katarina Kozics, Devra Davis & Igor Belyaev. Microwaves from mobile phone induce reactive oxygen species but not DNA damage, preleukemic fusion genes and apoptosis in hematopoietic stem/progenitor cells. *Scientific Reports* | (2019) 9:16182 | <https://doi.org/10.1038/s41598-019-52389-x>
 55. Fedorov, P.S.S. and P.A.N., Dynamic Effects of Submillimeter Wave Radiation on Biological Objects of Various Levels of Organization. *International Journal of Infrared and Millimeter Waves*, 2003.24(8): p.1235–1254.
 56. Feng Y, Prohofsky EW. Vibrational fluctuations of hydrogen bonds in a DNA double helix with nonuniform base pairs. *Biophys J*. 1990 Mar;57(3):547–553.
 57. Feynman, R.P., Robert B. Leighton and Matthew Sands (1963)."Quantum Behaviour". *The Feynman Lectures on Physics*. III. Addison-Wesley.
 58. Fremling M. Coherent State Wave Functions on the Torus, Licentiate Thesis, 2013.
 59. FRENCH, P.W., DONNELLAN, M.& MCKENZIE, D.R.1997.Electromagnetic radiation at 835 MHz changes morphology and inhibits proliferation of a human astrocytoma cell line. *Bioelectrochem. Bioenerg.*43: 13–18.
 60. French, P. (2003). *Vibrations and Waves*. Norton.ISBN 978-0-393-09936-2.
 61. Fröhlich, H. (1968). Long-range coherence and energy storage in biological systems. *Int.J.Quantum.Chem.*2:641–649.

62. Fröhlich, H. (1969). Quantum mechanical concepts in biology. In: Marois, M.Ed. From Theoretical Physics to Biology. Amsterdam, the Netherlands: North-Holland. pp.13–22.
63. Fröhlich, H. (1978). Coherent electric vibrations in biological systems and the cancer problem. Microwave theory and techniques. IEEE Trans.26:33.
64. Fröhlich, H.: Further evidence for coherent excitations in biological systems, Phys. Lett, 110A, 480-481, 1985.[2] Fröhlich, H.: Coherent excitation in active biological systems, In: Modern Bioelectrochemistry, F. Gutmann, &H. Keyzer, eds., New York: Plenum, 1986, pp.241-261,1986.
65. Fröhlich, H. (1988). Biological Coherence and Response to External Stimuli.Berlin, Heidelberg, New York: Springer.
66. Hinrikus, H., Bachmann, M., Lass, J. (2011). Parametric mechanism of excitation of the electroencephalographic rhythms by modulated microwave radiation.Int.J.Rad.Biol.87:1077–1085.
67. Hiie Hinrikus, Jaanus Lass, Denis Karai, Kristjan Pilt, and Maie Bachmann.Microwave effect on diffusion: a possible mechanism for non-thermal effect. Electromagn Biol Med, Early Online: 1–7! 2014 Informa Healthcare USA, Inc. DOI: [10.3109/15368378.2014.921195](https://doi.org/10.3109/15368378.2014.921195).
68. Hinrikus, H., Bachmann, M., Karai, D., Lass, J. (2016). Mechanism of low-level microwave radiation effect on nervous system. Electromagn Biol Med.36:202–212. DOI: [10.1080/15368378.2016.1251451](https://doi.org/10.1080/15368378.2016.1251451).
69. Jerman I. The Origin of Life from Quantum Vacuum, Water and Polar Molecules.American Journal of Modern Physics, 2016;5(4-1):34-43.
70. Geesink, J.H. and Meijer, D.K.F. (2016) Quantum Wave Information of Life Revealed: An Algorithm for Electromagnetic Frequencies that Create Stability of Biological Order, With Implications for Brain Function and Consciousness. NeuroQuantology,14, 106-125. DOI: [10.14704/nq.2016.14.1.911](https://doi.org/10.14704/nq.2016.14.1.911) and <https://neuroquantology.com/data-cms/articles/20191023010306pm911.pdf>
71. Geesink JH and Meijer, DKF. Bio-Soliton Model that predicts Non-Thermal Electromagnetic Radiation Frequency Bands, that either Stabilize or Destabilize Life Conditions. Electromagnetic Biology and Medicine, 2017a; 36, 357-378. DOI: [10.1080/15368378.2017.1389752](https://doi.org/10.1080/15368378.2017.1389752).
72. Geesink J H, Meijer D K F (2017b). Electromagnetic Frequency Patterns that are Crucial for Health and Disease Reveal a Generalized Biophysical Principle: the GM scale. Quantum Biosystems, 8, 1-16.
73. Geesink J H, Meijer D K F, (2018a) Mathematical Structure of the GM Life Algorithm that May Reflect Bohm's Implicate Order. J. Modern Physics, 9, 851- 897.
74. Geesink J H, Meijer D K F (2018b) A semi-harmonic electromagnetic frequency pattern organizes non-local states and quantum entanglement in both EPR studies and life systems. J. Modern Physics, 9, 898-924.
75. Geesink, J H, Meijer, D K F (2018d) Evidence for a Guiding Coherence Principle in Quantum Physics, Quantum Biosystems | 2018 | Vol 9 | Issue 1 | Page 1- 7.
76. Geesink, J H, Meijer, D K F (2018e) Is the Fabric of Reality Guided by a Semi-Harmonic, Toroidal Background Field? International Journal of Structural and Computational Biology,
77. Geesink, J H, Meijer, D K F (2019a) A novel biophysical quantum algorithm predicts super-conductive properties in animate and inanimate systems, Quantum Biosystems | 2019a | Vol 10 | Issue 1 | Page 1- 32.
78. Geesink, J H, Jerman, I, Meijer, D K F. Water: the cradle of life in action, cellular architecture is guided by coherent quantum frequencies as revealed in pure water, Water Journal, 2020a.
79. Geesink J H, Jerman I, Meijer D K F. Clay minerals: information network linking quantum coherence and first life, submitted, 2020b.
80. Geesink, JH. Informational code of biomolecules and its building blocks: quantum coherence versus decoherence, in preparation, 2020c.
81. Germash KV, Fil DV. Strong enhancement of third-harmonic generation in a double layer graphene system caused by electron-hole pairing, EPL (Europhysics Letters), 2017; Volume 118, Number 6.
82. Giannì, Matteo, Micaela Liberti, Francesca Apollonio and Guglielmo D'Inzeo. "Modeling electromagnetic fields detectability in a HH-like neuronal system: stochastic resonance and window behavior." Biological Cybernetics 94 (2005): 118-127. DOI: [10.1007/s00422-005-0029-5](https://doi.org/10.1007/s00422-005-0029-5).
83. Gioacchino DD, Marcelli A, PuriA, Bianconi A. Thea.c. susceptibilitythirdharmoniccomponentofNdO1-0.14F0.14FeAs: A flux dynamic magnetic analysis. Journal of Physics and Chemistry of Solids 71,2010;1046–1052.
84. Golinska K., A. Coherence function in biomedical signal processing: a short review of applications in Neurology,

- Cardiology and Gynecology, Studies in Logic, Grammar and Rhetoric 2011 | 25(38) | 73-82.
85. Halgamuge M.N., Efstratios Skafidas, Devra Davis. A meta-analysis of in vitro exposures to weak radiofrequency radiation exposure from mobile phones (1990–2015), Environmental Research, Volume 184, May 2020, 109227. <https://doi.org/10.1016/j.envres.2020.109227>.
 86. Huelga, S.F., Plenio, M.B. (2013). Vibration, quanta and biology. *Contemp.Phys.*54: 181.and E-print: arxiv: [1307.3530](https://arxiv.org/abs/1307.3530).
 87. Inbamalar T.M. and R. Sivakumar. Improved Algorithm for Analysis of DNA Sequences Using Multiresolution Transformation, Hindawi Publishing Corporation. Scientific World Journal Volume 2015, Article ID 786497, 9 pages. DOI : [10.1155/2015/786497](https://doi.org/10.1155/2015/786497).
 88. Jantzen, R.T. Geodesicson the Torus and other Surfaces of Revolution Clarified Using Under graduate Physics Tricks with Bonus: Non relativistic and Relativistic Kepler Problems. Physics, Mathematics Published 2012.
 89. Kadantsev, V.N., Goltsov, A. Collective excitations in alpha-helical protein structures interacting with environment. DOI: [10.1101/457580](https://doi.org/10.1101/457580).
 90. Kavokin, A. Exciton-polaritons in microcavities: Recent discoveries and perspectives. *Phys. Status Solidi B* 2010; 247, 1898;1906.
 91. Kodera S, Gomez-Tames J, Hirata A. Temperature elevation in the human brain and skin with thermoregulation during exposure to RF energy. *Biomedical Engineering Online*, 08 Jan 2018, 17(1):1, DOI: [10.1186/s12938-017-0432-x](https://doi.org/10.1186/s12938-017-0432-x).
 92. Lechelon, M. Thesis: Long-range electro dynamic interactions among biomolecules, PhD thesis in Biophysics. Under the supervision of Marco Pettini and Pierre Ferrier. Defended on 11-12-2017 in Aix-Marseille, in the framework of Ecole Doctorale Physique et Sciences de la Matière (Marseille), in partnership with CPT Centre de physique théorique. UMR 7332 (Marseille ; Toulon) (laboratory) and Centre d'Immunologie Marseille-Luminy (CIML) (laboratory). The president of the jury was Luca Varani. The jury was composed of Jérémie Torres, Didier Marguet, James N. Sturgis, Marius Réglier. The rapporteurs were Jack A. Tuszynski, Stefano Ruffo. Free download at www.theses.fr%2F2017AIXM0469.pdf
 93. Legrand, R.et al., Thermal microscopy of single biological cells. *Appl. Phys.Lett.*2015, 107,263703.
 94. Liboff, A.R. (1985). Geomagnetic cyclotron resonance in living cells. *J.Biol.Phys.*13:99–102.
 95. Lindstrom, E., E. Lundgren, "Intracellular Calcium Oscillations Induced in a T-cell Line by a Weak 50 Hz Magnetic Field". *J. of Cellular Physiology* 1993, 156:395-398.
 96. Lednev, V.V. (1991). Possible mechanism for the influence of weak magnetic fields on biological systems. *Bioelectromagnetics*.12:71–75. DOI [10.1002/bem.2250.120202](https://doi.org/10.1002/bem.2250.120202).
 97. Lednev, V.V. (1993). Possible mechanism for the effect of weak magnetic fields on biological systems. Correction of the basic expression and its consequences. In: Blank M, ed. Electricity and magnetism in biology and medicine. San Francisco, San Francisco Press, 1993:550-552.
 98. Lundholm, I.V., Helena Rodilla, Weixiao Y. Wahlgren, Annette Duelli, Gleb Bourenkov, Josip Vukusic, Ran Friedman, Jan Stake, Thomas Schneider, Gergely Katona.Terahertz radiation induces non-thermal structural changes associated with Fröhlich condensation in a protein crystal. *Structural Dynamics*, 2015; 2 (5): 054702 DOI: [10.1063/1.4931825](https://doi.org/10.1063/1.4931825).
 99. Marino C., Galloni P., and Merla C., Biological Effects of Electromagnetic Fields.In: Saleem Hashmi (editor-in-chief), Reference Module in Materials Science and Materials Engineering. Oxford: Elsevier; 2016. pp.1-9.ISBN: 978-0-12-803581-8.
 100. Marracino P., Daniel Havelka, Jiří Průša, Micaela Liberti, Jack Tuszynski, Ahmed T.Ayoub, Francesca Apollonio & Michal Cifra.Tubulin response to intense nanosecond-scale electric field in molecular dynamics simulation, *Scientific Reports* | (2019) 9:10477 | <https://doi.org/10.1038/s41598-019-46636-4>.
 101. McDermott M Let al., 2017.DNA's Chiral Spine of Hydration.ACS Central Science 3: 708-714. <https://doi.org/10.1021/acscentsci.7b00100>.
 102. Meijer, D.K.F.and Geesink, J.H. (2016c) Phonon Guided Biology: Architecture of Life and Conscious Perception Are Mediated by Toroidal Coupling of Phonon, Photon and Electron Information Fluxes at Discrete Eigenfrequencies. *Neuro- Quantology*, 14, 718-755. <https://doi.org/10.14704/nq.2016.14.4.985>
 103. Meijer, D.K.F.and Geesink, J.H. (2017c) The Folding of Life Proteins: Being a Guest in a Multi-Scale Landscape; On the Role of Long- and Short-Range Electromagnetic Pilot Mechanisms, in an Evolutionary Context. *Biological Physics*, Research Gate.

104. Melkikh, A.V. and Meijer, D.K.F. (2018) On a Generalized Levinthal's Paradox: The Role of Long- and Short Range Interactions on Complex Bio-Molecular Reactions, including Protein and DNA Folding. *Progress in Biophysics and Molecular Biology*, 132, 57-79. <https://doi.org/10.1016/j.pbiomolbio.2017.09.018>.
105. Meijer, D.K.F. and Geesink (2018f) Favourable and Unfavourable EMF Frequency Patterns in Cancer: Perspectives for Improved Therapy and Prevention. *Journal of Cancer Therapy*, 2018, 9.
106. Musumeci F., Rosaria Grasso, Luca Lanzanò, Agata Scordino, Antonio Triglia, Salvatore Tudisco, Marisa Gulino. Delayed luminescence: a novel technique to obtain new insights into water structure. *J Biol Phys* (2012) 38:181–195. DOI: [10.1007/s10867-011-9245-5](https://doi.org/10.1007/s10867-011-9245-5).
107. Naarala J., Mikko Kolehmainen and Jukka Juutilainen. Electromagnetic Fields, GenomicIn stability and Cancer: A Systems Biological View, *Genes* 2019, 10, 479; DOI: [10.3390/genes10060479](https://doi.org/10.3390/genes10060479).
108. Nardecchiai., Jeremie Torres, Mathias Lechelon, Valeria Giliberti, Michele Ortolani, Philippe Nouvel, Matteo Gori, Yoann Meriguet, Irene Donato, Jordane Preta, Luca Varani, James Sturgis, and Marco Pettini. Out-of-Equilibrium Collective Oscillation as Phonon Condensation in a Model Protein. *Physical Review X* 8, 031061 (2018).
109. Noor NA, Mohammed HS, Ahmed NA, Radwan NM. Variations in amino acid neurotransmitters in some brain areas of adult and young male albino rats due to exposure to electromagnetic radiation. *Med./bio. Eur Rev Med Pharmacol Sci* 2011; 15 (7): 729-742.
110. Olmi S., Gori M., Donato I., Pettini M. Collective behaviour of oscillating electric dipoles, *Cientific Reports* | (2018) 8:15748 | DOI: [10.1038/s41598-018-33990-y](https://doi.org/10.1038/s41598-018-33990-y).
111. Ozaktas H.M., Talha Cihad Gulcu, and M. Alper Kutay. Linear algebraic theory of partial coherence: continuous fields and measures of partial coherence. *Journal of the Optical Society of America A* Vol.33, Issue 11, pp.2115-2124 (2016) <https://doi.org/10.1364/JOSAA.33.002115>.
112. Paffi A, Apollonio F, d'Inzeo G, Liberti M. Stochastic resonance induced by exogenous noise in a model of a neuronal network. *Network*.2013;24(3): 99-113. DOI: [10.3109/0954898X.2013.793849](https://doi.org/10.3109/0954898X.2013.793849). Epub 2013 May 8.
113. Pall, M.L. (2013). Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. *J. Cell. Mol. Med.* XX:1–9.
114. Pang, X.F., Chen, X.R. (2001). Distribution of vibrational energy levels of protein molecular chains. *Commun. Theor. Phys.* (Beijing, China).35:323–326.
115. Pareja-Peña F., Antonio M. Burgos-Molina, Francisco Sendra-Portero & Miguel J. Ruiz-Gómez. Evidences of the (400 MHz 3 GHz) radiofrequency electromagnetic field influence on brain tumor induction. *Journal International Journal of Environmental Health Research*, 2020. <https://doi.org/10.1080/09603123.2020.1738352>
116. Pakhomov, A.G., Akyel, Y., Pakhomova, O.N., Stuck, B.E., Michael, R., Murphy, M.R., 1998. Current state and implications of research on biological effects of millimetre waves: are view of the literature. *Bioelectromagnetics* 19, 393–13. <https://www.ncbi.nlm.nih.gov/pubmed/9771583>
117. Pang, X.F., Chen, S., Wang, X., Zhong, L. (2016). Influences of electromagnetic energy on bio-energy transport through protein molecules in living systems and its experimental evidence. *Int.J.Mol.Sci.* 17:1130.
118. Pauling, L. Molecular basis of biological specificity. *Nature*, 248(5451):769(771, april 1974).
119. Pikov, V., X. Arakaki, M. Harrington, S.E. Fraser, and P.H. Siegel, "Modulation of neuronal activity and plasma membrane properties with low-power millimeter waves in organotypic cortical slices". *J. Neural Eng.*, vol.7, no.4, p.045003, Aug.2010.
120. Pirogova, E., Cosic, I. (2001). Examination of amino acid indexes within the resonant recognition model, *Proceedings of the 2nd Conference of the Victorian Chapter of the IEEE EMBS*, Melbourne, Australia
121. Poccia, N, Ricci, A, Bianconi, A. Fractal structure favouring superconductivity at high temperatures in a stack of membranes near a strain quantum critical point. *J. Supercond. Nov.Magn.* 2011a; 24, 1195–1200.
122. Poccia N. and Bianconi A. Meeting Report The Physics of Life and Quantum Complex Matter: A Case of Cross-Fertilization Life 1, 3-6; 2011b; DOI: [10.3390/life1010003](https://doi.org/10.3390/life1010003) life ISSN 2075-1729. www.mdpi.com/journal/life.
123. Pokorný, J., Jiří Pokorný; Jan Vrba. Electromagnetic communication between cells through tunnelling nanotubes, 2019 European Microwave Conference in Central Europe (EuMCE).
124. Preparata, G. (1995). QED Coherence in Condensed Matter. New Jersey, Singapore, London: World Scientific, pp.25–40.
125. Prohofsky EW (2004). RF absorption involving biological macromolecules. *Bioelectromagnetics*, 25(6):441-451.
126. Rajasekaran SJ, Okamoto L, Mathey M, Fechner V, Thampy, Gu GD, Cavalleri A. Probing optically silent

- superfluid stripes in cuprates. *Science* 2018; 359,575–579. <https://pubmed.ncbi.nlm.nih.gov/29420290/>
127. Reimers J.R., Laura K. McKemmish, Ross H. McKenzie, Alan E. Mark, and Noel S. Hush. Weak, strong, and coherent regimes of Fröhlich condensation and their applications to terahertz medicine and quantum consciousness. *PNAS* March 17, 2009 106 (11) 4219-4224; <https://doi.org/10.1073/pnas.0806273106>.
128. RenatiP., Zoltan Kovacs, Antonella De Ninno, Roumiana Tsenkova, Temperature dependence analysis of the NIR spectra of liquid water confirms the existence of two phases, one of which is in a coherent state *Journal of Molecular Liquids* 292 (2019)111449.
129. Romanenko S, Siegel PH, Wagenaar DA, Pikov V.2014 Effects of millimeter wave irradiation and equivalent thermal heating on the activity of individual neurons in the leech ganglion. *J. Neurophysiol.*112, 2423–2431. (DOI:[10.1152/jn.00357.2014](https://doi.org/10.1152/jn.00357.2014))
130. Romanenko S, Siegel PH, Pikov V, Wallace V. 2016, Alterations in neuronal action potentials hapeands pikin grate caused by pulsed 60 GHz millimetre wave radiation. In 41st Int. Conf on Infrared, Millimeter, and Terahertz Waves (IRMMW- THz), Copenhagen, Denmark, 25–30 September, pp.1–2. Piscataway, NJ: IEEE.
131. Romanenko S., Ryan Begley, Alan R. Harvey, Livia Hool, Vincent P. Wallace. The interaction between electromagnetic fields at megahertz, gigahertz and terahertz frequencies with cells, tissues and organisms: risks and potential. Published:06 December 2017 <https://doi.org/10.1098/rsif.2017.0585>.
132. Rozenbaum, Efim B. Sriram Ganeshan, and Victor Galitski. Lyapunov Exponent and Out-of-Time-Ordered Correlator's Growth Rate in a Chaotic System. *Phys. Rev.Lett.*118, 086801 – Published 21 February 2017.
133. Russell, CL.5 G wireless telecommunications expansion: Public health and environmental implications. *Environmental Research* 165 (2018) 484–495.
134. Sahu S, Ghosh S, Ghosh B, Aswani K, Hirata K, Fujita D, Bandyopadhyay A, 2013. Atomic water channel controlling remarkable properties of a single brain microtubule: Correlating single protein to its supramolecular assembly. *Biosensors and Bioelectronics*.47, 141-148. DOI: [10.1016/j.bios.2013.02.050](https://doi.org/10.1016/j.bios.2013.02.050).
135. Sahu S, Ghosh S, Fujita D, Bandyopadhyay A, 2015. Live visualizations of single isolated tubulin protein self-assembly via tunneling current: effect of electromagnetic pumping during spontaneous growth of microtubule. *Scientific Reports*.4 [1] (2015). DOI: [10.1038/srep07303](https://doi.org/10.1038/srep07303)
136. Salford, L.G., Nitty, H., et al. (2017) The Mammalian Brain in the Electromagnetic Fields Designed by Man with Special Reference to Blood-Brain Barrier Function, Neuronal Damage and Possible Physical Mechanisms. *Progress of Theoretical Physics Supplement*, 173, 283-309. <http://ptp.ipap.jp/link?PTPS/173/283>.
137. Scarfi, MR, Mats-Olof Mattsson, Myrtill Simkó, Olga Zeni. Special Issue: “Electric, Magnetic, and Electromagnetic Fields in Biology and Medicine: From Mechanisms to Biomedical Applications” *Int. J. Environ. Res. Public Health* 2019, 16, 4548; DOI:[10.3390/ijerph16224548](https://doi.org/10.3390/ijerph16224548).
138. Sheppard AR, Swicord ML, Balzano Q (2008). Quantitative evaluations of mechanisms of radiofrequency interactions with biological molecules and processes. *Health Phys*, 95(4):365-396.
139. Simkó M., Mats-Olof Mattsson. 5G Wireless Communication and Health Effects—A Pragmatic Review Based on Available Studies Regarding 6 to 100 GHz. *Int. J. Environ. Res. Public Health* 2019, 16, 3406; DOI:[10.3390/ijerph16183406](https://doi.org/10.3390/ijerph16183406).
140. Smith-Roe SL, Wyde ME, Stout MD, Winters JW, Hobbs CA, Shepard KG, Green AS, Kissling GE, Shockley KR, Tice RR, Bucher JR, Witt KL, NTP study, conclusions 2019. *Environ Mol Mutagen* 2019.
141. Sonderkamp, T, Geesink J H, Meijer D K F, (2019). Statistical analysis and prospective application of the GM-scale, a semi-harmonic EMF scale proposed to discriminate between “coherent” and “decoherent” EM frequencies on life conditions, *Quantum Biosystems*.10(2) 33-51.
142. Streltsov A. Colloquium: Quantum coherence as a resource, *Reviews of Modern Physics*. Volume 89, October-December 2017.
143. Taschin, A., Bartolini, P., Eramo, R., et al. (2013). Evidence of two distinct local structures of water from ambient to supercooled conditions. *Nat.Commun.*4:2401–2411.
144. Tranquada J. Kathryn Allen, Hidden superconductivity revealed. *Materials World magazine*, 2018.
145. Tielrooij K J, Timmer R L A, Bakker H J, Bonn M, 2009. Structure Dynamics of the Proton in Liquid Water Probed with Terahertz Time-Domain Spectroscopy. *Phys.Rev. Lett.*, 102:198303.
146. Usselman, R.J., Chavarriaga, C., Castello, P.R., et al. (2016). The quantum biology of reactive oxygen species partitioning impacts cellular bioenergetics. *Sci Rep.* 6:38543. DOI: [10.1038/srep38543](https://doi.org/10.1038/srep38543).

147. Vanderstraeten J, Verschaeve L. Biological effects of radiofrequency fields: Testing a paradigm shift in dosimetry. Environmental Research Volume 184, May 2020, 109387
148. Vasconcellos AR, Vannuchi FS, Mascarenhas S, Luzzi R. Fröhlich Condensate: Emergence of synergetic Dissipative Structures in Information Processing Biological and Condensed Matter Systems, Information, 2012.
149. Veljkovic, V., Cosic, I., Dimitrijevic, B., Lalovic, D. (1985). Is it possible to analyze DNA and protein sequence by the method of digital signal processing? IEEE Trans.Biomed.Eng.32:337–341.
150. Veljkovic, V., Slavic, I. (1972). Simple General-Model Pseudopotential. Phys. Rev. Lett. 29:105–107.
151. Viennot, D., Aubourg, L. Chaos, decoherence and emergent extra dimensions in D-brane dynamics with fluctuations. [arXiv:1802.08541v2 \[hep-th\]](https://arxiv.org/abs/1802.08541v2), 16 May 2018.
152. Voiekov V, Del Giudice E 2009 Water respiration – The Basis of the Living State Water 1 52-75.
153. Vukova T., Andrey Atanassov, Radoy Ivanov, Nicolina Radicheva. Intensity-dependent effects of microwave electromagnetic fields on acetylcholinesterase activity and protein conformation in frog skeletal muscles. March 2005 Medical science monitor: international medical journal of experimental and clinical research 11(2):BR50-6.
154. Weightman P. "Investigation of the Frohlich hypothesis with high intensity terahertz radiation", Proc. SPIE8941, Optical Interactions with Tissue and Cells XXV; and Terahertz for Biomedical Applications, 89411F (13 March 2014); <https://doi.org/10.1117/12.2057397>.
155. Wong KW, Fung PCW, Chow WK. 5D Model Theory for the Creating of Life Forms. Journal of Modern Physics, 2019, 10, 1548-1565, <https://www.scirp.org/journal/jmp>, ISSN Online: 2153-120X.
156. Wu, TM., Austin S. Bose-Einstein condensation in biological systems. Journal of Theoretical Biology, Volume 71, Issue 2, 20 March 1978, Pages 209-214.
157. Yakymenko I., Olexandr Tsybulin, Evgeniy Sidorik, Diane Henshel, Olga Kyrylenko4 and Sergiy Kyrylenko. Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation. Electromagn Biol Med, Early Online: 1–16, 2015 Informa Healthcare USA, Inc. DOI: [10.3109/15368378.2015.1043557](https://doi.org/10.3109/15368378.2015.1043557).
158. Zhedong Zhang, Girish S. Agarwal, Marlan O. Scully. Institute for Quantum Science and Engineering, Quantum fluctuations in Fröhlich condensate of molecular vibrations driven far from equilibrium. Phys. Rev. Lett. 122, 158101 (2019), DOI: [10.1103/PhysRevLett.122.158101](https://doi.org/10.1103/PhysRevLett.122.158101).
159. Zurek, Wojciech H. (1998) Decoherence, einselection and the existential interpretation (the rough guide). *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 356 (1743). 1793-1821. DOI: [10.1098/rsta.1998.0250](https://doi.org/10.1098/rsta.1998.0250).

Sección 5

Determinacion de la Causalidad por L. Hardell. Aplicación de los 9 principios desarrollados por Sir Bradford Hill, Fuerza de la asociación, Consistencia de asociación, Especificidad, Temporalidad, Gradiente biológico, Plausibilidad biológica, Coherencia. Evidencia de casos humanos, Analogía. (72)

Trabajo de revisión: Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation, by Michael Carlberg and Lennart Hardell

Department of Oncology, Faculty of Medicine and Health, Örebro University, 701 82 Örebro, Sweden
BioMed Research International, Volume 2017, Article ID 9218486, 17 pages,
[http://dx.doi.org/10.1155/2017/9218486](https://dx.doi.org/10.1155/2017/9218486)

1. A. B. Hill, "The environment and disease: association or causation?" *Journal of the Royal Society of Medicine*, vol. 58, no. 5, pp. 295–300, 1965
2. Interphone Study Group, "Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study," *International Journal of Epidemiology*, vol. 390, pp. 675–694, 2010
3. R. Saracci and J. Samet, "Commentary: call me on my mobile phone ... or better not? —a look at the INTERPHONE study results," *International Journal of Epidemiology*, vol. 39, no. 3, pp. 695–698, 2010
4. R. Baan, Y. Grosse, B. Lauby-Secretan et al., "Carcinogenicity of radiofrequency electromagnetic fields," *The Lancet Oncology*, vol. 12, no. 7, pp. 624–626, 2011
5. IARC Monographs on the Evaluation of Carcinogenic Risk to Humans, *Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields*, vol. 102, International Agency for Research on Cancer, Lyon, France, 2013, <http://monographs.iarc.fr/ENG/Monographs/vol102/mono102.pdf>
6. L. Hardell, A. Näsman, A. Pählson, A. Hallquist, and K. Hansson Mild, "Use of cellular telephones and the risk for brain tumours: A Case-control Study," *International Journal of Oncology*, vol. 15, no. 1, pp. 113–119, 1999
7. L. Hardell, K. Hansson Mild, A. Pählson, and A. Hallquist, "Ionizing radiation, cellular telephones and the risk for brain tumours," *European Journal of Cancer Prevention*, vol. 10, no. 6, pp. 523–529, 2001
8. L. Hardell, A. Hallquist, K. Hansson Mild, M. Carlberg, A. Pählson, and A. Lilja, "Cellular and cordless telephones and the risk for brain tumours," *European Journal of Cancer Prevention*, vol. 11, no. 4, pp. 377–386, 2002
9. L. Hardell, K. Hansson Mild, and M. Carlberg, "Further aspects on cellular and cordless telephones and brain tumours," *International Journal of Oncology*, vol. 22, no. 2, pp. 399–407, 2003
10. L. Hardell, M. Carlberg, and K. Hansson Mild, "Pooled analysis of two case-control studies on use of cellular and cordless telephones and the risk for malignant brain tumours diagnosed in 1997–2003," *International Archives of Occupational and Environmental Health*, vol. 79, no. 8, pp. 630–639, 2006.
11. L. Hardell, M. Carlberg, and K. Hansson Mild, "Pooled analysis of two case-control studies on the use of cellular and cordless telephones and the risk of benign brain tumours diagnosed during 1997–2003," *International Journal of Oncology*, vol. 28, no. 2, pp. 509–518, 2006.
12. L. Hardell, M. Carlberg, and K. Hansson Mild, "Mobile phone use and the risk for malignant brain tumors: a case-control study on deceased cases and controls," *Neuroepidemiology*, vol. 35, no. 2, pp. 109–114, 2010.
13. L. Hardell, M. Carlberg, and K. Hansson Mild, "Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects," *International Journal of Oncology*, vol. 38, no. 5, pp. 1465–1474, 2011.
14. Interphone Study Group, "Acoustic neuroma risk in relation to mobile telephone use: results of the INTERPHONE international case-control study," *Cancer Epidemiology*, vol. 358, pp. 453–464, 2011.
15. E. Cardis, B. K. Armstrong, J. D. Bowman et al., "Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five interphone countries," *Occupational and Environmental Medicine*, vol. 68, no. 9, pp. 631–640, 2011.
16. E. K. Ong and S. A. Glantz, "Tobacco industry efforts subverting International Agency for Research on Cancer's second-hand smoke study," *The Lancet*, vol. 355, no. 9211, pp. 1253–1259, 2000.
17. D. Michaels, *Doubt is Their Product. How Industry's Assault on Science Threatens Your Health*, Oxford University Press, New York, NY, USA, 2008.
18. T. O. McGarity and W. E. Wagner, *Bending Science. How Special Interests Corrupt Public Health Research*, Harvard University Press, London, UK, 2008.
19. N. Oreskes and E. M. Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*, Bloomsbury Press, New York, NY, USA, 2010.
20. M. J. Walker, Ed., *Corporate Ties that Bind. An Examination of Corporate Manipulation and Vested Interest in Public Health*, Skyhorse Publishing, New York, NY, USA, 2017.

21. World Health Organization, "Electromagnetic fields and public health: mobile phones," Fact Sheet no. 193, 2014, <http://www.who.int/mediacentre/factsheets/fs193/en/>.
22. A. J. Swerdlow, M. Feychtig, A. C. Green, L. Kheifets, and D. A. Savitz, "Mobile phones, brain tumors, and the interphone study: where are we now?" *Environmental Health Perspectives*, vol. 119, no. 11, pp. 1534–1538, 2011.
23. M. H. Repacholi, A. Lerchl, M. Röösli et al., "Systematic review of wireless phone use and brain cancer and other head tumors," *Bioelectromagnetics*, vol. 33, no. 3, pp. 187–206, 2012.
24. International Commission on Non-Ionizing Radiation Protection, "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300GHz)," *Health Physics*, vol. 74, pp. 494–522, 1998.
25. International Commission on Non-Ionizing Radiation Protection, "ICNIRP statement on the 'guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300GHz)'," *Health Physics*, vol. 97, pp. 257–258, 2009.
26. C. Sage and D. O. Carpenter, Eds., *BioInitiative Working Group: BioInitiative Report: A Rationale for a Biologically based Public Exposure Standard for Electromagnetic Fields (ELF and RF)*, Bioinitiative, 2007 <http://www.bioinitiative.org/table-of-contents/>.
27. BioInitiative Working Group: BioInitiative, *A Rationale for a Biologically Based Public Exposure Standard for Electromagnetic Fields (ELF and RF)*, Edited by C. Sage and D.O. Carpenter Bioinitiative, 2012, <http://www.bioinitiative.org/table-of-contents/>.
28. L. Hedendahl, M. Carlberg, and L. Hardell, "Electromagnetic hypersensitivity—an increasing challenge to the medical profession," *Reviews on Environmental Health*, vol. 30, no. 4, pp. 209–215, 2015.
29. Health Protection Agency, *Health Effects from Radiofrequency Electromagnetic Fields. Report of the Independent Advisory Group on Non-Ionising Radiation*, Documents of the Health Protection Agency. Radiation, Chemical and Environmental Hazards, 2012, http://webarchive.nationalarchives.gov.uk/20140629102627/http://www.hpa.org.uk/webc/HPAwebFile/HPAwe_b_C/1317133827077.
30. Nordic radiation safety authorities. Exposure from mobile phones, base stations and wireless networks. A statement by the Nordic radiation safety authorities, 2013, <http://www.nrpa.no/dav/1ce2548717.pdf>.
31. Health Canada, "Fact Sheet-What is Safety Code 6? Environmental and Workplace Health," 2015 http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct/safety_code_6_fs-code_securite_6_fr-eng.php.
32. The Institution of Engineering and Technology, "Do Low-Level Electromagnetic Fields up to 300GHz Harm Us?" 2016 (IET Position Statement). <https://www.theiet.org/media/9455/position-statement-on-electromagnetic-fields.pdf>
33. Scientific Committee on Emerging Newly Identified Health Risks, "Opinion on potential health effects of exposure to electromagnetic fields (EMF)," European Commission, 2015, http://ec.europa.eu/health/scientific_committees/emerging/docs/scenihr_o_041.pdf.
34. Swedish Radiation Safety Authority [Strälsäkerhetsmyndigheten], "Recent Research on EMF and Health Risk-Tenth report from SSM's Scientific Council on Electromagnetic Fields," 2015 <http://www.stralsakerhetsmyndigheten.se/Global/Publikationer/Rapport/Stralskydd/2015/SSM-Rapport-2015-19.pdf>.
35. Health Council of the Netherlands, "Mobile phones and cancer. Part 3. Update and overall conclusions from epidemiological and animal studies," 2016. https://www.gezondheidsraad.nl/sites/default/files/201606_mobilephonescancerpart3.pdf.
36. Swedish Radiation Safety Authority [Strälsäkerhetsmyndigheten] "Recent Research on EMF and Health Risk-Eleventh report from SSM's Scientific Council on Electromagnetic Fields, 2016. Including Thirteen years of electromagnetic field research monitored by SSM's Scientific Council on EMF and health: How has the evidence changed over time?" 2016.

http://www.stralsakerhetsmyndigheten.se/Global/Publikationer/Rapport/Stralskydd/2016/SSM_Rapport_2016_15_webb_1.pdf.

37. L. Hardell and M. Carlberg, "Using the Hill viewpoints from 1965 for evaluating strengths of evidence of the risk for brain tumors associated with use of mobile and cordless phones," *Reviews on Environmental Health*, vol. 28, no. 2-3, pp. 97–106, 2013.
38. L. Hardell and M. Carlberg, "Mobile phone and cordless phone use and the risk for glioma—analysis of pooled case-control studies in Sweden, 1997–2003 and 2007–2009," *Pathophysiology*, vol. 22, no. 1, pp. 1–13, 2015.
39. G. Coureau, G. Bouvier, P. Lebailly et al., "Mobile phone use and brain tumours in the CERENAT case-control study," *Occupational and Environmental Medicine*, vol. 71, no. 7, pp. 514–522, 2014.
40. M. C. Turner, S. Sadetzki, C. E. Langer et al., "Investigation of bias related to differences between case and control interview dates in five INTERPHONE countries," *Annals of Epidemiology*, vol. 26, no. 12, pp. 827.e2–832.e2, 2016.
41. D. Aydin, M. Feychting, J. Schuz et al., "Mobile phone use and brain tumors in children and adolescents: a multicenter case control study," *Journal of the National Cancer Institute*, vol. 103, no. 16, pp. 1264–1276, 2011.
42. L. Hardell, M. Carlberg, and K. Hansson Mild, "Re-analysis of risk for glioma in relation to mobile telephone use: Comparison with the results of the Interphone international case-control study," *International Journal of Epidemiology*, vol. 40, no. 4, pp. 1126–1128, 2011.
43. E. Cardis, I. Deltour, S. Mann et al., "Distribution of RF energy emitted by mobile phones in anatomical structures of the brain," *Physics in Medicine and Biology*, vol. 53, no. 11, pp. 2771–2783, 2008.
44. K. Grell, K. Frederiksen, J. Schuz et al., "The intracranial distribution of gliomas in relation to exposure from mobile phones: analyses from the INTERPHONE study," *American Journal of Epidemiology*, vol. 184, no. 11, pp. 818–828, 2016.
45. T. Tillmann, H. Ernst, J. Streckert et al., "Indication of cocarcinogenic potential of chronic UMTS-modulated radiofrequency exposure in an ethylnitrosourea mouse model," *International Journal of Radiation Biology*, vol. 86, no. 7, pp. 529–541, 2010.
46. A. Lerchl, M. Klose, K. Grote et al., "Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans," *Biochemical and Biophysical Research Communications*, vol. 459, no. 4, pp. 585–590, 2015.
47. M. Wyde, M. Cesta, C. Blystone et al., "Report of Partial Findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley_ SD rats (Whole Body Exposures)," Draft 5-19-2016. US National Toxicology Program (NTP), 2016. <http://biorxiv.org/content/biorxiv/early/2016/05/26/055699.full.pdf>.
48. L. Hardell, M. Carlberg, F. Söderqvist, and K. Hansson Mild, "Pooled analysis of case-control studies on acoustic neuroma diagnosed 1997–2003 and 2007–2009 and use of mobile and cordless phones," *International Journal of Oncology*, vol. 43, no. 4, pp. 1036–1044, 2013.
49. C. Liu, W. Duan, S. Xu et al., "Exposure to 1800 MHz radiofrequency electromagnetic radiation induces oxidative DNA base damage in a mouse spermatocyte-derived cell line," *Toxicology Letters*, vol. 218, no. 1, pp. 2–9, 2013.
50. I. Yakymenko, O. Tsybulin, E. Sidorik, D. Henshel, O. Kyrylenko, and S. Kyrylenko, "Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation," *Electromagnetic Biology and Medicine*, vol. 35, no. 2, pp. 186–202, 2016.
51. A. Burlaka, O. Tsybulin, E. Sidorik et al., "Overproduction of free radical species in embryonal cells exposed to low intensity radiofrequency radiation," *Experimental Oncology*, vol. 35, no. 3, pp. 219–225, 2013.
52. K. Megha, P. S. Deshmukh, B. D. Banerjee, A. K. Tripathi, and M. P. Abegaonkar, "Microwave radiation induced oxidative stress, cognitive impairment and inflammation in brain of Fischer rats," *Indian Journal of Experimental Biology*, vol. 50, no. 12, pp. 889–896, 2012.

53. K. Megha, P. S. Deshmukh, B. D. Banerjee, A. K. Tripathi, R. Ahmed, and M. P. Abegaonkar, "Low intensity microwave radiation induced oxidative stress, inflammatory response and DNA damage in rat brain," *Neuro Toxicology*, vol. 51, pp. 158–165, 2015.
54. R. Akhavan-Sigari, M. M. F. Baf, V. Ariabod, V. Rohde, and S. Rahighi, "Connection between cell phone use, p53 gene expression in different zones of glioblastoma multiforme and survival prognoses," *Rare Tumors*, vol. 6, no. 3, article no. 5350, 2014. DOI: [10.4081/rt.2014.5350](https://doi.org/10.4081/rt.2014.5350)
55. M. Carlberg and L. Hardell, "Decreased survival of glioma patients with astrocytoma grade IV (glioblastoma multiforme) associated with long-term use of mobile and cordless phones," *International Journal of Environmental Research and Public Health*, vol. 11, no. 10, pp. 10790–10805, 2014.
56. F. T. Vertosick Jr., R. G. Selker, and V. C. Arena, "Survival of patients with well-differentiated astrocytomas diagnosed in the era of computed tomography," *Neurosurgery*, vol. 28, no. 4, pp. 496–501, 1991.
57. L. Hardell and M. Carlberg, "Mobile and cordless phone use and brain tumor risk," in *Bioelectromagnetic and Subtle Energy Medicine*, P. J. Rosch, Ed., CRC Press, Boca Raton, Fla, USA, 2015.
58. G. Zada, A. E. Bond, Y.-P. Wang, S. L. Giannotta, and D. Deapen, "Incidence trends in the anatomic location of primary malignant brain tumors in the United States: 1992–2006," *World Neurosurgery*, vol. 77, no. 3-4, pp. 518–524, 2012.
59. L. Hardell and M. Carlberg, "Increasing rates of brain tumours in the Swedish National Inpatient Register and the Causes of Death Register," *International Journal of Environmental Research and Public Health*, vol. 12, no. 4, pp. 3793–3813, 2015.
60. F. de Vocht, "Inferring the 1985–2014 impact of mobile phone use on selected brain cancer subtypes using Bayesian structural time series and synthetic controls," *Environment International*, vol. 97, pp. 100–107, 2016.
61. F. Ozguner, Y. Bardak, and S. Comlekci, "Protective effects of melatonin and caffeic acid phenethyl ester against retinal oxidative stress in long-term use of mobile phone: a comparative study," *Molecular and Cellular Biochemistry*, vol. 282, no. 1-2, pp. 83–88, 2006.
62. World Health Organization International Agency for Research on Cancer, *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 80. Non-Ionizing Radiation, Part I: Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields*, IARC Press, Lyon, France, 2002, <http://monographs.iarc.fr/ENG/Monographs/vol80/mono80.pdf>.
63. L. Kheifets, A. Ahlbom, C. M. Crespi et al., "Pooled analysis of recent studies on magnetic fields and childhood leukaemia," *British Journal of Cancer*, vol. 103, no. 7, pp. 1128–1135, 2010.
64. L. Hardell, B. Holmberg, H. Malker, and L.-E. Paulsson, "Exposure to extremely low frequency electromagnetic fields and the risk of malignant diseases—an evaluation of epidemiological and experimental findings," *European Journal of Cancer Prevention*, vol. 4, no. 1, pp. 3–107, 1995.
65. M. C. Turner, G. Benke, J. D. Bowman et al., "Occupational exposure to extremely low-frequency magnetic fields and brain tumor risks in the INTEROCC study," *Cancer Epidemiology Biomarkers and Prevention*, vol. 23, no. 9, pp. 1863–1872, 2014.
66. M. Carlberg, T. Koppel, M. Ahonen, and L. Hardell, "Case control study on occupational exposure to extremely low frequency electromagnetic fields and glioma risk," *American Journal of Industrial Medicine*, In press.
67. M. Kundi, "Failure to detect a link between mobile phone use and brain tumours in a large Danish cohort study: but findings may be due to bias," *Evidence-Based Medicine*, vol. 17, no. 5, pp. 165–166, 2012.
68. F. Söderqvist, M. Carlberg, and L. Hardell, "Review of four publications on the Danish cohort study on mobile phone subscribers and risk of brain tumors," *Reviews on Environmental Health*, vol. 27, no. 1, pp. 51–58, 2012.
69. V. S. Benson, K. Pirie, J. Schüz, G. K. Reeves, V. Beral, and J. Green, "Mobile phone use and risk of brain neoplasms and other cancers: prospective study," *International Journal of Epidemiology*, vol. 42, pp. 792–802, 2013.

70. V. S. Benson, K. Pirie, J. Schuz, G. K. Reeves, V. Beral, and J. Green, "Authors' response to: the case of acoustic neuroma: comment on mobile phone use and risk of brain neoplasms and other cancers," *International Journal of Epidemiology*, vol. 43, no.1, article no. 275, 2014.
71. L. Hardell, M. Carlberg, and K. Hansson Mild, "Methodological aspects of epidemiological studies on the use of mobile phones and their association with brain tumors," *Open Environmental Sciences*, vol. 2, pp. 54–61, 2008.
72. M. Kundi, "Causality and the interpretation of epidemiologic evidence," *Environmental Health Perspectives*, vol. 114, no. 7, pp.969–974, 2006.

Sección 6

Determinacion de la Causalidad por C. J. Portier. Aplicación de los 9 principios desarrollados por Sir Bradford Hill, Fuerza de la asociación, Consistencia de asociación, Especificidad, Temporalidad, Gradiente biológico, Plausibilidad biológica, Coherencia. Evidencia de casos humanos, Analogía. (434)

Trabajo de revisión: Expert Report Christopher J. Portier, Ph. D. in support of general causation on behalf of plaintiffs, United States District Court Northern District of California (A, MDL No. 274 1 Case 3:16-md-0274 1-VC)

<https://usrtk.org/wp-content/uploads/2017/10/Expert-Report-of-Chris-Portier.pdf>

Director of the Environmental Toxicology Program (ETP) at NIEHS.

Director of the National Center for Environmental Health (NCEH)

Director of the Agency for Toxic Substances and Disease Registry (ATSDR). NCEH

Chair from 2005 to 2010 of the Subcommittee on Toxics and Risk of the President's National Science and Technology Council,

Chair of EPA'S Science Advisory Panel from 1998 to 2003

Chair of the International Agency for Research on Cancer (IARC)

1. Portier C, Hoel D: Optimal design of the chronic animal bioassay. *J Toxicol Environ Health* 1983;12(1):1-19.
2. Portier CJ, Hoel DG: Design of the Chronic Animal Bioassay for Goodness of Fit to Multistage Models. *Biometrics* 1983;39(3):809-809.
3. Bailer AJ, Portier CJ: Effects of treatment-induced mortality and tumor-induced mortality on tests for carcinogenicity in small samples. *Biometrics* 1988; 44(2):417- 431.
4. Portier CJ, Bailer AJ: Testing for increased carcinogenicity using a survival-adjusted quantal response test. *Fundam Appl Toxicol* 1989; 12(4):731-737.
5. Portier CJ, Hedges JC, Hoel DG: Age-specific models of mortality and tumor onset for historical control animals in the National Toxicology Program's carcinogenicity experiments. *Cancer Res* 1986;46(9):4372-4378.
6. Portier CJ, Bailer AJ: 2-Stage Models of Tumor-Incidence for Historical Control Animals in the National Toxicology Programs Carcinogenicity Experiments. *Journal of Toxicology and Environmental Health* 1989;27(1):21-45.
7. Portier CJ, Edler L: Two-stage models of carcinogenesis, classification of agents, and design of experiments. *Fundam Appl Toxicol* 1990;14(3):444-460.
8. Portier CJ, Hoel DG, Kaplan NL, Kopp A: Biologically based models for risk assessment. *IARC scientific publications* 1990(104):20-28.
9. Kopp-Schneider A, Portier CJ: Distinguishing between models of carcinogenesis: the role of clonal expansion. *Fundam Appl Toxicol* 1991; 17(3):601-613.
10. Kopp-Schneider A, Portier CJ, Rippmann F: The application of a multistage model that incorporates DNA damage and repair to the analysis of initiation/promotion experiments. *Math Biosci* 1991;105(2):139-166.
11. Kopp-Schneider A, Portier CJ, Rippmann F: The Application of a Multistage Model That Incorporates DNA

- Damage and Repair to the Analysis of Initiation Promotion Experiments. *Mathematical Biosciences* 1991,105(2):139-166.
12. Kopp-Schneider A, Portier CJ: Birth and Death Differentiation Rates of Papillomas in Mouse Skin. *Carcinogenesis* 1992,13(6):973-978.
 13. Portier CJ, Kopp-Schneider A, Sherman CD: Using Cell Replication Data in Mathematical-Modeling in Carcinogenesis. *Environmental Health Perspectives* 1993, 101:79-86.
 14. Kopp-Schneider A, Portier CJ, Sherman CD: The Exact Formula for Tumor-Incidence in the 2-Stage Model. *Risk Analysis* 1994,14(6):1079-1080.
 15. Portier C, Kohn M, Sherman CD, Lucier G: Modeling the number and size of hepatic focal lesions following exposure to 2378-TCDD. *Organohalogen Compounds* 1994, 21:393-397.
 16. Kopp-Schneider A, Portier CJ: Carcinoma formation in NMRI mouse skin painting studies is a process suggesting greater than two stages. *Carcinogenesis* 1995, 16(1):53-59.
 17. Portier CJ, Kopp-Schneider A, Sherman CD: Calculating tumor incidence rates in stochastic models of carcinogenesis. *Mathematical Biosciences* 1996, 135(2):129- 146.
 18. Portier CJ, Sherman CD, Kohn M, Edler L, Kopp-Schneider A, Maronpot RM, Lucier G: Modeling the number and size of hepatic focal lesions following exposure to 2,3,7,8-TCDD. *Toxicology and Applied Pharmacology* 1996, 138(1):20-30.
 19. Kopp-Schneider A, Portier C, Bannasch P: A model for hepatocarcinogenesis treating phenotypical changes in focal hepatocellular lesions as epigenetic events. *Math Biosci* 1998,148(2):181-204.
 20. ToyoshibaH, Sone H, Yamanaka T, Parham FM, Irwin RD, Boorman GA, Portier CJ: Gene interaction network analysis suggests differences between high and low doses of acetaminophen. *Toxicol Appl Pharmacol* 2006,215(3):306-316.
 21. Gohlke JM, Portier CJ: The forest for the trees: a systems approach to human health research. *Environ Health Perspect* 2007,115(9):1261-1263.
 22. Gohlke JM, Thomas R, Zhang Y, Rosenstein MC, Davis AP, Murphy C, Becker KG, Mattingly CJ, Portier CJ: Genetic and environmental pathways to complex diseases. *BMC Syst Biol* 2009,3:46.
 23. Gohlke JM, Thomas R, Woodward A, Campbell-Lendrum D, Pruss-Ustun A, Hales S, Portier CJ: Estimating the global public health implications of electricity and coal consumption. *Environ Health Perspect* 2011,119(6):821-826.
 24. Aylward LL, Kirman CR, Schoeny R, Portier CJ, Hays SM: Evaluation of biomonitoring data from the CDC National Exposure Report in a risk assessment context: perspectives across chemicals. *Environ Health Perspect* 2013,121(3):287-294.
 25. Trong I, Portier C: Proceedings of the Viet Nam — United States Scientific Conferences on Human Health and Environmental Effects of Agent Orange/Dioxin, Part 1 and 2. In: 2002; *Ha Noi, Vietnam*: US National Institute of Environmental Sciences and the Government of Vietnam; 2002:1100.
 26. Portier CJ, Wolfe MS (eds.): EMF Science Review Symposium Breakout Group Report for Epidemiology Research Findings. Research Triangle Park, North Carolina: National Institute of Environmental Health Sciences;1998.
 27. Portier CJ, Wolfe MS (eds.): EMF Science Review Symposium Breakout Group Report for Clinical and *In Vivo* Laboratory Findings. Research Triangle Park, North Carolina: National Institute of Environmental Health Sciences;1998.
 28. Portier CJ, Wolfe MS (eds.): Assessment of Health Effects from Exposure to Power- Line Frequency Electric and Magnetic Fields. Research Triangle Park, North Carolina: National Institute of Environmental Health Sciences;1998.
 29. Portier CJ, Thigpen Tart K, Carter S, Dilworth CH, Grambsch A, Gohlke JM, Hess J, Howard SN, Luber G, Lutz JT et al: A Human Health Perspective on ClimateChange.
 30. Preamble to the IARCMonographs. <http://monographs.iarc.fr/ENG/Preamble/CurrentPreamble.pdf>
 31. European Chemicals Agency: Guidance on the Application of the CLP Criteria: Guidance to Regulation (EC) No 1272/2008 on classification, labelling and packaging (CLP) of substances and mixtures. In. Edited by European Chemicals Agency. Helsinki, Finland: European Chemicals Agency;2015.
 32. USEPA: Guidelines for Carcinogen Risk Assessment. In. Edited by US Environmental Protection Agency. Washington DC; 2005:166.

33. Hill AB: The Environment and Disease: Association or Causation? *Proc R Soc Med* 1965, 58:295-300.
34. Humans IWGOrEoCRt: Non-ionizing radiation, Part 2: Radiofrequency electromagnetic fields. *IARC monographs on the evaluation of carcinogenic risks to humans/ World Health Organization, International Agency for Research on Cancer* 2013, 102(Pt2):1-460.
35. National Research Council. Washington (DC): National Academy of Sciences Press; 1994.
36. National Research Council. Washington (DC): National Academies Press;2009.
37. Handbook for Preparing Report on Carcinogens Monographs
38. Smith MT, Guyton KZ, Gibbons CF, Fritz JM, Portier CJ, Rusyn I, De Marini DM, Caldwell JC, Kavlock RJ, Lambert PF *et al*: Key Characteristics of Carcinogens as a Basis for Organizing Data on Mechanisms of Carcinogenesis. *Environ Health Perspect* 2016,124(6):713-721.
39. Muscat JE, Malkin MG, Thompson S, Shore RE, Stellman SD, McRee D, Neugut AI, Wynder EL: Handheld cellular telephone use and risk of brain cancer. *JAMA* 2000, 284(23):3001-3007.
40. Rothman KJ, Loughlin JE, Funch DP, Dreyer NA: Overall mortality of cellular telephone customers. *Epidemiology* 1996,7(3):303-305.
41. Rothman KJ, Chou CK, Morgan R, Balzano Q Guy AW, Funch DP, Preston-Martin S, Mandel J, Steffens R, Carlo G: Assessment of cellular telephone and other radio frequency exposure for epidemiologic research. *Epidemiology* 1996,7(3):291-298.
42. Funch DP, Rothman KJ, Loughlin JE, Dreyer NA: Utility of telephone company records for epidemiologic studies of cellular telephones. *Epidemiology* 1996, 7(3):299-302.
43. Inskip PD, Tarone RE, Hatch EE, Wilcosky TC, Shapiro WR, Selker RG, Fine HA, Black PM, Loeffler JS, Linet MS: Cellular-telephone use and brain tumors. *N Engl J Med* 2001,344(2):79-86.
44. Auvinen A, Hietanen M, Luukkonen R, Koskela RS: Brain tumors and salivary gland cancers among cellular telephone users. *Epidemiology* 2002,13(3):356-359.
45. Gousias K, Markou M, Voulgaris S, Goussia A, Voulgari P, BaiM, PolyzoidisK, Kyritsis A, Alamanos Y: Descriptive epidemiology of cerebral gliomas in northwest Greece and study of potential predisposing factors, 2005-2007. *Neuroepidemiology* 2009, 33(2):89-95.
46. Spinelli V, Chinot O, Cabaniols C, Giorgi R, Alfa P, Lehucher-Michel MP: Occupational and environmental risk factors for brain cancer: a pilot case-control study in France. *Presse medicale* 2010,39(2): e35-44.
47. Interphone Study Group: Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Int J Epidemiol* 2010, 39(3):675-694.
48. Christensen HC, Schuz J, Kosteljanetz M, Poulsen HS, Boice JD, Jr., McLaughlin JK, Johansen C: Cellular telephones and risk for brain tumors: a population-based, incident case-control study. *Neurology* 2005,64(7):1189-1195.
49. Christensen HC, Schuz J, Kosteljanetz M, Poulsen HS, Thomsen J, Johansen C: Cellular telephone use and risk of acoustic neuroma. *Am J Epidemiol* 2004,159(3):277-283.
50. Hartikka H, Heinavaara S, Mantyla R, Kahara V, Kurtio P, Auvinen A: Mobile phone use and location of glioma: a case-case analysis. *Bioelectromagnetics* 2009, 30(3):176-182.
51. Hepworth SJ, Schoemaker MJ, Muir KR, Swerdlow AJ, vanTongeren MJ, McKinney PA: Mobile phone use and risk of glioma in adults: case-control study. *Bmj* 2006, 332(7546):883-887.
52. Hours M, Bernard M, Montestrucq L, Arslan M, Bergeret A, Deltour I, Cardis E: [Cell Phones and Risk of brain and acoustic nerve tumours: the French INTERPHONE case-control study]. *Rev Epidemiol Sante Publique* 2007,55(5):321-332.
53. Klaeboe L, Blaasaas KG, Tynes T: Use of mobile phones in Norway and risk of intracranial tumours. *European journal of cancer prevention: the official journal of the European Cancer Prevention Organisation* 2007,16(2):158-164.
54. Lonn S, Ahlbom A, Hall P, Feychtung M, Swedish Interphone Study G: Long-term mobile phone use and brain tumor risk. *Am J Epidemiol* 2005,161(6):526-535.
55. Sadetzki S, Chetrit A, Jarus-Hakak A, Cardis E, Deutch Y, Duvdevani S, Zultan A, Novikov I, Freedman L, Wolf M: Cellular phone use and risk of benign and malignant parotid gland tumors--a nationwide case-control study. *Am J Epidemiol* 2008, 167(4):457-467.

56. Schlehofer B, Schlaefer K, Blettner M, Berg G, Bohler E, Hettinger I, Kunna-Grass K, Wahrendorf J, Schuz J, Interphone Study G: Environmental risk factors for sporadic acoustic neuroma (Interphone Study Group, Germany). *Eur J Cancer* 2007, 43(11):1741-1747.
57. Schoemaker MJ, Swerdlow AJ, Ahlbom A, Auvinen A, Blaasaas KG, Cardis E, Christensen HC, Feychtung M, Hepworth SJ, Johansen C et al: Mobile phone use and risk of acoustic neuroma: results of the Interphone case-control study in five North European countries. *Br J Cancer* 2005, 93(7):842-848.
58. Schuz J, Bohler E, Berg G, Schlehofer B, Hettinger I, Schlaefer K, Wahrendorf J, Kunna-Grass K, Blettner M: Cellular phones, cordless phones, and the risks of glioma and meningioma (Interphone Study Group, Germany). *Am J Epidemiol* 2006, 163(6):512-520.
59. Takebayashi T, Akiba S, Kikuchi Y, Taki M, Wake K, Watanabe S, Yamaguchi N: Mobile phone use and acoustic neuroma risk in Japan. *Occup Environ Med* 2006, 63(12):802-807.
60. Takebayashi T, Varsier N, Kikuchi Y, Wake K, Taki M, Watanabe S, Akiba S, Yamaguchi N: Mobile phone use, exposure to radiofrequency electromagnetic field, and brain tumour: A case-control study. *British Journal of Cancer* 2008, 98(3):652-659.
61. Schuz J, Bohler E, Schlehofer B, Berg G, Schlaefer K, Hettinger I, Kunna-Grass K, Wahrendorf J, Blettner M: Radiofrequency electromagnetic fields emitted from base stations of DECT cordless phones and the risk of glioma and meningioma (Interphone Study Group, Germany). *Radiat Res* 2006, 166(1 Pt 1):116-119.
62. Cardis E, Armstrong BK, Bowman JD, Giles GG, Hours M, Krewski D, McBride M, Parent ME, Sadetzki S, Woodward A et al: Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five Interphone countries. *Occup Environ Med* 2011, 68(9):631-640.
63. Lahkola A, Auvinen A, Raitanen J, Schoemaker MJ, Christensen HC, Feychtung M, Johansen C, Klaeboe L, Lonn S, Swerdlow AJ et al: Mobile phone use and risk of glioma in 5 North European countries. *Int J Cancer* 2007, 120(8):1769-1775.
64. Lahkola A, Salminen T, Raitanen J, Heinavaara S, Schoemaker MJ, Christensen HC, Feychtung M, Johansen C, Klaeboe L, Lonn S et al: Meningioma and mobile phone use--a collaborative case-control study in five North European countries. *Int J Epidemiol* 2008, 37(6):1304-1313.
65. Turner MC, Krewski D, Armstrong BK, Chetrit A, Giles GG, Hours M, McBride ML, Parent ME, Sadetzki S, Siemiatycki J et al: Allergy and brain tumors in the INTERPHONE study: pooled results from Australia, Canada, France, Israel, and New Zealand. *Cancer Causes Control* 2013, 24(5):949-960.
66. Interphone Study Group: Acoustic neuroma risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Cancer Epidemiol* 2011, 35(5):453-464.
67. Berg G, Schuz J, Samkange-Zeeb F, Blettner M: Assessment of radiofrequency exposure from cellular telephone daily use in an epidemiological study: German Validation study of the international case-control study of cancers of the brain-- INTERPHONE-Study. *J Expo Anal Environ Epidemiol* 2005, 15(3):217-224.
68. Lahkola A, Salminen T, Auvinen A: Selection bias due to differential participation in a case-control study of mobile phone use and brain tumors. *Ann Epidemiol* 2005, 15(5):321-325.
69. Samkange-Zeeb F, Berg G, Blettner M: Validation of self-reported cellular phone use. *J Expo Anal Environ Epidemiol* 2004, 14(3):245-248.
70. Vrijheid M, Armstrong BK, Bedard D, Brown J, Deltour I, Iavarone I, Krewski D, Lagorio S, Moore S, Richardson L et al: Recall bias in the assessment of exposure to mobile phones. *Journal of exposure science & environmental epidemiology* 2009, 19(4):369-381.
71. Vrijheid M, Deltour I, Krewski D, Sanchez M, Cardis E: The effects of recall errors and of selection bias in epidemiologic studies of mobile phone use and cancer risk. *Journal of exposure science & environmental epidemiology* 2006, 16(4):371-384.
72. Vrijheid M, Mann S, Vecchia P, Wiart J, Taki M, Ardoino L, Armstrong BK, Auvinen A, Bedard D, Berg-Beckhoff G et al: Determinants of mobile phone output power in a multinational study: implications for exposure assessment. *Occup Environ Med* 2009, 66(10):664-671.
73. Vrijheid M, Richardson L, Armstrong BK, Auvinen A, Berg G, Carroll M, Chetrit A, Deltour I, Feychtung M, Giles GG et al: Quantifying the impact of selection bias caused by nonparticipation in a case-control study of mobile phone use. *Ann Epidemiol* 2009, 19(1):33-41.
74. Vrijheid M, Cardis E, Armstrong BK, Auvinen A, Berg G, Blaasaas KG, Brown J, Carroll M, Chetrit A,

- Christensen HC *et al*: Validation of short-term recall of mobile phone use for the Interphone study. *Occup Environ Med* 2006;63(4):237-243.
75. Grell K, Frederiksen K, Schuz J, Cardis E, Armstrong B, Siemiatycki J, Krewski DR, McBride ML, Johansen C, Auvinen A *et al*: The Intracranial Distribution of Gliomas in Relation to Exposure From Mobile Phones: Analyses From the INTERPHONE Study. *Am J Epidemiol* 2016;184(11):818-828.
 76. Grell K, Diggle PJ, Frederiksen K, Schuz J, Cardis E, Andersen PK: A three-dimensional point process model for the spatial distribution of disease occurrence in relation to an exposure source. *Stat Med* 2015;34(23):3170-3180.
 77. Cardis E, Deltour I, Mann S, Moissonnier M, Taki M, Varsier N, Wake K, Wiart J: Distribution of RF energy emitted by mobile phones in anatomical structures of the brain. *Phys Med Biol* 2008;53(11):2771-2783.
 78. Larjavaara S, Schuz J, Swerdlow A, Feychtung M, Johansen C, Lagorio S, Tynes T, Klaeboe L, Tonjer SR, Blettner M *et al*: Location of gliomas in relation to mobile telephone use: a case-case and case-specular analysis. *Am J Epidemiol* 2011; 174(1):2-11.
 79. Hardell L, Carlberg M, Hansson Mild K: Mobile phone use and the risk for malignant brain tumors: a case-control study on deceased cases and controls. *Neuroepidemiology* 2010;35(2):109-114.
 80. Hardell L, Carlberg M, Mild KH: Case-control study of the association between the use of cellular and cordless telephones and malignant brain tumors diagnosed during 2000-2003. *Environ Res* 2006;100(2):232-241.
 81. Hardell L, Carlberg M, Soderqvist F, Mild KH: Case-control study of the association between malignant brain tumours diagnosed between 2007 and 2009 and mobile and cordless phone use. *Int J Oncol* 2013;43(6):1833-1845.
 82. Hardell L, Hansson Mild K, Carlberg M: Case-control study on the use of cellular and cordless phones and the risk for malignant brain tumours. *Int J Radiat Biol* 2002; 78(10):931-936.
 83. Hardell L, Hansson Mild K, Carlberg M: Further aspects on cellular and cordless telephones and brain tumours. *Int J Oncol* 2003;22(2):399-407.
 84. Hardell L, Nasman A, Pahlson A, Hallquist A, Hansson Mild K: Use of cellular telephones and the risk for brain tumours: A case-control study. *Int J Oncol* 1999; 15(1):113-116.
 85. Hardell L, Carlberg M, Hansson Mild K: Pooled analysis of two case-control studies on use of cellular and cordless telephones and the risk for malignant brain tumours diagnosed in 1997-2003. *Int Arch Occup Environ Health* 2006;79(8):630-639.
 86. Hardell L, Carlberg M: Use of mobile and cordless phones and survival of patients with glioma. *Neuroepidemiology* 2013;40(2):101-108.
 87. Hardell L, Carlberg M: Mobile phone and cordless phone use and the risk for glioma Analysis of pooled case-control studies in Sweden, 1997-2003 and 2007-2009. *Pathophysiology* 2015; 22(1):1-13.
 88. Baldi I, Coureau G, Jaffre A, Gruber A, Ducamp S, Provost D, Lebailly P, Vital A, Loiseau H, Salamon R: Occupational and residential exposure to electromagnetic fields and risk of brain tumors in adults: a case-control study in Gironde, France. *Int J Cancer* 2011;129(6):1477-1484.
 89. Coureau G, Bouvier G, Lebailly P, Fabbro-Peray P, Gruber A, Leffondre K, Guillamo JS, Loiseau H, Mathoulin-Pelissier S, Salamon R *et al*: Mobile phone use and brain tumours in the CERENAT case-control study. *Occup Environ Med* 2014; 71(7):514- 522.
 90. Hardell L, Carlberg M: Re: mobile phone use and brain tumours in the CERENAT case--control study. *Occup Environ Med* 2015;72(1):79.
 91. Coureau G, Leffondre K, Gruber A, Bouvier G, Baldi I: Author's response: re 'mobile phone use and brain tumours in the CERENAT case-control study'. *Occup Environ Med* 2015;72(1):79-80.
 92. Yoon S, Choi JW, Lee E, An H, Choi HD, Kim N: Mobile phone use and risk of glioma: a case-control study in Korea for 2002-2007. *Environ Health Toxicol* 2015; 30: e2015015.
 93. Schuz J, Jacobsen R, Olsen JH, Boice JD, Jr., McLaughlin JK, Johansen C: Cellular telephone use and cancer risk: update of a nationwide Danish cohort. *J Natl Cancer Inst* 2006;98(23):1707-1713.
 94. Johansen C, Boice J, Jr., McLaughlin J, Olsen J: Cellular telephones and cancer--a nationwide cohort study in Denmark. *J Natl Cancer Inst* 2001;93(3):203-207.
 95. Frei P, Poulsen AH, Johansen C, Olsen JH, Steding-Jessen M, Schuz J: Use of mobile phones and risk of

- brain tumours: update of Danish cohort study. *Bmj* 2011, 343:d6387.
96. Dalton SO, Schuz J, Johansen C, Engholm G, Kjaer SK, Steding-Jessen M, Storm HH, Olsen JH: [Social inequality and incidence of and survival from cancer in Denmark-- secondary publication]. *Ugeskr Laeger* 2010, 172(9):691-696.
 97. Schuz J, Waldemar G, Olsen JH, Johansen C: Risks for central nervous system diseases among mobile phone subscribers: a Danish retrospective cohort study. *PLoS One* 2009, 4(2): e4389.
 98. Schuz J, Steding-Jessen M, Hansen S, Stangerup SE, Caye-Thomassen P, Poulsen AH, Olsen JH, Johansen C: Long-term mobile phone use and the risk of vestibular schwannoma: a Danish nationwide cohort study. *Am J Epidemiol* 2011, 174(4):416- 422.
 99. Benson VS, Pirie K, Schuz J, Reeves GK, Beral V, Green J, Million Women Study C: Mobile phone use and risk of brain neoplasms and other cancers: prospective study. *Int J Epidemiol* 2013, 42(3):792-802.
 100. Benson VS, Pirie K, Green J, Bull D, Casabonne D, Reeves GK, Beral V, Million Women Study C: Hormone replacement therapy and incidence of central nervous system tumours in the Million Women Study. *Int J Cancer* 2010, 127(7):1692-1698.
 101. Beral V, Million Women Study C: Breast cancer and hormone-replacement therapy in the Million Women Study. *Lancet* 2003, 362(9382):419-427.
 102. De Vocht F: The case of acoustic neuroma: Comment on mobile phone use and risk of brain neoplasms and other cancers. *Int J Epidemiol* 2014, 43(1):273-274.
 103. Benson VS, Pirie K, Schuz J, Reeves GK, Beral V, Green J: Authors' response to: the case of acoustic neuroma: comment on mobile phone use and risk of brain neoplasms and other cancers. *Int J Epidemiol* 2014, 43(1):275.
 104. Elliott P, Toledano MB, Bennett J, Beale L, de Hoogh K, Best N, Briggs DJ: Mobile phone base stations and early childhood cancers: case-control study. *Bmj* 2010, 340:c3077.
 105. Aydin D, Feychtting M, Schuz J, Tynes T, Andersen TV, Schmidt LS, Poulsen AH, Johansen C, Prochazka M, Lannering B et al: Mobile phone use and brain tumors in children and adolescents: a multicenter case-control study. *J Natl Cancer Inst* 2011, 103(16):1264-1276.
 106. Aydin D, Feychtting M, Schuz J, Andersen TV, Poulsen AH, Prochazka M, Klaeboe L, Kuehni CE, Tynes T, Roosli M: Impact of random and systematic recall errors and selection bias in case-control studies on mobile phone use and brain tumors in adolescents (CEFALO study). *Bioelectromagnetics* 2011, 32(5):396-407.
 107. Morgan LL, Herberman RB, Philips A, Lee Davis D: Re: Mobile phone use and brain tumors in children and adolescents: a multicenter case-control study. *J Natl Cancer Inst* 2012, 104(8):635-637; author reply637-638.
 108. Soderqvist F, Carlberg M, Hansson Mild K, Hardell L: Childhood brain tumour risk and its association with wireless phones: a commentary. *Environ Health* 2011, 10:106.
 109. Li CY, Liu CC, Chang YH, Chou LP, Ko MC: A population-based case-control study of radiofrequency exposure in relation to childhood neoplasm. *The Science of the total environment* 2012, 435-436:472-478.
 110. Feltbower RG, Fleming SJ, Picton SV, Alston RD, Morgan D, Achilles J, McKinney PA, Birch JM: UK case control study of brain tumours in children, teenagers and young adults: a pilot study. *BMC research notes* 2014, 7:14.
 111. Momoli F, Siemiatycki J, McBride ML, Parent ME, Richardson L, Bedard D, Platt R, Vrijheid M, Cardis E, Krewski D: Probabilistic Multiple-Bias Modeling Applied to the Canadian Data From the Interphone Study of Mobile Phone Use and Risk of Glioma, Meningioma, Acoustic Neuroma, and Parotid Gland Tumors. *Am J Epidemiol* 2017, 186(7):885-893.
 112. Hardell L, Hallquist A, Mild KH, Carlberg M, Pahlson A, Lilja A: Cellular and cordless telephones and the risk for brain tumours. *European journal of cancer prevention: the official journal of the European Cancer Prevention Organisation* 2002, 11(4):377- 386.
 113. Roosli M, Lagorio S, Schoemaker MJ, Schuz J, Feychtting M: Brain and Salivary Gland Tumors and Mobile Phone Use: Evaluating the Evidence from Various Epidemiological Study Designs. *Annu Rev Public Health* 2019, 40:221-238.
 114. Wang P, Hou C, Li Y, Zhou D: Wireless Phone Use and Risk of Adult Glioma: Evidence from a Meta-Analysis. *World Neurosurg* 2018, 115: e629-e636.
 115. Yang M, Guo W, Yang C, Tang J, Huang Q Feng S, Jiang A, Xu X, Jiang G: Mobile phone use and glioma risk: A systematic review and meta-analysis. *PLoS One* 2017, 12(5):e0175136.

116. Wang Y, Guo X: Meta-analysis of association between mobile phone use and glioma risk. *J Cancer Res Ther* 2016,12(Supplement):C298-C300.
117. Myung SK, Ju W, McDonnell DD, Lee YJ, Kazinets G, Cheng CT, Moskowitz JM: Mobile phone use and risk of tumors: a meta-analysis. *Journal of clinical oncology: official journal of the American Society of Clinical Oncology* 2009,27(33):5565-5572.
118. Kan P, Simonsen SE, Lyon JL, Kestle JR: Cellular phone use and brain tumor: a meta- analysis. *Journal of neuro-oncology* 2008,86(1):71-78.
119. Hardell L, Carlberg M, Soderqvist F, Hansson Mild K: Meta-analysis of long-term mobile phone use and the association with brain tumours. *Int J Oncol* 2008, 32(5):1097-1103.
120. Lahkola A, Tokola K, Auvinen A: Meta-analysis of mobile phone use and intracranial tumors. *Scandinavian journal of work, environment & health* 2006, 32(3):171-177.
121. Hardell L, Carlberg M, Hansson Mild K: Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects. *Int J Oncol* 2011,38(5):1465-1474.
122. Hardell L, Carlberg M, Hansson Mild K: Use of mobile phones and cordless phones is associated with increased risk for glioma and acoustic neuroma. *Pathophysiology* 2013,20(2):85-110.
123. Hardell L, Carlberg M, Hansson Mild K: Re-analysis of risk for glioma in relation to mobile telephone use: comparison with the results of the Interphone international case-control study. *Int J Epidemiol* 2011, 40(4):1126-1128.
124. Deltour I, Johansen C, Auvinen A, Feychting M, Klaeboe L, Schuz J: Time trends in brain tumor incidence rates in Denmark, Finland, Norway, and Sweden, 1974-2003. *J Natl Cancer Inst* 2009,101(24):1721-1724.
125. Lonn S, Klaeboe L, Hall P, Mathiesen T, Auvinen A, Christensen HC, Johansen C, Salminen T, Tynes T, Feychting M: Incidence trends of adult primary intracerebral tumors in four Nordic countries. *Int J Cancer* 2004,108(3):450-455.
126. Inskip PD, Hoover RN, Devesa SS: Brain cancer incidence trends in relation to cellular telephone use in the United States. *Neuro Oncol* 2010,12(11):1147-1151.
127. de Vocht F, Burstyn I, Cherrie JW: Time trends (1998-2007) in brain cancer incidence rates in relation to mobile phone use in England. *Bioelectromagnetics* 2011,32(5):334-39.
128. Ding LX, Wang YX: Increasing incidence of brain and nervous tumours in urban Shanghai, China, 1983-2007. *Asian Pac J Cancer Prev* 2011,12(12):3319-3322.
129. Aydin D, Feychting M, Schuz J, Roosli M, team Cs: Childhood brain tumours and use of mobile phones: comparison of a case-control study with incidence data. *Environ Health* 2012,11:35.
130. Deltour I, Auvinen A, Feychting M, Johansen C, Klaeboe L, Sankila R, Schuz J: Mobile phone use and incidence of glioma in the Nordic countries 1979-2008: consistency check. *Epidemiology* 2012,23(2):301-307.
131. Little MP, Rajaraman P, Curtis RE, Devesa SS, Inskip PD, Check DP, Linet MS: Mobile phone use and glioma risk: comparison of epidemiological study results with incidence trends in the United States. *Bmj* 2012,344:e1147.
132. Barchana M, Margalit M, Liphshitz I: Changes in brain glioma incidence and laterality correlates with use of mobile phones - a nation wide population based study in Israel. *Asian Pac J Cancer Prev* 2012,13(11):5857-5863.
133. Hsu MH, Syed-Abdul S, Scholl J, Jian WS, Lee P, Iqbal U, Li YC: The incidence rate and mortality of malignant brain tumors after 10 years of intensive cell phone use in Taiwan. *European journal of cancer prevention: the official journal of the European Cancer Prevention Organisation* 2013, 22(6):596-598.
134. Kim SJ, Ioannides SJ, Elwood JM: Trends in incidence of primary brain cancer in New Zealand, 1995 to 2010. *Aust N Z J Public Health* 2015,39(2):148-152.
135. Sato Y, Kiyohara K, Kojimahara N, Yamaguchi N: Time trend in incidence of malignant neoplasms of the central nervous system in relation to mobile phone use among young people in Japan. *Bioelectromagnetics* 2016,37(5):282-289.
136. Chapman S, Azizi L, Luo Q, Sitas F: Has the incidence of brain cancer risen in Australia since the introduction of mobile phones 29 years ago? *Cancer Epidemiol* 2016,42:199-205.
137. Dobes M, Khurana VG, Shadbolt B, Jain S, Smith SF, Smee R, Dexter M, Cook R: Increasing incidence of

- glioblastoma multiforme and meningioma, and decreasing incidence of Schwannoma (2000-2008): Findings of a multicenter Australian study. *Surg Neurol Int* 2011;2:176.
138. de Vocht F: Inferring the 1985-2014 impact of mobile phone use on selected brain cancer subtypes using Bayesian structural time series and synthetic controls. *Environ Int* 2016;97:100-107.
 139. de Vocht F: Corrigendum to "Inferring the 1985-2014 impact of mobile phone use on selected brain cancer subtypes using Bayesian structural time series and synthetic controls" [Environ. Int. (2016), 97, 100-107]. *Environ Int* 2017, 101:201- 202.
 140. de Vocht F: Analyses of temporal and spatial patterns of glioblastoma multiforme and other brain cancer subtypes in relation to mobile phones using synthetic counterfactuals. *Environ Res* 2019;168:329-335.
 141. Hardell L, Carlberg M: Mobile phones, cordless phones and rates of brain tumors in different age groups in the Swedish National Inpatient Register and the Swedish Cancer Register during 1998-2015. *PLoS One* 2017;12(10):e0185461.
 142. Hardell L, Carlberg M: Increasing rates of brain tumours in the Swedish national inpatient register and the causes of death register. *Int J Environ Res Public Health* 2015;12(4):3793-3813.
 143. Philips A, Henshaw DL, Lamburn G, O'Carroll MJ: Brain Tumours: Rise in Glioblastoma Multiforme Incidence in England 1995-2015 Suggests an Adverse Environmental or Lifestyle Factor. *J Environ Public Health* 2018;2018:7910754.
 144. Keinan-Boker L, Friedman E, Silverman BG: Trends in the incidence of primary brain, central nervous system and intracranial tumors in Israel, 1990-2015. *Cancer Epidemiol* 2018;56:6-13.
 145. Karipidis K, Elwood M, Benke G, Sanagou M, Tjong L, Croft RJ: Mobile phone use and incidence of brain tumour histological types, grading or anatomical location: a population-based ecological study. *BMJ Open* 2018;8(12):e024489.
 146. Nilsson J, Jaras J, Henriksson R, Holgersson G, Bergstrom S, Estenberg J, Augustsson T, Bergqvist M: No Evidence for Increased Brain Tumour Incidence in the Swedish National Cancer Register Between Years 1980-2012. *Anticancer Res* 2019, 39(2):791-796.
 147. Natukka T, Raitanen J, Haapasalo H, Auvinen A: Incidence trends of adult malignant brain tumors in Finland, 1990-2016. *Acta Oncol* 2019;58(7):990-996.
 148. Muscat JE, Malkin MG, Shore RE, Thompson S, Neugut AI, Stellman SD, Bruce J: Handheld cellular telephones and risk of acoustic neuroma. *Neurology* 2002; 58(8):1304-1306.
 149. Warren HG, Prevatt AA, Daly KA, Antonelli PJ: Cellular telephone use and risk of intratemporal facial nerve tumor. *Laryngoscope* 2003;113(4):663-667.
 150. Lonn S, Ahlbom A, Hall P, Feychtig M: Mobile phone use and the risk of acoustic neuroma. *Epidemiology* 2004;15(6):653-659.
 151. Pettersson D, Mathiesen T, ProchazkaM, Bergenheim T, Florentzson R, HarderH, Nyberg G, Siesjo P, Feychtig M: Long-term mobile phone use and acoustic neuroma risk. *Epidemiology* 2014;25(2):233-241.
 152. Han YY, Berkowitz O, Talbott E, Kondziolka D, Donovan M, Lunsford LD: Are frequent dental x-ray examinations associated with increased risk of vestibular schwannoma? *J Neurosurg* 2012, 117Suppl:78-83.
 153. Hardell L, Carlberg M, Hansson Mild K: Case-control study on cellular and cordless telephones and the risk for acoustic neuroma or meningioma in patients diagnosed 2000-2003. *Neuroepidemiology* 2005;25(3):120-128.
 154. Hardell L, Carlberg M, Hansson Mild K: Pooled analysis of two case-control studies on the use of cellular and cordless telephones and the risk of benign brain tumours diagnosed during 1997-2003. *International journal of oncology* 2006;28(2):509-518.
 155. Hardell L, Carlberg M, Soderqvist F, Mild KH: Pooled analysis of case-control studies on acoustic neuroma diagnosed 1997-2003 and 2007-2009 and use of mobile and cordless phones. *Int J Oncol* 2013;43(4):1036-1044.
 156. Corona AP, Ferrite S, Lopes Mda S, Rego MA: Risk factors associated with vestibular nerve schwannomas. *Otol Neurotol* 2012;33(3):459-465.
 157. Pettersson D, Bottai M, Mathiesen T, Prochazka M, Feychtig M: Validation of self- reported start year of mobile phone use in a Swedish case-control study on radiofrequency fields and acoustic neuroma risk. *Journal of exposure science & environmental epidemiology* 2015;25(1):72-79.
 158. Sato Y, Akiba S, Kubo O, Yamaguchi N: A case-case study of mobile phone use and acoustic neuroma risk

- in Japan. *Bioelectromagnetics* 2011;32(2):85-93.
159. Tillmann T, Ernst H, Ebert S, Kuster N, Behnke W, Rittinghausen S, Dasenbrock C: Carcinogenicity study of GSM and DCS wireless communication signals in B6C3F1 mice. *Bioelectromagnetics* 2007;28(3):173-187.
 160. Gart JJ, Chu KC, Tarone RE: Statistical issues in interpretation of chronic bioassay tests for carcinogenicity. *J Natl Cancer Inst* 1979;62(4):957-974.
 161. National Toxicology P: Toxicology and carcinogenesis studies in B6C3F1/N mice exposed to whole-body radio frequency radiation at a frequency (1,900 MHz) and modulations (GSM and CDMA) used by cell phones. *Natl Toxicol Program Tech Rept Series* 2018(596):1-260.
 162. Tarone R: The Use of Historical Control Information in Testing for a Trend in Proportions. *Biometrics* 1982;38(1):6.
 163. Smith-Roe SL, Wyde ME, Stout MD, Winters JW, Hobbs CA, Shepard KG, Green AS, Kissling GE, Shockley KR, Tice RR *et al*: Evaluation of the genotoxicity of cell phone radiofrequency radiation in male and female rats and mice following subchronic exposure. *Environ Mol Mutagen* 2020; 61(2):276-290.
 164. Chou CK, Guy AW, Kunz LL, Johnson RB, Crowley JJ, Krupp JH: Long-term, low-level microwave irradiation of rats. *Bioelectromagnetics* 1992;13(6):469-496.
 165. La Regina M, Moros EG, Pickard WF, Straube WL, Baty J, Roti Roti JL: The effect of chronic exposure to 835.62 MHz FDMA or 847.74 MHz CDMA radiofrequency radiation on the incidence of spontaneous tumors in rats. *Radiat Res* 2003; 160(2):143-151.
 166. Anderson LE, Sheen DM, Wilson BW, Grumbein SL, Creim JA, Sasser LB: Two-year chronic bioassay study of rats exposed to a 1.6 GHz radiofrequency signal. *Radiat Res* 2004;162(2):201-210.
 167. Haseman JK, Arnold J, Eustis SL: Tumor incidence in Fischer 344 rats: NTP historical data. In: *Pathology of the Fischer Rat*. Edited by Boorman GA, Eustis SL, Elwell MR, Montgomery CA, MacKenzie WF. San Diego: Academic Press;1990.
 168. NTP Historical Control Database 1984-1999 Fischer Rat
 169. OECD: Guidance Document 116 on the Conduct and Design of Chronic Toxicity and Carcinogenicity Studies. In. Edited by Environment Health and Safety Publications. Paris: OECD;2012.
 170. Smith P, Kuster N, Ebert S, Chevalier HJ: GSM and DCS wireless communication signals: combined chronic toxicity/carcinogenicity study in the Wistar rat. *Radiat Res* 2007;168(4):480-492.
 171. Bartsch H, Kupper H, Scheurten U, Deerberg F, Seebald E, DietzK, Mecke D, Probst H, Stehle T, Bartsch C: Effect of chronic exposure to a GSM-like signal (mobile phone) on survival of female Sprague-Dawley rats: modulatory effects by month of birth and possibly stage of the solar cycle. *Neuro Endocrinol Lett* 2010;31(4):457-473.
 172. National Toxicology P: Toxicology and carcinogenesis studies in Hsd: Sprague Dawley sd rats exposed to whole-body radio frequency radiation at a frequency (900 MHz) and modulations (GSM and CDMA) used by cell phones. . *Natl Toxicol Program Tech Rept Series* 2018(595):1-384.
 173. FalcioniL, Bua L, Tibaldi E, Lauriola M, De Angelis L, Gnudi F, Mandrioli D, Manservigi M, Manservisi F, Manzoli I *et al*: Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8GHz GSM base station environmental emission. *Environ Res* 2018;165:496-503.
 174. Repacholi MH, Basten A, Gebski V, Noonan D, Finnie J, Harris AW: Lymphomas in E mu-Pim1 transgenic mice exposed to pulsed 900 MHZ electromagnetic fields. *Radiat Res* 1997;147(5):631-640.
 175. Utteridge TD, Gebski V, Finnie JW, Vernon-Roberts B, Kuchel TR: Long-term exposure of E-mu-Pim1 transgenic mice to 898.4 MHz microwaves does not increase lymphoma incidence. *Radiat Res* 2002;158(3):357-364.
 176. Oberto G, Rolfo K, Yu P, Carbonatto M, Peano S, Kuster N, Ebert S, Tofani S: Carcinogenicity study of 217 Hz pulsed 900 MHz electromagnetic fields in Pim1 transgenic mice. *Radiat Res* 2007;168(3):316-326.
 177. Saran A, Pazzaglia S, Mancuso M, Rebessi S, Di Majo V, Tanori M, Lovisolo GA, Pinto R, Marino C: Effects of exposure of newborn patched1 heterozygous mice to GSM, 900 MHz. *Radiat Res* 2007;168(6):733-740.
 178. Sommer AM, Streckert J, Bitz AK, Hansen VW, Lerchl A: No effects of GSM- modulated 900 MHz electromagnetic fields on survival rate and spontaneous development of lymphoma in female AKR/J mice. *BMC Cancer* 2004;4:77.
 179. Sommer AM, Bitz AK, Streckert J, Hansen VW, Lerchl A: Lymphoma development in mice chronically

- exposed to UMTS-modulated radiofrequency electromagnetic fields. *Radiat Res* 2007, 168(1):72-80.
180. Lee HJ, Jin YB, Lee JS, Choi SY, Kim TH, Pack JK, Choi HD, Kim N, Lee YS: Lymphoma development of simultaneously combined exposure to two radiofrequency signals in AKR/J mice. *Bioelectromagnetics* 2011, 32(6):485-492.
 181. Szmigelski S, Szudzinski A, Pietraszek A, Bielec M, Janiak M, Wrembel JK: Accelerated development of spontaneous and benzopyrene-induced skin cancer in mice exposed to 2450-MHz microwave radiation. *Bioelectromagnetics* 1982, 3(2):179-191.
 182. Toler JC, Shelton WW, Frei MR, Merritt JH, Stedham MA: Long-term, low-level exposure of mice prone to mammary tumors to 435 MHz radiofrequency radiation. *Radiat Res* 1997, 148(3):227-234.
 183. Frei MR, Berger RE, Dusch SJ, Guel V, Jauchem JR, Merritt JH, Stedham MA: Chronic exposure of cancer-prone mice to low-level 2450 MHz radiofrequency radiation. *Bioelectromagnetics* 1998, 19(1):20-31.
 184. Frei MR, Jauchem JR, Dusch SJ, Merritt JH, Berger RE, Stedham MA: Chronic, low- level (1.0 W/kg) exposure of mice prone to mammary cancer to 2450 MHz microwaves. *Radiat Res* 1998, 150(5):568-576.
 185. Jauchem JR, Ryan KL, Frei MR, Dusch SJ, Lehnert HM, Kovatch RM: Repeated exposure of C3H/HeJ mice to ultra-wideband electromagnetic pulses: lack of effects on mammary tumors. *Radiat Res* 2001, 155(2):369-377.
 186. Chagnaud JL, Moreau JM, Veyret B: No effect of short-term exposure to GSM- modulated low-power microwaves on benzo(a)pyrene-induced tumours in rat. *Int J Radiat Biol* 1999, 75(10):1251-1256.
 187. Mason PA, Walters TJ, Di Giovanni J, Beason CW, Jauchem JR, Dick EJ, Jr., Mahajan K, Dusch SJ, Shields BA, Merritt JH et al: Lack of effect of 94 GHz radiofrequency radiation exposure in an animal model of skin carcinogenesis. *Carcinogenesis* 2001, 22(10):1701-1708.
 188. Imaida K, Kuzutani K, Wang J, Fujiwara O, Ogiso T, Kato K, Shirai T: Lack of promotion of 7,12-dimethylbenz[a]anthracene-initiated mouse skin carcinogenesis by 1.5 GHz electromagnetic near fields. *Carcinogenesis* 2001, 22(11):1837-1841.
 189. Huang TQ Lee JS, Kim TH, Pack JK, Jang JJ, Seo JS: Effect of radiofrequency radiation exposure on mouse skin tumorigenesis initiated by 7,12- dimethybenz[alpha]anthracene. *Int J Radiat Biol* 2005, 81(12):861-867.
 190. Paulraj R, Behari J: Effects of low-level microwave radiation on carcinogenesis in Swiss Albino mice. *A&O/Cell Biochem* 2011, 348(1-2):191-197.
 191. Heikkinen P, Kosma VM, Hongisto T, Huuskonen H, Hyysalo P, Komulainen H, Kumlin T, Lahtinen T, Lang S, Puranen L et al: Effects of mobile phone radiation on X-ray- induced tumorigenesis in mice. *Radiat Res* 2001, 156(6):775-785.
 192. Bartsch H, Bartsch C, Seebald E, Deerberg F, Dietz K, Vollrath L, Mecke D: Chronic exposure to a GSM-like signal (mobile phone) does not stimulate the development of DMBA-induced mammary tumors in rats: results of three consecutive studies. *Radiat Res* 2002, 157(2):183-190.
 193. Anane R, Dulou PE, Taxile M, Geffard M, Crespeau FL, Veyret B: Effects of GSM-900 microwaves on DMBA-induced mammary gland tumors in female Sprague-Dawley rats. *Radiat Res* 2003, 160(4):492-497.
 194. Yu D, Shen Y, Kuster N, Fu Y, Chiang H: Effects of 900 MHz GSM wireless communication signals on DMBA-induced mammary tumors in rats. *Radiat Res* 2006, 165(2):174-180.
 195. Hruby R, Neubauer G, Kuster N, Frauscher M: Study on potential effects of "902- MHz GSM-type Wireless Communication Signals" on DMBA-induced mammary tumours in Sprague-Dawley rats. *Mutation research* 2008, 649(1-2):34-44.
 196. Adey WR, Byus CV, Cain CD, Higgins RJ, Jones RA, Kean CJ, Kuster N, MacMurray A, Stagg RB, Zimmerman G et al: Spontaneous and nitrosourea-induced primary tumors of the central nervous system in Fischer 344 rats chronically exposed to 836 MHz modulated microwaves. *Radiat Res* 1999, 152(3):293-302.
 197. Adey WR, Byus CV, Cain CD, Higgins RJ, Jones RA, Kean CJ, Kuster N, MacMurray A, Stagg RB, Zimmerman G: Spontaneous and nitrosourea-induced primary tumors of the central nervous system in Fischer 344 rats exposed to frequency-modulated microwave fields. *Cancer Res* 2000, 60(7):1857-1863.
 198. Zook BC, Simmens SJ: The effects of 860 MHz radiofrequency radiation on the induction or promotion of brain tumors and other neoplasms in rats. *Radiat Res* 2001, 155(4):572-583.
 199. Zook BC, Simmens SJ: The effects of pulsed 860 MHz radiofrequency radiation on the promotion of neurogenic tumors in rats. *Radiat Res* 2006, 165(5):608-615.
 200. Shirai T, Kawabe M, Ichihara T, Fujiwara O, Taki M, Watanabe S, Wake K, Yamanaka Y, Imaida K, Asamoto

- M et al: Chronic exposure to a 1.439 GHz electromagnetic field used for cellular phones does not promote N-thylnitrosourea-induced central nervous system tumors in F344 rats. *Bioelectromagnetics* 2005, 26(1):59-68.
201. Shirai T, Ichihara T, Wake K, Watanabe S, Yamanaka Y, Kawabe M, Taki M, Fujiwara O, Wang J, Takahashi S et al: Lack of promoting effects of chronic exposure to 1.95- GHz W-CDMA signals for IMT-2000 cellular system on development of N- ethylnitrosourea-induced central nervous system tumors in F344 rats. *Bioelectromagnetics* 2007, 28(7):562-572.
 202. Imaida K, Taki M, Watanabe S, Kamimura Y, Ito T, Yamaguchi T, Ito N, Shirai T: The 1.5 GHz electromagnetic near-field used for cellular phones does not promote rat liver carcinogenesis in a medium-term liver bioassay. *Jpn J Cancer Res* 1998, 89(10):995-1002.
 203. Imaida K, Taki M, Yamaguchi T, Ito T, Watanabe S, Wake K, Aimoto A, Kamimura Y, Ito N, Shirai T: Lack of promoting effects of the electromagnetic near-field used for cellular phones (929.2 MHz) on rat liver carcinogenesis in a medium-term liver bioassay. *Carcinogenesis* 1998, 19(2):311-314.
 204. Szudzinski A, Pietraszek A, Janiak M, Wrembel J, Kalczak M, Szmigielski S: Acceleration of the development of benzopyrene-induced skin cancer in mice by microwave radiation. *Arch Dermatol Res* 1982, 274(3-4):303-312.
 205. Wu RY, Chiang H, Shao BJ, Li NG, Fu YD: Effects of 2.45-GHz microwave radiation and phorbol ester 12-O-tetradecanoylphorbol-13-acetate on dimethylhydrazine- induced colon cancer in mice. *Bioelectromagnetics* 1994, 15(6):531-538.
 206. Heikkinen P, Kosma VM, Alhonen L, Huuskonen H, Komulainen H, Kumlin T, Laitinen JT, Lang S, Puranen L, Juutilainen J: Effects of mobile phone radiation on UV- induced skin tumorigenesis in ornithine decarboxylase transgenic and non- transgenic mice. *Int J Radiat Biol* 2003, 79(4):221-233.
 207. Heikkinen P, Ernst H, Huuskonen H, Komulainen H, Kumlin T, Maki-Paakkonen J, Puranen L, Juutilainen J: No effects of radiofrequency radiation on 3-chloro-4- (dichloromethyl)-5-hydroxy-2(5H)-furanone-induced tumorigenesis in female Wistar rats. *Radiat Res* 2006, 166(2):397-408.
 208. Tillmann T, Ernst H, Streckert J, Zhou Y, Taugner F, Hansen V, Dasenbrock C: Indication of cocarcinogenic potential of chronic UMTS-modulated radiofrequency exposure in an ethylnitrosourea mouse model. *Int J Radiat Biol* 2010, 86(7):529- 541.
 209. Higgins JPT, Green S: Cochrane Handbook for Systematic Reviews of Interventions. In., 5.1.0 edn: The Cochrane Collaboration;2011.
 210. Birnbaum LS, Thayer KA, Bucher JR, Wolfe MS: Implementing systematic review at the National Toxicology Program: status and next steps. *Environ Health Perspect* 2013, 121(4): A108-109.
 211. Murray HE, Thayer KA: Implementing systematic review in toxicological profiles: ATSDR and NIEHS/NTP collaboration. *Journal of environmental health* 2014, 76(8):34-35.
 212. Rooney AA, Boyles AL, Wolfe MS, Bucher JR, Thayer KA: Systematic review and evidence integration for literature-based environmental health science assessments. *Environ Health Perspect* 2014, 122(7):711-718.
 213. Vandenberg LN, Agerstrand M, Beronius A, Beausoleil C, Bergman A, Bero LA, Bornehag CG, Boyer CS, Cooper GS, Cotgreave I et al: A proposed framework for the systematic review and integrated assessment (SYRINA) of endocrine disrupting chemicals. *Environmental health : a global access science source* 2016, 15(1):74.
 214. Aghadavod E, Khodadadi S, Baradaran A, Nasri P, Bahmani M, Rafieian-Kopaei M: Role of Oxidative Stress and Inflammatory Factors in Diabetic Kidney Disease. *Iran J Kidney Dis* 2016, 10(6):337-343.
 215. Kamceva G, Arsova-Sarafinovska Z, Ruskovska T, Zdravkovska M, Kamceva-Panova L, Stikova E: Cigarette Smoking and Oxidative Stress in Patients with Coronary Artery Disease. *Open Access Maced J Med Sci* 2016, 4(4):636-640.
 216. Qureshi MA, Kim YO, Schuppan D: Hepatocellular carcinoma in nonalcoholic fatty liver disease: A link between oxidative stress and T-cell suppression. *Hepatology* 2016, 64(5):1794-1797.
 217. Sayanthooran S, Magana-Arachchi DN, Gunerathne L, Abeysekera TD, Sooriyapathirana SS: Upregulation of Oxidative Stress Related Genes in a Chronic Kidney Disease Attributed to Specific Geographical Locations of Sri Lanka. *Biomed Res Int* 2016, 2016:7546265.
 218. Turkmen K: Inflammation, oxidative stress, apoptosis, and autophagy in diabetes mellitus and diabetic kidney disease: the Four Horsemen of the Apocalypse. *Int Urol Nephrol* 2016.
 219. Vakonaki E, Tsarouhas K, Spandidos DA, Tsatsakis AM: Complex interplay of DNA damage, DNA repair

- genes, and oxidative stress in coronary artery disease. *Anatol J Cardiol* 2016;16(12):939.
220. Hecht F, Pessoa CF, Gentile LB, Rosenthal D, Carvalho DP, Fortunato RS. The role of oxidative stress on breast cancer development and therapy. *Tumor Biol*. 2016; 37 (4):4281–4291. DOI: [10.1007/s13277-016-4873-9](https://doi.org/10.1007/s13277-016-4873-9).
221. Li L, Chen F: Oxidative stress, epigenetics, and cancer stem cells in arsenic carcinogenesis and prevention. *Curr Pharmacol Rep* 2016;2(2):57-63.
222. Perse M: Oxidative stress in the pathogenesis of colorectal cancer: cause or consequence? *Biomed Res Int* 2013;2013:725710.
223. Prasad S, Gupta SC, Pandey MK, Tyagi AK, Deb L: Oxidative Stress and Cancer: Advances and Challenges. *Oxid Med Cell Longev* 2016;2016: 5010423.Toyokuni S: Oxidative stress as an iceberg in carcinogenesis and cancerbiology. *Arch Biochem Biophys* 2016, 595:46-49.
224. Gulati, S., Yadav, A., Kumar, N. et al. Phenotypic and genotypic characterization of antioxidant enzyme system in human population exposed to radiation from mobile towers. *Mol Cell Biochem* 440, 1–9 (2018). <https://doi.org/10.1007/s11010-017-3150-6>
225. Zothansima, Zosangzuali M, Lalramdinpuii M, Jagetia GC: Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations. *Electromagn Biol Med* 2017;36(3):295-305.
226. Khalil AM, Abu Khadra KM, Aljaberi AM, Gagaa MH, Issa HS: Assessment of oxidant/antioxidant status in saliva of cell phone users. *Electromagn Biol Med* 2014;33(2):92-97.
227. Abu Khadra KM, Khalil AM, Abu Samak M, Aljaberi A: Evaluation of selected biochemical parameters in the saliva of young males using mobile phones. *Electromagn Biol Med* 2015;34(1):72-76.
228. Malini SS: RESOLVING THE ENIGMA OF EFFECT OF MOBILE PHONE USAGE ON SPERMATOGENESIS IN HUMANS IN SOUTH INDIAN POPULATION. *Asian Journal of Pharmaceutical and Clinical Research* 2017;10(2):233-237.
229. Khalil AM, Alshamali AM, Gagaa MH: Detection of oxidative stress induced by mobile phone radiation in tissues of mice using 8-oxo-7, 8-dihydro-20- deoxyguanosine as a biomarker. *World Acad Sci Eng Technol* 2011;76:657-622.
230. Bahreyni Toossi MH, Sadeghnia HR, Mohammad Mahdizadeh Feyzabadi M, Hosseini M, Hedayati M, Mosallanejad R, Beheshti F, Alizadeh Rahvar Z: Exposure to mobile phone (900-1800 MHz) during pregnancy: tissue oxidative stress after childbirth. I *Matern Fetal Neonatal Med* 2018;31(10):1298-1303.
231. Shahin S, Singh VP, Shukla RK, Dhawan A, Gangwar RK, Singh SP, Chaturvedi CM: 2.45 GHz microwave irradiation-induced oxidative stress affects implantation or pregnancy in mice, *Mus musculus*. *Appl Biochem Biotechnol* 2013, 169(5):1727- 1751.
232. Shahin S, Mishra V, Singh SP, Chaturvedi CM: 2.45-GHz microwave irradiation adversely affects reproductive function in male mouse, *Mus musculus* by inducing oxidative and nitrosative stress. *Free Radic Res* 2014;48(5):511-525.
233. Shahin S, Singh SP, Chaturvedi CM: Mobile phone (1800MHz) radiation impairs female reproduction in mice, *Mus musculus*, through stress induced inhibition of ovarian and uterine activity. *Reprod Toxicol* 2017;73:41-60.
234. Shahin S, Banerjee S, Swarup V, Singh SP, Chaturvedi CM: From the Cover: 2.45-GHz Microwave Radiation Impairs Hippocampal Learning and Spatial Memory: Involvement of Local Stress Mechanism-Induced Suppression of iGluR/ERK/CREB Signaling. *Toxicol Sci* 2018;161(2):349-374.
235. Shahin S, Singh SP, Chaturvedi CM: 1800 MHz mobile phone irradiation induced oxidative and nitrosative stress leads to p53 dependent Bax mediated testicular apoptosis in mice, *Mus musculus*. *J Cell Physiol* 2018;233(9):7253-7267.
236. Pandey N, Giri S, Das S, Upadhyaya P: Radiofrequency radiation (900 MHz)-induced DNA damage and cell cycle arrest in testicular germ cells in swiss albino mice. *Toxicol Ind Health* 2017;33(4):373-384.
237. Esmekaya MA, Tuysuz MZ, Tomruk A, Canseven AG, Yucel E, Aktuna Z, Keskil S, Seyhan N: Effects of cell phone radiation on lipid peroxidation, glutathione and nitric oxide levels in mouse brain during epileptic seizure. *J Chem Neuroanat* 2016, 75(PtB):111-115.
238. Zong C, Ji Y, He Q, Zhu S, Qin F, Tong J, Cao Y: Adaptive response in mice exposed to 900 MHZ radiofrequency fields: bleomycin-induced DNA and oxidative damage/repair. *Int J Radiat Biol* 2015;91(3):270-

276.

- 239. Ahmed NA, Radwan NM, Aboul Ezz HS, Salama NA: The antioxidant effect of Green Tea Mega EGCG against electromagnetic radiation-induced oxidative stress in the hippocampus and striatum of rats. *Electromagn Biol Med* 2017,36(1):63-73.
- 240. Bilgici B, Akar A, Avci B, Tuncel OK: Effect of 900 MHz radiofrequency radiation on oxidative stress in rat brain and serum. *Electromagn Biol Med* 2013,32(1):20-29.
- 241. Cetin H, Naziroglu M, Celik O, Yuksel M, Pastaci N, Ozkaya MO: Liver antioxidant stores protect the brain from electromagnetic radiation (900 and 1800 MHz)- induced oxidative stress in rats during pregnancy and the development of offspring. *J Matern Fetal Neonatal Med* 2014,27(18):1915-1921.
- 242. Ertilav K, Uslusoy F, Ataizi S, Naziroglu M: Long term exposure to cell phone frequencies (900 and 1800 MHz) induces apoptosis, mitochondrial oxidative stress and TRPV1 channel activation in the hippocampus and dorsal root ganglion of rats. *Metab Brain Dis* 2018,33(3):753-763.
- 243. Eser O, Songur A, Aktas C, Karavelioglu E, Caglar V, Aylak F, Ozguner F, Kanter M: The effect of electromagnetic radiation on the rat brain: an experimental study. *Turk Neurosurg* 2013,23(6):707-715.
- 244. Maaroufi K, Had-Aissouni L, Melon C, Sakly M, Abdelmelek H, Poucet B, Save E: Spatial learning, monoamines and oxidative stress in rats exposed to 900 MHz electromagnetic field in combination with iron overload. *Behav Brain Res* 2014, 258:80-89.
- 245. Sharma S, Shukla S: Effect of electromagnetic radiation on redox status, acetylcholine esterase activity and cellular damage contributing to the diminution of the brain working memory in rats. *Journal of chemical neuroanatomy* 2020, 106:101784.
- 246. Asl JF, Goudarzi M, Shoghi H: The radio-protective effect of rosmarinic acid against mobile phone and Wi-Fi radiation-induced oxidative stress in the brains of rats. *Pharmacological Reports: PR2020*.
- 247. Kesari KK, Kumar S, Behari J: 900-MHz microwave radiation promotes oxidation in rat brain. *Electromagn Biol Med* 2011,30(4):219-234.
- 248. Motawi TK, Darwish HA, Moustafa YM, Labib MM: Biochemical modifications and neuronal damage in brain of young and adult rats after long-term exposure to mobile phone radiations. *Cell Biochem Biophys* 2014,70(2):845-855.
- 249. Narayanan SN, Kumar RS, Kedage V, Nalini K, Nayak S, Bhat PG: Evaluation of oxidant stress and antioxidant defense in discrete brain regions of rats exposed to 900 MHz radiation. *Bratislava Medical Journal-Bratislavské Lekarske Listy* 2014, 115(5):260-266.
- 250. Tan S, Wang H, Xu X, Zhao L, Zhang J, Dong J, Yao B, Wang H, Zhou H, Gao Y et al: Study on dose-dependent, frequency-dependent, and accumulative effects of 1.5 GHz and 2.856 GHz microwave on cognitive functions in Wistar rats. *Sci Rep* 2017, 7(1):10781.
- 251. Avci B, Akar A, Bilgici B, Tuncel OK: Oxidative stress induced by 1.8 GHz radio frequency electromagnetic radiation and effects of garlic extract in rats. *Int J Radiat Biol* 2012,88(11):799-805.
- 252. Bodera P, Makarova K, Zawada K, Antkowiak B, Paluch M, Sobiczewska E, Sirav B, Siwicki AK, Stankiewicz W: The effect of 1800MHz radio-frequency radiation on NMDA receptor subunit NR1 expression and peroxidation in the rat brain in healthy and inflammatory states. *Biomed Pharmacother* 2017,92:802-809.
- 253. Shehu A, Mohammed A, Magaji RA, Muhammad MS: Exposure to mobile phone electromagnetic field radiation, ringtone and vibration affects anxiety-like behaviour and oxidative stress biomarkers in albino wistar rats. *Metab Brain Dis* 2016,31(2):355-362.
- 254. Gurler HS, Bilgici B, Akar AK, Tomak L, Bedir A: Increased DNA oxidation (8-OHdG) and protein oxidation (AOPP) by low level electromagnetic field (2.45 GHz) in rat brain and protective effect of garlic. *Int J Radiat Biol* 2014,90(10):892-896.
- 255. Naziroglu M, Celik O, Ozgul C, Cig B, Dogan S, Bal R, Gumral N, Rodriguez AB, Pariente JA: Melatonin modulates wireless (2.45 GHz)-induced oxidative injury through TRPM2 and voltage gated Ca (2+) channels in brain and dorsal root ganglion in rat. *Physiol Behav* 2012,105(3):683-692.
- 256. Ait-AissaS, de Gannes FP, Taxile M, Billaudel B, Hurtier A, Haro E, Ruffie G, Athane A, Veyret B, Lagroye I: In situ expression of heat-shock proteins and 3-nitrotyrosine in brains of young rats exposed to a WiFi signal in utero and in early life. *Radiat Res* 2013,179(6):707-716.
- 257. Othman H, Ammari M, Sakly M, Abdelmelek H: Effects of prenatal exposure to WIFI signal (2.45GHz) on postnatal development and behavior in rat: Influence of maternal restraint. *Behav Brain Res* 2017,326:291-302.

258. Othman H, Ammari M, Sakly M, Abdelmelek H: Effects of repeated restraint stress and WiFi signal exposure on behavior and oxidative stress in rats. *Metab Brain Dis* 2017,32(5):1459-1469.
259. Hidisoglu E, Kantar Gok D, Er H, Akpinar D, Uysal F, Akkoyunlu G, Ozen S, Agar A, Yargicoglu P: 2100-MHz electromagnetic fields have different effects on visual evoked potentials and oxidant/antioxidant status depending on exposure duration. *Brain Res* 2016,1635:1-11.
260. Kesari KK, Meena R, Nirala J, Kumar J, Verma HN: Effect of 3G cell phone exposure with computer controlled 2-D stepper motor on non-thermal activation of the hsp27/p38MAPK stress pathway in rat brain. *Cell Biochem Biophys* 2014, 68(2):347- 358.
261. Sahin D, Ozgur E, Guler G, Tomruk A, Unlul, Sepici-Dincel A, Seyhan N: The 2100MHz radiofrequency radiation of a 3G-mobile phone and the DNA oxidative damage in brain. *J Chem Neuroanat* 2016, 75(PtB):94-98.
262. Esmekaya MA, Ozer C, Seyhan N: 900 MHz pulse-modulated radiofrequency radiation induces oxidative stress on heart, lung, testis and liver tissues. *Gen Physiol Biophys* 2011,30(1):84-89.
263. Ozorak A, Naziroglu M, Celik O, Yuksel M, Ozcelik D, Ozkaya MO, Cetin H, Kahya MC, Kose SA: Wi-Fi (2.45 GHz)- and mobile phone (900 and 1800 MHz)-induced risks on oxidative stress and elements in kidney and testis of rats during pregnancy and the development of offspring. *Biol Trace Elem Res* 2013,156(1-3):221-229.
264. Shahin NN, El-Nabarawy NA, Gouda AS, Megarbane B: The protective role of spermine against male reproductive aberrations induced by exposure to electromagnetic field - An experimental investigation in the rat. *Toxicol Appl Pharmacol* 2019,370:117-130.
265. Yahyazadeh A, Altunkaynak BZ: Protective effects of luteolin on rat testis following exposure to 900 MHz electromagnetic field. *Biotech Histochem* 2019, 94(4):298- 307.
266. Oksay T, Naziroglu M, Dogan S, Guzel A, Gumral N, Kosar PA: Protective effects of melatonin against oxidative injury in rat testis induced by wireless (2.45 GHz) devices. *Andrologia* 2014,46(1):65-72.
267. Kesari KK, Kumar S, Behari J: Effects of radiofrequency electromagnetic wave exposure from cellular phones on the reproductive pattern in male Wistar rats. *Appl Biochem Biotechnol* 2011,164(4):546-559.
268. Sokolovic D, Djordjevic B, Kocic G, Stoimenov TJ, Stanojkovic Z, Sokolovic DM, Veljkovic A, Ristic G, Despotovic M, Milisavljevic D *et al*: The Effects of Melatonin on Oxidative Stress Parameters and DNA Fragmentation in Testicular Tissue of Rats Exposed to Microwave Radiation. *Adv Clin Exp Med*2015, 24(3):429-436.
269. KoçA, Ünal D, Çimentepe E, Bayrak Ö, Karataş ÖF, Yildirim ME, Bayrak R, Aydin M: The effects of antioxidants on testicular apoptosis and oxidative stress produced by cell phones. *Turk J Med Sci* 2013,43(1):131-137.
270. Oyewopo AO, Olaniyi SK, Oyewopo CI, Jimoh AT: Radiofrequency electromagnetic radiation from cell phone causes defective testicular function in male Wistar rats. *Andrologia* 2017,49(10).
271. Al-Damegh MA: Rat testicular impairment induced by electromagnetic radiation from a conventional cellular telephone and the protective effects of the antioxidants vitamins C and E. *Clinics (Sao Paulo)* 2012,67(7):785-792.
272. Gautam R, Singh KV, Nirala J, Murmu NN, Meena R, Rajamani P: Oxidative stress- mediated alterations on sperm parameters in male Wistar rats exposed to 3G mobile phone radiation. *Andrologia* 2019,51(3): e13201.
273. Kuzay D, Ozer C, Sirav B, Canseven AG, Seyhan N: Oxidative effects of extremely low frequency magnetic field and radio frequency radiation on testes tissues of diabetic and healthy rats. *Bratisl Lek Listy* 2017,118(5):278-282.
274. Atasoy HI, Gunal MY, Atasoy P, Elgun S, Bugdayci G: Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices. *J Pediatr Urol* 2013,9(2):223-229.
275. Zhu W, Cui Y, Feng X, Li Y, Zhang W, Xu J, Wang H, Lv S: The apoptotic effect and the plausible mechanism of microwave radiation on rat myocardial cells. *Can J Physiol Pharmacol* 2016,94(8):849-857.
276. Gumral N, Saygin M, Asci H, Uguz AC, Celik O, Doguc DK, Savas HB, Comlekci S: The effects of electromagnetic radiation (2450 MHz wireless devices) on the heart and blood tissue: role of melatonin. *Bratisl Lek Listy* 2016,117(11):665-671.
277. Djordjevic B, Sokolovic D, Kocic G, Veljkovic A, Despotovic M, Basic J, Jevtovic- Stoimenov T, Sokolovic DM: The effect of melatonin on the liver of rats exposed to microwave radiation. *Bratisl Lek Listy* 2015,116(2):96-

- 100.
278. Bodera P, Stankiewicz W, Antkowiak B, Paluch M, Kieliszek J, Sobiech J, Niemcewicz M: Influence of electromagnetic field (1800 MHz) on lipid peroxidation in brain, blood, liver and kidney in rats. *Int J Occup Med Environ Health* 2015,28(4):751-759.
 279. Chauhan P, Verma HN, Sisodia R, Kesari KK: Microwave radiation (2.45 GHz)- induced oxidative stress: Whole-body exposure effect on histopathology of Wistar rats. *Electromagn Biol Med* 2017,36(1):20-30.
 280. Postaci I, Coskun O, Senol N, Aslankoc R, Comlekci S: The physiopathological effects of quercetin on oxidative stress in radiation of 4.5 g mobile phone exposed liver tissue of rat. *Bratisl Lek Listy* 2018,119(8):481-489.
 281. Kuybulu AE, Oktem F, Ciris IM, Sutcu R, Ormeci AR, Comlekci S, Uz E: Effects of long- term pre- and post-natal exposure to 2.45 GHz wireless devices on developing male rat kidney. *Ren Fail* 2016,38(4):571-580.
 282. Demirel S, Doganay S, Turkoz Y, Dogan Z, Turan B, Firat PG: Effects of third generation mobile phone-emitted electromagnetic radiation on oxidative stress parameters in eye tissue and blood of rats. *Cutan Ocul Toxicol* 2012,31(2):89-94.
 283. Eker ED, Arslan B, Yildirim M, Akar A, Aras N: The effect of exposure to 1800 MHz radiofrequency radiation on epidermal growth factor, caspase-3, Hsp27 and p38MAPK gene expressions in the rat eye. *Bratisl Lek Listy* 2018,119(9):588-592.
 284. Tok L, Naziroglu M, Dogan S, Kahya MC, Tok O: Effects of melatonin on Wi-Fi- induced oxidative stress in lens of rats. *Indian J Ophthalmol* 2014,62(1):12-15.
 285. Aynali G, Naziroglu M, Celik O, Dogan M, Yariktas M, Yasan H: Modulation of wireless (2.45 GHz)-induced oxidative toxicity in laryngotracheal mucosa of rat by melatonin. *Eur Arch Otorhinolaryngol* 2013,270(5):1695-1700.
 286. Sangun O, Dundar B, Darici H, Comlekci S, Doguc DK, Celik S: The effects of long- term exposure to a 2450 MHz electromagnetic field on growth and pubertal development in female Wistar rats. *Electromagn Biol Med* 2015,34(1):63-71.
 287. Yuksel M, Naziroglu M, Ozkaya MO: Long-term exposure to electromagnetic radiation from mobile phones and Wi-Fi devices decreases plasma prolactin, progesterone, and estrogen levels but increases uterine oxidative stress in pregnant rats and their offspring. *Endocrine* 2016,52(2):352-362.
 288. Aydin B, Akar A: Effects of a 900-MHz electromagnetic field on oxidative stress parameters in rat lymphoid organs, polymorphonuclear leukocytes and plasma. *Arch Med Res* 2011,42(4):261-267.
 289. Akbari A, Jelodar G, Nazifi S: Vitamin C protects rat cerebellum and encephalon from oxidative stress following exposure to radiofrequency wave generated by a BTS antenna model. *Toxicol Mech Methods* 2014, 24(5):347-352.
 290. Kerimoglu G, Hanci H, Bas O, Asian A, Erol HS, Turgut A, Kaya H, Cankaya S, Sonmez OF, Odaci E: Pernicious effects of long-term, continuous 900-MHz electromagnetic field throughout adolescence on hippocampus morphology, biochemistry and pyramidal neuron numbers in 60-day-old Sprague Dawley male rats. *J Chem Neuroanat* 2016,77:169-175.
 291. Ragy MM: Effect of exposure and withdrawal of 900-MHz-electromagnetic waves on brain, kidney and liver oxidative stress and some biochemical parameters in male rats. *Electromagn Biol Med* 2015,34(4):279-284.
 292. Tang J, Zhang Y, Yang L, Chen Q, Tan L, Zuo S, Feng H, Chen Z, Zhu G: Exposure to 900 MHz electromagnetic fields activates the mkp-1/ERK pathway and causes blood- brain barrier damage and cognitive impairment in rats. *Brain Research* 2015, 1601:92-101.
 293. Varghese R, Majumdar A, Kumar G, Shukla A: Rats exposed to 2.45GHz of non- ionizing radiation exhibit behavioral changes with increased brain expression of apoptotic caspase 3. *Pathophysiology* 2018,25(1):19-30.
 294. Alkis ME, Bilgin HM, Akpolat V, Dasdag S, Yegin K, Yavas MC, Akdag MZ: Effect of 900-, 1800-, and 2100-MHz radiofrequency radiation on DNA and oxidative stress in brain. *Electromagn Biol Med* 2019,38(1):32-47.
 295. Yang XS, He GL, Hao YT, Xiao Y, Chen CH, Zhang GB, Yu ZP: Exposure to 2.45 GHz electromagnetic fields elicits an HSP-related stress response in rat hippocampus. *Brain research bulletin* 2012,88(4):371-378.
 296. Hanci H, Kerimoglu G, Mercantepe T, Odaci E: Changes in testicular morphology and oxidative stress biomarkers in 60-day-old Sprague Dawley rats following exposure to continuous 900-MHz electromagnetic field for 1 h a day throughout adolescence. *Reprod Toxicol* 2018,81:71-78.
 297. Jelodar G, Akbari A, Nazifi S: The prophylactic effect of vitamin C on oxidative stress indexes in rat eyes

- following exposure to radiofrequency wave generated by a BTS antenna model. *Int J Radiat Biol* 2013,89(2):128-131.
298. Liu Q Si T, Xu X, Liang F, Wang L, Pan S: Electromagnetic radiation at 900 MHz induces sperm apoptosis through bcl-2, bax and caspase-3 signaling pathways in rats. *Reprod Health* 2015,12(1):65.
 299. Bin-Meferij MM, El-Kott AF: The radioprotective effects of Moringa oleifera against mobile phone electromagnetic radiation-induced infertility in rats. *Int J Clin Exp Med* 2015,8(8):12487-12497.
 300. Oguzturk H, Beytur R, Ciftci O, Turtay MG, Samdanci E, Dilek OF: Does 3-G mobile phone radiofrequency affect oxidative stress, sperm characteristics and testis histology? *Fresenius Environ Bull* 2011,20(3):646-653.
 301. Saygin M, Asci H, Ozmen O, Cankara FN, Dincoglu D, Ilhan I: Impact of 2.45 GHz microwave radiation on the testicular inflammatory pathway biomarkers in young rats: The role of gallic acid. *Environ Toxicol* 2016,31(12):1771-1784.
 302. Lee HJ, Jin YB, Kim TH, Pack JK, Kim N, Choi HD, Lee JS, Lee YS: The effects of simultaneous combined exposure to CDMA and WCDMA electromagnetic fields on rat testicular function. *Bioelectromagnetics* 2012,33(4):356-364.
 303. Odaci E, Unal D, Mercantepe T, Topal Z, Hanci H, Turedi S, Erol HS, Mungan S, Kaya H, Colakoglu S: Pathological effects of prenatal exposure to a 900 MHz electromagnetic field on the 21-day-old male rat kidney. *Biotech Histochem* 2015, 90(2):93-101.
 304. Turedi S, Kerimoglu G, Mercantepe T, Odaci E: Biochemical and pathological changes in the male rat kidney and bladder following exposure to continuous 900- MHz electromagnetic field on postnatal days 22-59<sup>. *Int J Radiat Biol* 2017, 93(9):990-999.
 305. Okatan DO, Okatan AE, Hanci H, Demir S, Yaman SO, Colakoglu S, Odaci E: Effects of 900-MHz electromagnetic fields exposure throughout middle/late adolescence on the kidney morphology and biochemistry of the female rat. *Toxicol Ind Health* 2018, 34(10):693-702.
 306. Bedir R, Tumkaya L, Mercantepe T, Yilmaz A: Pathological Findings Observed in the Kidneys of Postnatal Male Rats Exposed to the 2100 MHz Electromagnetic Field. *Arch Med Res* 2018,49(7):432-440.
 307. Topal Z, Hanci H, Mercantepe T, Erol HS, Keles ON, Kaya H, Mungan S, Odaci E: The effects of prenatal long-duration exposure to 900-MHz electromagnetic field on the 21-day-old newborn male rat liver. *Turk J Med Sci* 2015,45(2):291-297.
 308. Ismaiil LA, Joumaa WH, Moustafa ME: The impact of exposure of diabetic rats to 900 MHz electromagnetic radiation emitted from mobile phone antenna on hepatic oxidative stress. *Electromagn Biol Med* 2019,38(4):287-296.
 309. Okatan DO, Kulaber A, Kerimoglu G, Odaci E: Altered morphology and biochemistry of the female rat liver following 900-megahertz electromagnetic field exposure during mid to late adolescence. *Biotech Histochem* 2019,94(6):420-428.
 310. Tumkaya L, Yilmaz A, Akyildiz K, Mercantepe T, Yazici ZA, Yilmaz H: Prenatal Effects of a 1,800-MHz Electromagnetic Field on Rat Livers. *Cells Tissues Organs* 2019, 207(3-4):187-196.
 311. Okatan DO, Kaya H, Aliyazicioglu Y, Demir S, Colakoglu S, Odaci E: Continuous 900- megahertz electromagnetic field applied in middle and late-adolescence causes qualitative and quantitative changes in the ovarian morphology, tissue and blood biochemistry of the rat. *Int J Radiat Biol* 2018, 94(2):186-198.
 312. Saygin M, Ozmen O, Erol O, Ellidag HY, Ilhan I, Aslankoc R: The impact of electromagnetic radiation (2.45 GHz, Wi-Fi) on the female reproductive system: The role of vitamin C. *Toxicol Ind Health* 2018, 34(9):620-630.
 313. Turedi S, Hanci H, Topal Z, Unal D, Mercantepe T, Bozkurt I, Kaya H, Odaci E: The effects of prenatal exposure to a 900-MHz electromagnetic field on the 21-day-old male rat heart. *Electromagn Biol Med* 2015,34(4):390-397.
 314. Kerimoglu G, Mercantepe T, Erol HS, Turgut A, Kaya H, Colakoglu S, Odac iE: Effects of long-term exposure to 900-megahertz electromagnetic field on heart morphology and biochemistry of male adolescent rats. *Biotech Histochem* 2016, 91(7):445-454.
 315. Ikinci A, Mercantepe T, Unal D, Erol HS, Sahin A, Asian A, Bas O, Erdem H, Sonmez OF, Kaya H et al: Morphological and antioxidant impairments in the spinal cord of male offspring rats following exposure to a continuous 900MHz electromagnetic field during early and mid-adolescence. *J Chem Neuroanat* 2016, 75(PtB):99-104.

316. Kerimoglu G, Asian A, Bas O, Colakoglu S, Odaci E: Adverse effects in lumbar spinal cord morphology and tissue biochemistry in Sprague Dawley male rats following exposure to a continuous 1-h a day 900-MHz electromagnetic field throughout adolescence. *J Chem Neuroanat* 2016, 78:125-130.
317. Kerimoglu G, Guney C, Ersöz S, Odaci E: A histopathological and biochemical evaluation of oxidative injury in the sciatic nerves of male rats exposed to a continuous 900-megahertz electromagnetic field throughout all periods of adolescence. *J Chem Neuroanat* 2018, 91:1-7.
318. Yang H, Zhang Y, Wang Z, Zhong S, Hu G, Zuo W: The Effects of Mobile Phone Radiofrequency Radiation on Cochlear Stria Marginal Cells in Sprague—Dawley Rats. *Bioelectromagnetics* 2020, 41(3):219-229.
319. Masoumi A, Karbalaei N, Mortazavi SMJ, Shabani M: Radiofrequency radiation emitted from Wi-Fi (2.4 GHz) causes impaired insulin secretion and increased oxidative stress in rat pancreatic islets. *Int J Radiat Biol* 2018, 94(9):850-857.
320. Hancı H, Turedi S, Topal Z, Mercantepe T, Bozkurt I, Kaya H, Ersöz S, Ünal B, Odaci E: Can prenatal exposure to a 900 MHz electromagnetic field affect the morphology of the spleen and thymus, and alter biomarkers of oxidative damage in 21-day-old male rats? *Biotech Histochem* 2015, 90(7):535-543.
321. Megha K, Deshmukh PS, Banerjee BD, Tripathi AK, Ahmed R, Abegaonkar MP: Low intensity microwave radiation induced oxidative stress, inflammatory response and DNA damage in rat brain. *Neurotoxicology* 2015, 51:158-165.
322. Deshmukh PS, Banerjee BD, Abegaonkar MP, Megha K, Ahmed RS, Tripathi AK, Mediratta PK: Effect of low-level microwave radiation exposure on cognitive function and oxidative stress in rats. *Indian J Biochem Biophys* 2013, 50(2):114-119.
323. Megha K, Deshmukh PS, Banerjee BD, Tripathi AK, Abegaonkar MP: Microwave radiation induced oxidative stress, cognitive impairment and inflammation in brain of Fischer rats. *Indian J Exp Biol* 2012, 50(12):889-896.
324. Marzook EA, Abd El Moneim AE, Elhadary AA: Protective role of sesame oil against mobile base station-induced oxidative stress. *Journal of Radiation Research and Applied Sciences* 2019, 7(1):1-6.
325. Ghoneim FM, Arafat EA: Histological and histochemical study of the protective role of rosemary extract against harmful effect of cell phone electromagnetic radiation on the parotid glands. *Acta Histochem* 2016, 118(5):478-485.
326. Bouji M, Lecomte A, Gamez C, Blazy K, Villegier AS: Impact of Cerebral Radiofrequency Exposures on Oxidative Stress and Corticosterone in a Rat Model of Alzheimer's Disease. *J Alzheimers Dis* 2020, 73(2):467-476.
327. Kalanjati VP, Purwantari KE, Prasetyowati L: Aluminium foil damped the adverse effect of 2100 MHz mobile phone-induced radiation on the blood parameters and myocardium in rats. *Environ Sci Pollut Res Int* 2019, 26(12):11686-11689.
328. Furtado-Filho OV, Borba JB, Dallegrave A, Pizzolato TM, Henriques JA, Moreira JC, Saffi J: Effect of 950 MHz UHF electromagnetic radiation on biomarkers of oxidative damage, metabolism of UFA and antioxidants in the livers of young rats of different ages. *Int J Radiat Biol* 2014, 90(2):159-168.
329. Furtado-Filho OV, Borba JB, MaraschinT, Souza LM, Henriques JA, Moreira JC, SaffiJ: Effects of chronic exposure to 950 MHz ultra-high-frequency electromagnetic radiation on reactive oxygen species metabolism in the right and left cerebral cortex of young rats of different ages. *Int J Radiat Biol* 2015, 91(11):891-897.
330. Hussein S, El-Saba AA, Galal MK: Biochemical and histological studies on adverse effects of mobile phone radiation on rat's brain. *J Chem Neuroanat* 2016, 78:10-19.
331. Hancı H, Odaci E, Kaya H, Aliyazıcıoğlu Y, Turan I, Demir S, Colakoglu S: The effect of prenatal exposure to 900-MHz electromagnetic field on the 21-old-day rat testicle. *Reprod Toxicol* 2013, 42:203-209.
332. Guler G, Ozgur E, Keles H, Tomruk A, Vural SA, Seyhan N: Neurodegenerative changes and apoptosis induced by intrauterine and extrauterine exposure of radiofrequency radiation. *J Chem Neuroanat* 2016, 75(PtB):128-133.
333. Guler G, Tomruk A, Ozgur E, Sahin D, Sepici A, Altan N, Seyhan N: The effect of radiofrequency radiation on DNA and lipid damage in female and male infant rabbits. *Int J Radiat Biol* 2012, 88(4):367-373.
334. Ozgur E, Kismali G, Guler G, Akcay A, Ozkurt G, Sel T, Seyhan N: Effects of prenatal and postnatal exposure to GSM-like radiofrequency on blood chemistry and oxidative stress in infant rabbits, an experimental study. *Cell Biochem Biophys* 2013, 67(2):743-751.
335. Kismali G, Ozgur E, Guler G, Akcay A, Sel T, Seyhan N: The influence of 1800 MHz GSM-like signals on

- blood chemistry and oxidative stress in non-pregnant and pregnant rabbits. *Int J Radiat Biol* 2012,88(5):414-419.
336. Vasan S, Veerachari S: Mobile Phone Electromagnetic Waves and Its Effect on Human Ejaculated Semen: An in vitro Study. *International Journal of Infertility & Fetal Medicine* 2012,3(1):15-21.
 337. Nakatani-Enomoto S, Okutsu M, Suzuki S, Suganuma R, Groiss SJ, Kadowaki S, Enomoto H, Fujimori K, Ugawa Y: Effects of 1950 MHz W-CDMA-like signal on human spermatozoa. *Bioelectromagnetics* 2016,37(6):373-381.
 338. Ding SS, Sun P, Zhang Z, Liu X, TianH, Huo YW, Wang LR, Han Y, Xing JP: Moderate Dose of Trolox Preventing the Deleterious Effects of Wi-Fi Radiation on Spermatozoa In vitro through Reduction of Oxidative Stress Damage. *Chinese Medical Journal* 2018,131(4):402-412.
 339. Lu YS, Huang BT, Huang YX: Reactive oxygen species formation and apoptosis in human peripheral blood mononuclear cell induced by 900 MHz mobile phone radiation. *Oxid Med Cell Longev* 2012,2012:740280.
 340. Kazemi E, Mortazavi SM, Ali-Ghanbari A, Sharifzadeh S, Ranjbaran R, Mostafavi-Pour Z, Zal F, Haghani M: Effect of 900 MHz Electromagnetic Radiation on the Induction of ROS in Human Peripheral Blood Mononuclear Cells. *Journal of Biomedical Physics & Engineering* 2015,5(3):105-114.
 341. Lasalvia M, Scrima R, Perna G, Piccoli C, Capitanio N, Biagi PF, Schiavulli L, Ligonz T, Centra M, Casamassima G et al: Exposure to 1.8 GHz electromagnetic fields affects morphology, DNA-related Raman spectra and mitochondrial functions in human lympho-monocytes. *PLoS ONE* 2018,13(2): e0192894.
 342. Durdik M, Kosik P, Markova E, Somsedikova A, Gajdosechova B, Nikitina E, Horvathova E, Kozics K, Davis D, Belyaev I: Microwaves from mobile phone induce reactive oxygen species but not DNA damage, preleukemic fusion genes and apoptosis in hematopoietic stem/progenitor cells. *Scientific Reports* 2019, 9(1):16182.
 343. Tsoy A, Saliev T, Abzhanova E, Turgambayeva A, Kaiyrlykyzy A, Akishev M, Saparbayev S, Umbayev B, Askarova S: The Effects of Mobile Phone Radiofrequency Electromagnetic Fields on beta-Amyloid-Induced Oxidative Stress in Human and Rat Primary Astrocytes. *Neuroscience* 2019,408:46-57.
 344. Glaser K, Rohland M, Kleine-Ostmann T, Schrader T, Stopper H, HintzscheH: Effect of Radiofrequency Radiation on Human Hematopoietic Stem Cells. *Radiation Research* 2016,186(5):455-465.
 345. Xu S, Chen G, Chen C, Sun C, Zhang D, Murbach M, Kuster N, Zeng Q, Xu Z: Cell type- dependent induction of DNA damage by 1800 MHz radiofrequency electromagnetic fields does not result in significant cellular dysfunctions. *PLoS One* 2013,8(1): e54906.
 346. Silva V, Hilly 0, Strenov Y, Tzabari C, Hauptman Y, Feinmesser R: Effect of cell phone- like electromagnetic radiation on primary human thyroid cells. *Int J Radiat Biol* 2016,92(2):107-115.
 347. Ozsobaci NP, Ergun DD, Tuncdemir M, Ozcelik D: Protective Effects of Zinc on 2.45 GHz Electromagnetic Radiation-Induced Oxidative Stress and Apoptosis in HEK293 Cells. *Biol Trace Elem Res* 2020,194(2):368-378.
 348. Pastaci Ozsobaci N, Duzgun Ergun D, Durmus S, Tuncdemir M, Uzun H, Gelisgen R, Ozcelik D: Selenium supplementation ameliorates electromagnetic field-induced oxidative stress in the HEK293 cells. *J Trace Elem Med Biol* 2018,50:572-579.
 349. Sefidbakht Y, Moosavi-Movahedi AA, Hosseinkhani S, Khodagholi F, Torkzadeh- Mahani M, Foolad F, Faraji-Dana R: Effects of 940 MHz EMF on bioluminescence and oxidative response of stable luciferase producing HEK cells. *Photochemical & Photobiological Sciences: Official Journal of the European Photochemistry Association and the European Society for Photobiology* 2014,13(7):1082-1092.
 350. Sun Y, Zong L, Gao Z, Zhu S, Tong J, Cao Y: Mitochondrial DNA damage and oxidative damage in HL-60 cells exposed to 900MHz radiofrequency fields. *Mutation research* 2017,797-799:7-14.
 351. Naziroglu M, Cig B, Dogan S, Uguz AC, Dilek S, Faouzi D: 2.45-Gz wireless devices induce oxidative stress and proliferation through cytosolic Ca(2)(+) influx in human leukemia cancer cells. *Int J Radiat Biol* 2012,88(6):449-456.
 352. von Niederhausern N, Ducray A, Zielinski J, Murbach M, Mevissen M: Effects of radiofrequency electromagnetic field exposure on neuronal differentiation and mitochondrial function in SH-SY5Y cells. *Toxicology in Vitro* 2019,61:104609.
 353. Pouilletierde Gannes F, Haro E, Hurtier A, Taxile M, Ruffie G, Billaudel B, Veyret B, Lagroye I: Effect of exposure to the edge signal on oxidative stress in brain cell models. *Radiation Research* 2011,175(2):225-230.

354. Kang KA, Lee HC, Lee JJ, Hong MN, Park MJ, Lee YS, Choi HD, Kim N, Ko YG, Lee JS: Effects of combined radiofrequency radiation exposure on levels of reactive oxygen species in neuronal cells. *Journal of Radiation Research* 2014,55(2):265-276.
355. Stefi AL, Margaritis LH, Skouroliakou AS, Vassilacopoulou D: Mobile phone electromagnetic radiation affects Amyloid Precursor Protein and alpha-synuclein metabolism in SH-SY5Y cells. *Pathophysiology* 2019,26(3-4):203-212.
356. Zielinski J, Ducray AD, Moeller AM, Murbach M, Kuster N, Mevissen M: Effects of pulse-modulated radiofrequency magnetic field (RF-EMF) exposure on apoptosis, autophagy, oxidative stress and electron chain transport function in human neuroblastoma and murine microglial cells. *Toxicology in Vitro* 2020,68:104963.
357. Marjanovic Cermak AM, Pavicic I, Trosic I: Oxidative stress response in SH-SY5Y cells exposed to short-term 1800 MHz radiofrequency radiation. *J Environ Sci Health A Tox Haz Ord Subst Environ Eng* 2018,53(2):132-138.
358. Choi J, Min K, Jeon S, Kim N, Pack JK, Song K: Continuous Exposure to 1.7 GHz LTE Electromagnetic Fields Increases Intracellular Reactive Oxygen Species to Decrease Human Cell Proliferation and Induce Senescence. *Scientific Reports* 2020, 10(1):9238.
359. Cig B, Naziroglu M: Investigation of the effects of distance from sources on apoptosis, oxidative stress and cytosolic calcium accumulation via TRPV1 channels induced by mobile phones and Wi-Fi in breast cancer cells. *Biochim Biophys Acta* 2015, 1848(10 PtB):2756-2765.
360. Kahya MC, Naziroglu M, Cig B: Selenium reduces mobile phone (900 MHz)-induced oxidative stress, mitochondrial function, and apoptosis in breast cancer cells. *Biological trace element research* 2014,160(2):285-293.
361. Ni S, Yu Y, Zhang Y, Wu W, Lai K, Yao K: Study of oxidative stress in human lens epithelial cells exposed to 1.8 GHz radiofrequency fields. *PLoS One* 2013, 8(8):e72370.
362. Hong MN, Kim BC, Ko YG, Lee YS, Hong SC, Kim T, Pack JK, Choi HD, Kim N, Lee JS: Effects of 837 and 1950 MHz radiofrequency radiation exposure alone or combined on oxidative stress in MCF10A cells. *Bioelectromagnetics* 2012,33(7):604-611.
363. Qin F, Shen T, Cao H, Qian J, Zou D, Ye M, Pei H: CeO₂NPs relieve radiofrequency radiation, improve testosterone synthesis, and clock gene expression in Leydig cells by enhancing antioxidation. *Int J Nanomedicine* 2019,14:4601-4611.
364. Kohestani NV, Zavareh S, Lashkarbolouki T, Azimipour F: Exposure to cell phone induce oxidative stress in mice preantral follicles during in vitro cultivation: An experimental study. *Int J Reprod Biomed (Yazd)* 2019,17(9):637-646.
365. Houston BJ, Nixon B, King BV, Aitken RJ, De Iuliis GN: Probing the Origins of 1,800 MHz Radio Frequency Electromagnetic Radiation Induced Damage in Mouse Immortalized Germ Cells and Spermatozoa in vitro. *Frontiers in public health* 2018, 6:270.
366. Hou Q Wang M, Wu S, Ma X, An G, Liu H, Xie F: Oxidative changes and apoptosis induced by 1800-MHz electromagnetic radiation in NIH/3T3 cells. *Electromagnetic Biology and Medicine* 2015,34(1):85-92.
367. Xing F, Zhan Q, He Y, Cui J, He S, Wang G: 1800MHz Microwave Induces p53 and p53-Mediated Caspase-3 Activation Leading to Cell Apoptosis In Vitro. *PLoS One* 2016,11(9):e0163935.
368. Li R, Ma M, Li L, Zhao L, Zhang T, Gao X, Zhang D, Zhu Y, Peng Q Luo X et al: The Protective Effect of Autophagy on DNA Damage in Mouse Spermatocyte-Derived Cells Exposed to 1800 MHz Radiofrequency Electromagnetic Fields. *Cellular Physiology and Biochemistry* 2018,48(1):29-41.
369. Liu C, Duan W, Xu S, Chen C, He M, Zhang L, Yu Z, Zhou Z: Exposure to 1800 MHz radiofrequency electromagnetic radiation induces oxidative DNA base damage in a mouse spermatocyte-derived cell line. *Toxicology Letters* 2013,218(1):2-9.
370. Liu K, Zhang G, Wang Z, Liu Y, Dong J, Dong X, Liu J, Cao J, Ao L, Zhang S: The protective effect of autophagy on mouse spermatocyte derived cells exposure to 1800MHz radiofrequency electromagnetic radiation. *Toxicology Letters* 2014, 228(3):216-224.
371. Lu Y, He M, Zhang Y, Xu S, Zhang L, He Y, Chen C, Liu C, Pi H, Yu Z et al: Differential pro-inflammatory responses of astrocytes and microglia involve STAT3 activation in response to 1800 MHz radiofrequency fields. *PLoS ONE* 2014,9(9):e108318.
372. He GL, Liu Y, Li M, Chen CH, Gao P, Yu ZP, Yang XS: The amelioration of phagocytic ability in microglial

- cells by curcumin through the inhibition of EMF-induced pro- inflammatory responses. *Journal of neuroinflammation* 2014;11:49.
373. Wang X, Liu C, Ma Q, Feng W, Yang L, Lu Y, Zhou Z, Yu Z, Li W, Zhang L: 8-oxoG DNA glycosylase-1 inhibition sensitizes Neuro-2a cells to oxidative DNA base damage induced by 900 MHz radiofrequency electromagnetic radiation. *Cell Physiol Biochem* 2015;37(3):1075-1088.
 374. Kim JY, Kim HJ, Kim N, Kwon JH, Park MJ: Effects of radiofrequency field exposure on glutamate-induced oxidative stress in mouse hippocampal HT22 cells. *Int J Radiat Biol* 2017;93(2):249-256.
 375. Lee JS, Kim JY, Kim HJ, Kim JC, Lee JS, Kim N, Park MJ: Effects of combined radiofrequency field exposure on amyloid-beta-induced cytotoxicity in HT22 mouse hippocampal neurones. *J Radiat Res* 2016; 57(6):620-626.
 376. Lopez-Furelos A, Salas-Sanchez AA, Ares-Pena FJ, Leiro-Vidal JM, Lopez-Martin E: Exposure to radiation from single or combined radio frequencies provokes macrophage dysfunction in the RAW 264.7 cell line. *International Journal of Radiation Biology* 2018;94(6):607-618.
 377. Lin YY, Wu T, Liu JY, Gao P, Li KC, Guo QY, Yuan M, Lang HY, Zeng LH, Guo GZ: 1950MHz Radio Frequency Electromagnetic Radiation Inhibits Testosterone Secretion of Mouse Leydig Cells. *Int J Environ Res Public Health* 2017;15(1).
 378. Zuo WQ, Hu YJ, Yang Y, Zhao XY, Zhang YY, Kong W, Kong WJ: Sensitivity of spiral ganglion neurons to damage caused by mobile phone electromagnetic radiation will increase in lipopolysaccharide-induced inflammation in vitro model. *Neuroinflammation* 2015;12:105.
 379. Marjanovic AM, Pavicic I, Trosic I: Cell oxidation-reduction imbalance after modulated radiofrequency radiation. *Electromagnetic Biology and Medicine* 2015; 34(4):381-386.
 380. Marjanovic Cermak AM, Pavicic I, Tariba Lovakovic B, Pizent A, Trosic I: In vitro non- thermal oxidative stress response after 1800 MHz radiofrequency radiation. *General physiology and biophysics* 2017;36(4):407-414.
 381. Jooyan N, Goliae B, Bigdeli B, Faraji-Dana R, Zamani A, Entezami M, Mortazavi SMJ: Direct and indirect effects of exposure to 900MHz GSM radiofrequency electromagnetic fields on CHO cell line: Evidence of bystander effect by non- ionizing radiation. *Environmental Research* 2019;174:176-187.
 382. Meena R, Kumari K, Kumar J, Rajamani P, Verma HN, Kesari KK: Therapeutic approaches of melatonin in microwave radiations-induced oxidative stress- mediated toxicity on male fertility pattern of Wistar rats. *Electromagn Biol Med* 2014;33(2):81-91.
 383. Pandey N, Giri S: Melatonin attenuates radiofrequency radiation (900 MHz)- induced oxidative stress, DNA damage and cell cycle arrest in germ cells of male Swiss albino mice. *Toxicol Ind Health* 2018;34(5):315-327.
 384. Kumar S, Nirala JP, Behari J, Paulraj R: Effect of electromagnetic irradiation produced by 3G mobile phone on male rat reproductive system in a simulated scenario. *Indian J Exp Biol* 2014;52(9):890-897. Jeong YJ, Son Y, Han NK, Choi HD, Pack JK, Kim N, Lee YS, Lee HJ: Impact of Long- Term RF-EMF on Oxidative Stress and Neuroinflammation in Aging Brains of C57BL/6 Mice. *Int J Mol Sci* 2018;19(7).
 385. Yang SY, Zhang TX, Cui YF, Zhang C, Wang SM, Xu H, Jin W: Effect of high power microwave on gene expressio of immune tissues in rats. *Chinese Journal of Clinical Rehabilitation* 2006;10(29):132-137.
 386. Vanishree M, Manvikar V, Rudraraju A, Reddy KMP, Kumar NHP, Quadri SJM: Significance of micronuclei in buccal smears of mobile phone users: A comparative study. *J Oral Maxillofac Pathol* 2018;22(3):448.
 387. de Oliveira FM, Carmona AM, Ladeira C: Is mobile phone radiation genotoxic? An analysis of micronucleus frequency in exfoliated buccal cells. *Mutation research* 2017;822:41-46.
 388. Gulati S, Yadav A, Kumar N, Kanupriya, Aggarwal NK, Kumar R, Gupta R: Effectof GSTM1 and GSTT1 Polymorphisms on Genetic Damage in Humans Populations Exposed to Radiation From Mobile Towers. *Arch Environ Contam Toxicol* 2016; 70(3):615-625.
 389. Banerjee S, Singh NN, Sreedhar G, Mukherjee S: Analysis of the Genotoxic Effects of Mobile Phone Radiation using Buccal Micronucleus Assay: A Comparative Evaluation. *J Clin Diagn Res* 2016;10(3):ZC82-85.
 390. Daroit NB, Vissoli F, Magnusson AS, Vieira GR, Rados PV: Cell phone radiation effects on cytogenetic abnormalities of oral mucosal cells. *Broz Oral Res* 2015;29(1):1-8.
 391. Souza Lda C, Cerqueira Ede M, Meireles JR: Assessment of nuclear abnormalities in exfoliated cells from the oral epithelium of mobile phone users. *Electromagn Biol Med* 2014;33(2):98-102.
 392. Ros-Llor I, Sanchez-Siles M, Camacho-Alonso F, Lopez-Jornet P: Effect of mobile phones on micronucleus frequency in human exfoliated oral mucosal cells. *Oral Dis* 2012;18(8):786-792.

393. Radwan M, Jurewicz J, Merecz-KotD, SobalaW, RadwanP, BochenekM, HankeW: Sperm DNA damage-the effect of stress and everyday life factors. *Int J Impot Res* 2016,28(4):148-154.
394. Jurewicz J, Radwan M, Sobala W, Ligocka D, Radwan P, Bochenek M, Hanke W: Lifestyle and semen quality: role of modifiable risk factors. *Syst Biol Reprod Med* 2014,60(1):43-51.
395. GandhiG, Kaur G, Nisar U: Across-section al case control study on genetic damage in individuals residing in the vicinity of a mobile phone base station. *Electromagn Biol Med* 2015,34(4):344-354.
396. Cam ST, Seyhan N: Single-strand DNA breaks in human hair root cells exposed to mobile phone radiation. *Int J Radiat Biol* 2012,88(5):420-424.
397. Jiang B, Zong C, Zhao H, Ji Y, Tong J, Cao Y: Induction of adaptive response in mice exposed to 900MHz radiofrequency fields: application of micronucleus assay. *Mutation research* 2013,751(2):127-129.
398. Jiang B, Nie J, Zhou Z, Zhang J, Tong J, Cao Y: Adaptive response in mice exposed to 900 MHz radiofrequency fields: primary DNA damage. *PLoS One* 2012,7(2): e32040.
399. Chaturvedi CM, Singh VP, SinghP, Basu P, Singaravel M, Shukla RK, Dhawan A, Pati AK, Gangwar RK, Singh SP: "2.45 GHz (CW) microwave irradiation alters circadian organization, spatial memory, DNA structure in the brain cells and blood cell counts of male mice, *mus musculus*". *Progress In Electromagnetics Research B* 2011,29:23-42.
400. Usikalu, M R, Obembe, O O, Akinyemi, M L, Zhu, J: Short-duration exposure to 2.45 GHz microwave radiation induces DNA damage in Sprague Dawley rats reproductive systems. *African Journal of Biotechnology* 2013,12(2):115-122.
401. Akdag MZ, Dasdag S, Canturk F, Karabulut D, Caner Y, Adalier N: Does prolonged radiofrequency radiation emitted from Wi-Fi devices induce DNA damage in various tissues of rats? *J Chem Neuroanat* 2016, 75(PtB):116-122.
402. Gurbuz N, Sirav B, Colbay M, Yetkin I, Seyhan N: No genotoxic effect in exfoliated bladder cells of rat under the exposure of 1800 and 2100 MHz radio frequency radiation. *Electromagn Biol Med* 2014,33(4):296-301.
403. Atli Sekerooglu Z, Akar A, Sekerooglu V: Evaluation of the cytogenotoxic damage in immature and mature rats exposed to 900 MHz radiofrequency electromagnetic fields. *Int J Radiat Biol* 2013,89(11):985-992.
404. Sekerooglu V, Akar A, Sekerooglu ZA: Cytotoxic and genotoxic effects of high- frequency electromagnetic fields (GSM 1800 MHz) on immature and mature rats. *Ecotoxicol Environ Saf* 2012,80:140-144.
405. Trosic I, Pavicic I, Milkovic-Kraus S, Mladinic M, Zeljezic D: Effect of electromagnetic radiofrequency radiation on the rats' brain, liver and kidney cells measured by comet assay. *Coll Antropol* 2011,35(4):1259-1264.
406. Gouda EM, Galal MK, Abdalaziz SA: Adverse Effect of Mobile Phone on TP53, BRCA1 Genes and DNA Fragmentation in Albino Rat Liver. *International Journal of Genomics and Proteomics* 2013,4(1):84-88.
407. Deshmukh PS, Megha K, Banerjee BD, Ahmed RS, Chandna S, Abegaonkar MP, Tripathi AK: Detection of Low-Level Microwave Radiation Induced Deoxyribonucleic Acid Damage Vis-a-vis Genotoxicity in Brain of Fischer Rats. *Toxicol Int* 2013, 20(1):19-24.
408. Deshmukh PS, Nasare N, Megha K, Banerjee BD, Ahmed RS, Singh D, Abegaonkar MP, Tripathi AK, Mediratta PK: Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation. *Int J Toxicol* 2015, 34(3):284- 290.
409. Deshmukh PS, MeghaK, Nasare N, Banerjee BD, Ahmed RS, Abegaonkar MP, Tripathi AK, Mediratta PK: Effect of Low Level Subchronic Microwave Radiation on Rat Brain. *Biomed Environ Sci* 2016,29(12):858-867.
410. Danese E, Lippi G, Buonocore R, Benati M, Bovo C, Bonaguri C, Salvagno GL, Brocco G, Roggenbuck D, Montagnana M: Mobile phone radiofrequency exposure hasno effect on DNA double strand breaks (DSB) in human lymphocytes. *Ann Transl Med* 2017,5(13):272.
411. Waldmann P, Bohnenberger S, Greinert R, Hermann-Then B, Heselich A, Klug SJ, Koenig J, Kuhr K, Kuster N, Merker M et al: Influence of GSM signals on human peripheral lymphocytes: study of genotoxicity. *Radiat Res* 2013,179(2):243-253.
412. Sannino A, Zeni O, Romeo S, Massa R, Gialanella G, Grossi G, Manti L, Vijayalaxmi, Scarfi MR: Adaptive response in human blood lymphocytes exposed to non-ionizing radiofrequency fields: resistance to ionizing radiation-induced damage. *J Radiat Res* 2014,55(2):210-217.
413. Zeni O, Sannino A, Romeo S, Massa R, Sarti M, Reddy AB, Prihoda TJ, Vijayalaxmi, Scarfi MR: Induction of an adaptive response in human blood lymphocytes exposed to radiofrequency fields: influence of the universal mobile telecommunication system (UMTS) signal and the specific absorption rate. *Mutation*

- research 2012, 747(1):29-35.
414. Vijayalaxmi, Reddy AB, McKenzie RJ, McIntosh RL, Prihoda TJ, Wood AW: Incidence of micronuclei in human peripheral blood lymphocytes exposed to modulated and unmodulated 2450 MHz radiofrequency fields. *Bioelectromagnetics* 2013, 34(7):542-548.
 415. Falone S, Sannino A, Romeo S, Zeni O, Santini SJ, Rispoli R, Amicarelli F, Scarfi MR: Protective effect of 1950 MHz electromagnetic field in human neuroblastoma cells challenged with menadione. *Sci Rep* 2018, 8(1):13234.
 416. Al-Serori H, FerkF, Kundi M, Bileck A, GernerC, Misik M, NersesyanA, WaldherrM, Murbach M, Lah TT et al: Mobile phone specific electromagnetic fields induce transient DNA damage and nucleotide excision repair in serum-deprived human glioblastoma cells. *PLoS One* 2018, 13(4):e0193677.
 417. Su L, Wei X, Xu Z, Chen G: RF-EMF exposure at 1800 MHz did not elicit DNA damage or abnormal cellular behaviors in different neurogenic cells. *Bioelectromagnetics* 2017, 38(3):175-185.
 418. Ozgur E, Guler G, Kismali G, Seyhan N: Mobilephoneradiationaltersproliferation of hepatocarcinoma cells. *Cell Biochem Biophys* 2014, 70(2):983-991.
 419. Zhijian C, Xiaoxue L, Wei Z, Yezhen L, Jianlin L, Deqiang L, Shijie C, Lifen J, Jiliang H: Studying the protein expression in human B lymphoblastoid cells exposed to 1.8- GHz (GSM) radiofrequency radiation (RFR) with protein microarray. *Biochem Biophys Res Commun* 2013, 433(1):36-39.
 420. Speit G, Gminski R, Tauber R: Genotoxic effects of exposure to radiofrequency electromagnetic fields (RF-EMF) in HL-60 cells are not reproducible. *Mutation research* 2013, 755(2):163-166.
 421. Hintzsche H, Jastrow C, Kleine-Ostmann T, Schrader T, Stopper H: 900 MHz radiation does not induce micronucleus formation in different cell types. *Mutagenesis* 2012, 27(4):477-483.
 422. Schrader T, Kleine-Ostmann T, Munter K, Jastrow C, Schmid E: Spindle disturbances in human-hamster hybrid (A(L) cells induced by the electrical component of the mobile communication frequency range signal. *Bioelectromagnetics* 2011, 32(4):291-301.
 423. He Q Sun Y, Zong L, Tong J, Cao Y: Induction of Poly (ADP-ribose) Polymerase in Mouse Bone Marrow Stromal Cells Exposed to 900 MHz Radiofrequency Fields: Preliminary Observations. *Biomed Res Int* 2016, 2016:4918691.
 424. Ji Y, He Q, Sun Y, Tong J, Cao Y: Adaptive response in mouse bone-marrow stromal cells exposed to 900-MHz radiofrequency fields: Gamma-radiation-induced DNA strand breaks and repair. *J Toxicol Environ Health A* 2016, 79(9-10):419-426.
 425. He Q Zong L, Sun Y, Vijayalaxmi, Prihoda TJ, Tong J, Cao Y: Adaptive response in mouse bone marrow stromal cells exposed to 900MHz radiofrequency fields: Impact of poly (ADP-ribose) polymerase (PARP). *Mutation research* 2017, 820:19- 25.
 426. Suzuki S, Okutsu M, Suganuma R, Komiya H, Nakatani-Enomoto S, Kobayashi S, Ugawa Y, Tateno H, Fujimori K: Influence of radiofrequency-electromagnetic waves from 3rd-generation cellular phones on fertilization and embryo development in mice. *Bioelectromagnetics* 2017, 38(6):466-473.
 427. Duan W, Liu C, Zhang L, He M, Xu S, Chen C, Pi H, Gao P, Zhang Y, Zhong M et al: Comparison of the genotoxic effects induced by 50 Hz extremely low-frequency electromagnetic fields and 1800 MHz radiofrequency electromagnetic fields in GC- 2 cells. *Radiat Res* 2015, 183(3):305-314.
 428. Liu C, Gao P, Xu SC, Wang Y, Chen CH, He MD, Yu ZP, Zhang L, Zhou Z: Mobile phone radiation induces mode-dependent DNA damage in a mouse spermatocyte-derived cell line: a protective role of melatonin. *Int J Radiat Biol* 2013, 89(11):993-1001.
 429. Sun C, Wei X, Fei Y, Su L, Zhao X, Chen G, Xu Z: Mobile phone signal exposure triggers a hormesis-like effect in Atm (+/+) and Atm (-/-) mouse embryonic fibroblasts. *Sci Rep* 2016, 6:37423.
 430. Herrala M, Mustafa E, Naarala J, Juutilainen J: Assessment of genotoxicity and genomic instability in rat primary astrocytes exposed to 872 MHz radiofrequency radiation and chemicals. *Int J Radiat Biol* 2018, 94(10):883-889.
 431. Kumar G, Wood AW, Anderson V, McIntosh RL, Chen YY, McKenzie RJ: Evaluation of hematopoietic system effects after in vitro radiofrequency radiation exposure in rats. *Int J Radiat Biol* 2011, 87(2):231-240.
 432. Zeni O, Sannino A, Sarti M, Romeo S, Massa R, Scarfi MR: Radiofrequency radiation at 1950 MHz (UMTS) does not affect key cellular endpoints in neuron-like PC12 cells. *Bioelectromagnetics* 2012, 33(6):497-507.
 433. Ballardin M, Tusa I, Fontana N, Monorchio A, Pelletti C, Rogovich A, Barale R, Scarpato R: Non-thermal effects of 2.45 GHz microwaves on spindle assembly, mitotic cells and viability of Chinese hamster V-79

- cells. *Mutation research* 2011, 716(1-2):1-9.
434. Sannino A, Zeni O, Romeo S, Massa R, Scarfi MR: Adverse and beneficial effects in Chinese hamster lung fibroblast cells following radiofrequency exposure. *Bioelectromagnetics* 2017,38(4):245-254.

Sección 7

Información de base sobre la acción de los CEM y el 5G. Efectos genotóxicos produciendo roturas simples y dobles en las cadenas de ADN. Inicio del proceso de cancerogénesis

Trabajo de revisión: 5G: Great risk for EU, U.S. and International Health, Compelling evidence for eight Distinct Types of great harm caused by Electromagnetic Field(EMF) exposures and the mechanism that causes them. Written and Compiled by Martin L. Pall, PhD Professor Emeritus of Biochemistry and Basic Medical Sciences. Washington State University
martin_pall@wsu.edu 503-232-3883 May 17, 2018

1. Glaser ZR, PhD. 1971 Naval Medical Research Institute Research Report, June 1971. Bibliography of Reported Biological Phenomena ("Effects") and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation. Report No. 2 Revised. https://scholar.google.com/scholar?q=Glaser+naval+medical+microwave+radiofrequency+1972&btnG=&hl=en&as_sdt=0%2C38 (Accessed Sept. 9, 2017)
2. Goldsmith JR. 1997 Epidemiologic evidence relevant to radar (microwave) effects. *Environ Health Perspect* 105(Suppl 6):1579-1587.
3. Yakymenko IL, Sidorik EP, Tsybulin AS. 1999 [Metabolic changes in cells underelectromagnetic radiation of mobile communication systems]. *Ukr Biokhim Zh*(1999), 2011 Mar-Apr:20-28.
4. Aitken RJ, De Iuliis GN. 2007 Origins and consequences of DNA damage in male germcells. *Reprod Biomed Online* 14:727-733.
5. Hardell, L., Sage, C. 2008. Biological effects from electromagnetic field exposure andpublic exposure standards. *Biomed. Pharmacother.* 62, 104-109.
6. Hazout A, Menezo Y, Madelenat P, Yazbeck C, Selva J, Cohen-Bacrie P. 2008 [Causesand clinical implications of sperm DNA damages]. *Gynecol Obstet Fertil*; 36:1109-1117.
7. Phillips JL, Singh NP, Lai H. 2009 Electromagnetic fields and DNA damage. *Pathophysiology* 16:79-88.
8. Ruediger HW. 2009 Genotoxic effects of radiofrequency electromagnetic fields. *Pathophysiology*. 16:89-102.
9. Makker K, Varghese A, Desai NR, Mouradi R, Agarwal A. 2009 Cell phones: modernman's nemesis? *Reprod Biomed Online* 18:148-157.
10. Yakymenko I, Sidorik E. 2010 Risks of carcinogenesis from electromagneticradiation and mobile telephony devices. *Exp Oncol* 32:729-736.
11. Yakimenko IL, Sidorik EP, Tsybulin AS. 2011 [Metabolic changes in cells underelectromagnetic radiation of mobile communication systems]. *Ukr Biokhim Zh* (1999).2011 Mar-Apr;83(2):20-28.
12. Gye MC, Park CJ. 2012 Effect of electromagnetic field exposure on the reproductive system. *Clin Exp Reprod Med* 39:1-9. DOI: [10.5653/cerm.2012.39.1.1](https://doi.org/10.5653/cerm.2012.39.1.1)
13. Pall, ML. 2013. Electromagnetic fields act via activation of voltage-gated calciumchannels to produce beneficial or adverse effects. *J Cell Mol Med* 17:958-965. doi:10.1111/jcmm.12088.
14. Pall, M. L. 2015 Scientific evidence contradicts findings and assumptions of CanadianSafety Panel 6: microwaves act through voltage-gated calcium channel activation toinduce biological impacts at non-thermal levels, supporting a paradigm shift formicrowave/lower frequency electromagnetic field action. *Rev. Environ. Health* 3, 99-116. DOI: [10.1515/reveh-2015-0001](https://doi.org/10.1515/reveh-2015-0001).
15. Hensinger P, Wilke E. 2016. Mobilfunk-Studienergebnisse bestätigen Risiken Studienrecherche 2016-4 veröffentlicht. *Umwelt Medizin Gesellschaft* 29:3/2016.
16. Houston BJ, Nixon B, King BV, De Iuliis GN, Aitken RJ. 2016 The effects ofradiofrequency electromagnetic radiation on sperm function. *Reproduction* 152: R263-R276.

17. Batista Napotnik T, Reberšek M, Vernier PT, Mali B, Miklavčič D. 2016 Effects of highvoltage nanosecond electric pulses on eukaryotic cells (*in vitro*): A systematic review. *Bioelectrochemistry*. 2016 Aug; 110:1-12. DOI: [10.1016/j.bioelechem.2016.02.011](https://doi.org/10.1016/j.bioelechem.2016.02.011).
18. Asghari A, Khaki AA, Rajabzadeh A, Khaki A. 2016 A review on Electromagneticfields (EMFs) and the reproductive system. *Electron Physician*. 2016 Jul 25;8(7):2655-2662. DOI: <https://doi.org/10.19082/2655>.
19. Pall ML. 2018 How cancer can be caused by microwave frequency electromagneticfield (EMF) exposures: EMF activation of voltage-gated calcium channels (VGCCs) cancause cancer including tumor promotion, tissue invasion and metastasis via 15mechanisms. Chapter 7 in *Mobile Communications and Public Health*, Marko Markov, Ed., CRC press, pp 163-184.
20. Pall ML. 2018 Wi-Fi is an important threat to human health. *Environ Res* 164:404-416.
21. Wilke I. 2018 Biological and pathological effects of 2.45 GHz on cells, fertility, brainand behavior. *Umwelt Medizin Gesellschaft* 2018 Feb 31 (1).

Sección 8

Daño a la fertilidad masculina y femenina, hormonas sexuales más bajas, libido más baja y niveles aumentados del aborto espontáneo.

1. Glaser ZR, PhD. 1971 Naval Medical Research Institute Research Report, June 1971.Bibliography of Reported Biological Phenomena ("Effects") and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation. Report No. 2 Revised. https://scholar.google.com/scholar?q=Glaser+naval+medical+microwave+radiofrequency+1972&btnG=&hl=en&as_sdt=0%2C38 (Accessed Sept. 9, 2017)
2. Tolgskaya MS, Gordon ZV. 1973. Pathological Effects of Radio Waves, Translatedfrom Russian by B Haigh. Consultants Bureau, New York/London, 146 pages.
3. Goldsmith JR. 1997 Epidemiological evidence relevant to radar (microwave) effects. *Environ Health Perspect* 105(Suppl 6):1579-1587.
4. Aitken RJ, De Juliis GN. 2007 Origins and consequences of DNA damage in male germcells. *Reprod Biomed Online* 14:727-733.
5. Hazout A, Menezo Y, Madelenat P, Yazbeck C, Selva J, Cohen-Bacie P. 2008 [Causesand clinical implications of sperm DNA damages]. *Gynecol Obstet Fertil*; 36:1109-1117.
6. Makker K, Varghese A, Desai NR, Mouradi R, Agarwal A. 2009 Cell phones: modernman's nemesis? *Reprod Biomed Online* 18:148-157.
7. Kang N, Shang XJ, Huang YF. 2010 [Impact of cell phone radiation on malereproduction]. *Zhonghua Nan Ke Xue* 16:1027-1030.
8. Gye MC, Park CJ. 2012 Effect of electromagnetic field exposure on the reproductivesystem. *Clin Exp Reprod Med* 39:1-9. <https://doi.org/10.5653/cerm.2012.39.1.1>
9. La Vignera S, Condorelli RA, Vicari E, D'Agata R, Calogero AE. 2012 Effects of theexposure to mobile phones on male reproduction: a review of the literature. *J Androl*33:350-356.
10. Carpenter DO. 2013 Human disease resulting from exposure to electromagnetic fields. *Rev Environ Health* 2013; 28:159-172.
11. Naziroğlu M, Yüksel M, Köse SA, Özkaya MO. 2013 Recent reports of Wi-Fi andmobile phone-induced radiation on oxidative stress and reproductive signaling pathwaysin females and males. *J Membr Biol* 246:869-875.
12. Adams JA, Galloway TS, Mondal D, Esteves SC, Mathews F. 2014 Effect of mobiletelephones on sperm quality: a systematic review and meta-analysis. *Environ Int* 70:106-112.
13. Liu K, Li Y, Zhang G, Liu J, Cao J, Ao L, Zhang S. 2014 Association between mobilephone use and semen quality: a systematic review and meta-analysis. *Andrology* 2:491-501.
14. K Sri N. 2015 Mobile phone radiation: physiological & pathophysiologicalconsiderations. *Indian J Physiol Pharmacol* 59:125-135.
15. Hensinger P, Wilke E. 2016. Mobilfunk-Studienergebnisse bestätigen RisikenStudienrecherche 2016-4 veröffentlicht. *Umwelt Medizin Gesellschaft* 29:3/2016.

16. Houston BJ, Nixon B, King BV, De Iuliis GN, Aitken RJ. 2016 The effects of radiofrequency electromagnetic radiation on sperm function. *Reproduction* 152:R263-R276
17. Pall ML. 2018 Wi-Fi is an important threat to human health. *Environ Res* 164:404-416.
18. Wilke I. 2018 Biological and pathological effects of 2.45 GHz on cells, fertility, brain and behavior. *Umwelt Medizin Gesellschaft* 2018 Feb 31 (1).

Sección 9

Ataque de los CEM al sistema nervioso, incluido el cerebro, lo que lleva a efectos neurológicos y/ neuropsiquiátricos y posiblemente muchos otros efectos. Autismo.

1. Marha K. 1966 Biological Effects of High-Frequency Electromagnetic Fields (Translation). ATD Report 66-92. July 13, 1966 (ATD Work Assignment No. 78, Task 11). <https://apps.dtic.mil/sti/pdfs/AD0642029.pdf> (accessed March 12, 2018)
2. Glaser ZR, PhD. 1971 Naval Medical Research Institute Research Report, June 1971. Bibliography of Reported Biological Phenomena ("Effects") and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation. Report No. 2 Revised. https://scholar.google.com/scholar?q=Glaser+naval+medical+microwave+radiofrequency+1972&btnG=&hl=en&as_sdt=0%2C38 (Accessed Sept. 9, 2017)
3. Tolgskaya MS, Gordon ZV. 1973. Pathological Effects of Radio Waves, Translated from Russian by Haigh. Consultants Bureau, New York/London, 146 pages.
4. Bise W. 1978 Low power radio-frequency and microwave effects on human electroencephalogram and behavior. *Physiol Chem Phys* 10:387-398.
5. Raines, J. K. 1981. Electromagnetic Field Interactions with the Human Body: Observed Effects and Theories. Greenbelt, Maryland: National Aeronautics and Space Administration 1981; 116 p.
6. Frey AH. 1993 Electromagnetic field interactions with biological systems. *FASEB J* 7:272-281.
7. Lai H. 1994 Neurological effects of radiofrequency electromagnetic radiation. In: *Advances in Electromagnetic Fields in Living Systems*, Vol. 1, J.C. Lin, Ed., Plenum Press, New York, pp. 27-88.
8. Grigor'ev IuG. 1996 [Role of modulation in biological effects of electromagnetic radiation]. *Radiats Biol Radioecol* 36:659-670.
9. Lai, H. 1998 Neurological effects of radiofrequency electromagnetic radiation. http://www.mapcuzin.com/radiofrequency/henry_lai2.htm.
10. Aitken RJ, De Iuliis GN. 2007 Origins and consequences of DNA damage in male germ cells. *Reprod Biomed Online* 14:727-733.
11. Hardell, L., Sage, C. 2008. Biological effects from electromagnetic field exposure and public exposure standards. *Biomed Pharmacother*. 62, 104-109.
12. Makker K, Varghese A, Desai NR, Mouradi R, Agarwal A. 2009 Cell phones: modern man's nemesis? *Reprod Biomed Online* 18:148-157.
13. Khurana VG, Hardell L, Everaert J, Bortkiewicz A, Carlberg M, Ahonen M. 2010 Epidemiological evidence for a health risk from mobile phone base stations. *Int J Occup Environ Health* 16:263-267.
14. Levitt, B. B., Lai, H. 2010. Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays. *Environ. Rev.* 18,369-395. DOI: [10.1139/A10-018](https://doi.org/10.1139/A10-018)
15. Carpenter DO. 2013 Human disease resulting from exposure to electromagnetic fields. *Rev Environ Health* 2013; 28:159-172.
16. Politański P, Bortkiewicz A, Zmyśloni M. 2016 [Effects of radio- and microwaves emitted by wireless communication devices on the functions of the nervous system selected elements]. *Med Pr* 67:411-421.
17. Hensinger P, Wilke E. 2016. Mobilfunk-Studienergebnisse bestätigen Risiken Studienrecherche 2016-4 veröffentlicht. *Umwelt Medizin Gesellschaft* 29:3/2016.
18. Pall ML. 2016 Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression. *J Chem Neuroanat* 75(PtB):43-51. DOI: <https://doi.org/10.1016/j.jchemneu.2015.08.001>.

19. Hecht, Karl. 2016 Health Implications of Long-Term Exposures to Electromagnetic Fields. Brochure 6 of A Brochure Series of the Competence Initiative for the Protection of Humanity, the Environment and Democracy. http://kompetenzinitiative.net/KIT/wp-content/uploads/2016/07/KI_Brochure-6_K_Hecht_web.pdf (accessed Feb. 11, 2018)
20. Sangün Ö, Dündar B, Çömlekçi S, Büyükgeliz A. 2016 The Effects of Electromagnetic Field on the Endocrine System in Children and Adolescents. *Pediatr Endocrinol Rev* 13:531-545.
21. Belyaev I, Dean A, Eger H, Hubmann G, Jandrisovits R, Kern M, Kundi M, Moshammer H, Lercher P, Müller K, Oberfeld G, Ohnsorge P, Pelzmann P, Scheingraber C, Thill R. 2016 EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses. *Rev Environ Health* DOI: [10.1515/reveh-2016-0011](https://doi.org/10.1515/reveh-2016-0011).
22. Zhang J, Sumich A, Wang GY. 2017 Acute effects of radiofrequency electromagnetic field emitted by mobile phone on brain function. *Bioelectromagnetics* 38:329-338. DOI: [10.1002/bem.22052](https://doi.org/10.1002/bem.22052).
23. Lai H. 2018. A Summary of Recent Literature (2007–2017) on Neurological Effects of Radio Frequency Radiation. Chapter 8 in *Mobile Communications and Public Health*, Marko Markov, Ed., CRC press, pp 185-220.
24. Pall ML. 2018 Wi-Fi is an important threat to human health. *Environ Res* 164:404-416.
25. Wilke I. 2018 Biological and pathological effects of 2.45 GHz on cells, fertility, brain and behavior. *Umwelt Medizin Gesselschaft* 2018 Feb 31 (1).

Sección 10

Producción de niveles elevados de apoptosis (muerte celular programada), origen de enfermedades neurodegenerativas e infertilidad

1. Glaser ZR, PhD. 1971 Naval Medical Research Institute Research Report, June 1971. Bibliography of Reported Biological Phenomena ("Effects") and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation. Report No. 2 Revised. https://scholar.google.com/scholar?q=Glaser+naval+medical+microwave+radiofrequency+1972&btnG=&hl=en&as_sdt=0%2C38 (Accessed Sept. 9, 2017)
2. Tolgskaya MS, Gordon ZV. 1973. Pathological Effects of Radio Waves, Translated from Russian by B Haigh. Consultants Bureau, New York/London, 146 pages.
3. Raines, J. K. 1981. Electromagnetic Field Interactions with the Human Body: Observed Effects and Theories. Greenbelt, Maryland: National Aeronautics and Space Administration 1981; 116 p.
4. Hardell L, Sage C. 2008. Biological effects from electromagnetic field exposure and public exposure standards. *Biomed. Pharmacother.* 62:104-109. DOI: [10.1016/j.biopha.2007.12.004](https://doi.org/10.1016/j.biopha.2007.12.004).
5. Makker K, Varghese A, Desai NR, Mouradi R, Agarwal A. 2009 Cell phones: modern man's nemesis? *Reprod Biomed Online* 18:148-157.
6. Levitt, B. B., Lai, H. 2010. Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays. *Environ. Rev.* 18,369-395. DOI: [10.1139/A10-018](https://doi.org/10.1139/A10-018)
7. Yakymenko I, Sidorik E. 2010 Risks of carcinogenesis from electromagnetic radiation and mobile telephony devices. *Exp Oncol* 32:729-736.
8. Yakimenco IL, Sidorik EP, Tsybulin AS. 2011 [Metabolic changes in cells under electromagnetic radiation of mobile communication systems]. *Ukr Biokhim Zh* (1999).2011 Mar-Apr;83(2):20-28.
9. Pall, ML. 2013. Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. *J Cell Mol Med* 17:958-965. DOI: [10.1111/jcmm.12088](https://doi.org/10.1111/jcmm.12088).
10. Pall ML. 2016 Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression. *J Chem Neuroanat* 75(PtB):43-51. doi: [10.1016/j.jchemneu.2015.08.001](https://doi.org/10.1016/j.jchemneu.2015.08.001).

11. Batista Napotnik T, Reberšek M, Vernier PT, Mali B, Miklavčič D. 2016 Effects of highvoltage nanosecond electric pulses on eukaryotic cells (*in vitro*): A systematic review. *Bioelectrochemistry*. 2016 Aug; 110:1-12. DOI: [10.1016/j.bioelechem.2016.02.011](https://doi.org/10.1016/j.bioelechem.2016.02.011).
12. Asghari A, Khaki AA, Rajabzadeh A, Khaki A. 2016 A review on Electromagneticfields (EMFs) and the reproductive system. *Electron Physician*. 2016 Jul 25;8(7):2655-2662. DOI: [10.19082/2655](https://doi.org/10.19082/2655).
13. Pall ML. 2018 Wi-Fi is an important threat to human health. *Environ Res* 164:404-416.

Sección 11

Producción de estrés oxidativo celular y daño por radicales libres

1. Raines, J. K. 1981. Electromagnetic Field Interactions with the Human Body: ObservedEffects and Theories. Greenbelt, Maryland: National Aeronautics and SpaceAdministration 1981; 116 p.
2. Hardell, L., Sage, C. 2008. Biological effects from electromagnetic field exposure anpublic exposure standards. *Biomed. Pharmacother.* 62, 104-109.
3. Hazout A, Menezo Y, Madelenat P, Yazbeck C, Selva J, Cohen-Bacie P. 2008 [Causesand clinical implications of sperm DNA damages]. *Gynecol Obstet Fertil*;36:1109-1117
4. Makker K, Varghese A, Desai NR, Mouradi R, Agarwal A. 2009 Cell phones: modernman's nemesis? *Reprod Biomed Online* 18:148-157.
5. Desai NR, Kesari KK, Agarwal A. 2009 Pathophysiology of cell phone radiation: oxidative stress and carcinogenesis with focus on the male reproductive system. *Reproduct Biol Endocrinol* 7:114.
6. Yakymenko I, Sidorik E. 2010 Risks of carcinogenesis from electromagneticradiation and mobile telephony devices. *Exp Oncol* 32:729-736.
7. Yakimenko IL, Sidorik EP, Tsybulin AS. 2011 [Metabolic changes in cells underelectromagnetic radiation of mobile communication systems]. *Ukr Biokhim Zh* (1999).2011 Mar-Apr;83(2):20-28.
8. Consales, C., Merla, C., Marino, C., et al. 2012. Electromagnetic fields, oxidative stressand neurodegeneration. *Int. J. Cell Biol.* 2012: 683897.
9. LaVignera et al 2012 La Vignera S, Condorelli RA, Vicari E, D'Agata R, Calogero AE.2012 Effects of the exposure to mobile phones on male reproduction: a review of theliterature. *J Androl* 33:350-356.
10. Pall, ML. 2013. Electromagnetic fields act via activation of voltage-gated calciumchannels to produce beneficial or adverse effects. *J Cell Mol Med* 17:958-965. DOI:[10.1111/jcmm.12088](https://doi.org/10.1111/jcmm.12088).
11. Naziroğlu M, Yüksel M, Köse SA, Özkaya MO. 2013 Recent reports of Wi-Fi andmobile phone-induced radiation on oxidative stress and reproductive signaling pathwaysin females and males. *J Membr Biol* 246:869-875.
12. Pall, M. L. 2015. Scientific evidence contradicts findings and assumptions of CanadianSafety Panel 6: microwaves act through voltage-gated calcium channel activation toinduce biological impacts at non-thermal levels, supporting a paradigm shift formicrowave/lower frequency electromagnetic field action. *Rev. Environ. Health* 3, 99-116.
13. Yakymenko I, Tsybulin O, Sidorik E, Henshel D, Kyrylenko O, Kysylenko S. 2015Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation. *Electromagnetic Biol Med*: Early Online 1-16. ISSN: 1536-8378.
14. Hensinger P, Wilke E. 2016. Mobilfunk-Studienergebnisse bestätigenRisiken Studienrecherche 2016-4 veröffentlicht. *Umwelt Medizin Gesellschaft*29:3/2016.
15. Houston BJ, Nixon B, King BV, De Iuliis GN, Aitken RJ. 2016 The effects ofradiofrequency electromagnetic radiation on sperm function. *Reproduction* 152:R263-R276.
16. Dasdag S, Akdag MZ. 2016 The link between radiofrequencies emitted from wireless technologies and oxidative stress. *J Chem Neuroanat* 75(Pt B):85-93.
17. Wang H, Zhang X. 2017 Magnetic fields and reactive oxygen species. *Int J Mol Sci*.2017 Oct 18;18(10). pii: E2175. DOI: [10.3390/ijms18102175](https://doi.org/10.3390/ijms18102175).
18. Pall ML. 2018 Wi-Fi is an important threat to human health. *Environ Res* 164:404-416.

19. Wilke I. 2018 Biological and pathological effects of 2.45 GHz on cells, fertility, brainand behavior. Umwelt Medizin Gesselshaft 2018 Feb 31 (1).

Sección 12

Ataque de los CEM al sistema endocrino y a las hormonas.

1. Glaser ZR, PhD. 1971 Naval Medical Research Institute Research Report, June 1971.Bibliography of Reported Biological Phenomena ("Effects") and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation. Report No. 2 Revised.
https://scholar.google.com/scholar?q=Glaser+naval+medical+microwave+radiofrequency+1972&btnG=&hl=en&as_sdt=0%2C38 (Accessed Sept. 9, 2017)
2. Tolgskaya MS, Gordon ZV. 1973. Pathological Effects of Radio Waves, Translated From Russian by B Haigh. Consultants Bureau, New York/London, 146 pages.
3. Raines, J. K. 1981. Electromagnetic Field Interactions with the Human Body: Observed Effects and Theories. Greenbelt, Maryland: National Aeronautics and Space Administration 1981; 116 p.
4. Hardell, L., Sage, C. 2008. Biological effects from electromagnetic field exposure and public exposure standards. Biomed. Pharmacother. 62, 104-109.
5. Makker K, Varghese A, Desai NR, Mouradi R, Agarwal A. 2009 Cell phones: modernman's nemesis? Reprod Biomed Online 18:148-157.
6. Gye MC, Park CJ. 2012 Effect of electromagnetic field exposure on the reproductive system. Clin Exp Reprod Med 39:1-9. <http://www.doi.org/10.5653/cerm.2012.39.1.1>
7. Pall, M. L. 2015. Scientific evidence contradicts findings and assumptions of Canadian Safety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action. Rev. Environ. Health 3, 99-116.
8. Sangün Ö, Dündar B, Çömlekçi S, Büyükgelbiz A. 2016 The Effects of Electromagnetic Field on the Endocrine System in Children and Adolescents. Pediatr Endocrinol Rev13:531-545.
9. Hecht, Karl. 2016 Health Implications of Long-Term Exposures to Electrosmog. Brochure 6 of A Brochure Series of the Competence Initiative for the Protection of Humanity, the Environment and Democracy. http://kompetenzinitiative.net/KIT/wp-content/uploads/2016/07/KI_Brochure-6_K_Hecht_web.pdf (accessed Feb. 11, 2018)
10. Asghari A, Khaki AA, Rajabzadeh A, Khaki A. 2016 A review on Electromagnetic fields (EMFs) and the reproductive system. Electron Physician. 2016 Jul 25;8(7):2655-2662. DOI: [10.19082/2655](https://doi.org/10.19082/2655).
11. Pall ML. 2018 Wi-Fi is an important threat to human health. Environ Res 164:404-416.
12. Wilke I. 2018 Biological and pathological effects of 2.45 GHz on cells, fertility, brain and behavior. Umwelt Medizin Gesselshaft 2018 Feb 31 (1).

Sección 13

Producción de un exceso de calcio intracelular por apertura de los canales de calcio.

1. Adey WR. 1988 Cell membranes: the electromagnetic environment and cancer promotion. Neurochem Res.13:671-677.
2. Walleczek, J. 1992. Electromagnetic field effects on cells of the immune system: the role of calcium signaling. FASEB J. 6, 3177-3185.
3. Adey, WR. 1993 Biological effects of electromagnetic fields. J Cell Biochem 51:410-416.
4. Frey AH. 1993 Electromagnetic field interactions with biological systems. FASEB J7:272-281.
5. Funk RHW, Monsees T, Özkuçur N. 2009 Electromagnetic effects—Form cell biologyto medicine. Prog Histochem Cytochem 43:177-264.
6. Yakymenko IL, Sidorik EP, Tsybulin AS. 1999 [Metabolic changes in cells under electromagnetic radiation of mobile communication systems]. Ukr Biokhim Zh (1999), 2011 Mar-Apr:20-28.

7. Gye MC, Park CJ. 2012 Effect of electromagnetic field exposure on the reproductive system. *Clin Exp Reprod Med* 39:1-9. doi.org/10.5653/cerm.2012.39.1.1
8. Pall, ML. 2013. Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. *J Cell Mol Med* 17:958-965. doi:10.1111/jcmm.12088.
9. Pall ML. 2014 Electromagnetic field activation of voltage-gated calcium channels: rolein therapeutic effects. *Electromagn Biol Med*. 2014 Apr 8 doi:10.3109/15368378.2014.906447.
10. Pall ML. 2015 How to approach the challenge of minimizing non-thermal health effects of microwave radiation from electrical devices. *International Journal of Innovative Research in Engineering & Management (IJIREM)* ISSN: 2350-0557, Volume-2, Issue -5, September 2015; 71-76.
11. Pall, M. L. 2015 Scientific evidence contradicts findings and assumptions of CanadianSafety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action. *Rev. Environ. Health* 3, 99-116. doi: 10.1515/reveh-2015-0001.
12. Pall ML. 2016 Electromagnetic fields act similarly in plants as in animals: Probable activation of calcium channels via their voltage sensor. *Curr Chem Biol* 10: 74-82.
13. Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression. *J Chem Neuroanat* 75(PtB):43-51. DOI: [10.1016/j.jchemneu.2015.08.001](https://doi.org/10.1016/j.jchemneu.2015.08.001).
14. Batista Napotnik T, Reberšek M, Vernier PT, Mali B, Miklavčič D. 2016. Effects of High Voltage Nanosecond Electric Pulses on Eukaryotic Cells (*in vitro*): A Systematic Review. *Bioelectrochemistry*. 2016 Aug;110:1-12. DOI: [10.1016/j.bioelechem.2016.02.011](https://doi.org/10.1016/j.bioelechem.2016.02.011).
15. Asghari A, Khaki AA, Rajabzadeh A, Khaki A. 2016 A review on electromagnetic fields (EMFs) and the reproductive system. *Electron Physician*. 2016 Jul 25;8(7):2655-2662. DOI: [10.19082/2655](https://doi.org/10.19082/2655).

Sección 14

La sensibilidad biológica a la radiación pulsada y sus efectos:

1. Osipov YuA, 1965 [Labor hygiene and the effect of radiofrequency electromagnetic fields on workers]. Leningrad Meditsina Publishing House, 220 pp.
2. Pollack H, Healer J. 1967 Review of Information on Hazards to Personnel from High-Frequency Electromagnetic Radiation. Institute for Defense Analyses; Research and Engineering Support Division. IDA/HQ 67-6211, Series B, May 1967.
3. Frey AH. 1974 Differential biologic effects of pulsed and continuous electromagnetic fields and mechanisms of effect. *Ann N Y Acad Sci* 238: 273-279.
4. Creighton MO, Larsen LE, Stewart-De Haan PJ, Jacobi JH, Sanwal M, Baskerville JC, Bassen HE, Brown DO, Trevithick JR. 1987 In vitro studies of microwave-induced cataract. II. Comparison of damage observed for continuous wave and pulsed microwaves. *Exp Eye Res* 45:357-373.
5. Grigor'ev IuG. 1996 [Role of modulation in biological effects of electromagnetic radiation]. *Radiats Biol Radioecol* 36:659-670.
6. Belyaev I. 2005 Non-thermal biological effects of microwaves. *Microwave Rev* 11:13-29.
7. Belyaev I. 2005 Non-thermal biological effects of microwaves: current knowledge, further perspective and urgent needs. *Electromagn Biol Med* 24(3):375-403.
8. Markov MS. 2007 Pulsed electromagnetic field therapy: History, state of the art and future. *The Environmentalist* 27:465-475.
9. Van Boxem K, Huntoon M, Van Zundert J, Patijn J, van Kleef M, Joosten EA. 2014 Pulsed radiofrequency: a review of the basic science as applied to the pathophysiology of radicular pain: a call for clinical translation. *Reg Anesth Pain Med*. 2014 Mar-Apr;39(2):149-59.
10. Belyaev, I. 2015. Biophysical mechanisms for nonthermal microwave effects. In: *Electromagnetic Fields in Biology and Medicine*, Marko S. Markov, ed, CRC Press, NewYork, pp 49-67.
11. Pall, M. L. 2015 Scientific evidence contradicts findings and assumptions of CanadianSafety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action. *Rev. Environ. Health* 3, 99-116. DOI: [10.1515/reveh-2015-0001](https://doi.org/10.1515/reveh-2015-0001).

12. Panagopoulos DJ, Johansson O, Carlo GL. 2015 Real versus simulated mobile phone exposures in experimental studies. BioMed. Res. Int. 2015, article ID 607053, 8 pages. DOI: [10.1155/2015/607053](https://doi.org/10.1155/2015/607053).
13. Batista Napotnik T, Reberšek M, Vernier PT, Mali B, Miklavčič D. 2016 Effects of high voltage nanosecond electric pulses on eukaryotic cells (in vitro): A systematic review. Bioelectrochemistry. 2016 Aug;110:1-12. DOI: [10.1016/j.bioelechem.2016.02.011](https://doi.org/10.1016/j.bioelechem.2016.02.011).

Sección 15

Inicio del proceso de cancerogénesis mediante diferentes mecanismos de producción de cancer a nivel celular:

1. Dwyer, M. J., Leeper, D. B. 1978 A Current Literature Report on the Carcinogenic Properties of Ionizing and Nonionizing Radiation. DHEW Publication (NIOSH) 78-134, March 1978.
2. Marino AA, Morris DH. 1985 Chronic electromagnetic stressors in the environment. A risk factor in human cancer. J environ sci health C3:189-219.
3. Adey WR. 1988 Cell membranes: the electromagnetic environment and cancer promotion. Neurochem Res.13:671-677.
4. Adey WR. 1990 Joint actions of environmental nonionizing electromagnetic fields and chemical pollution in cancer promotion. Environ Health Perspect 86:297-305.
5. Frey AH. 1993 Electromagnetic field interactions with biological systems. FASEB J7:272-281.
6. Goldsmith JR. 1995 Epidemiological evidence of radiofrequency radiation (microwave) effects on health in military, broadcasting and occupational settings. Int J Occup EnvironHealth 1:47-57.
7. Goldsmith JR. 1997 Epidemiologic evidence relevant to radar (microwave) effects. EnvHealth Perspect 105(Suppl 6):1579-1587.
8. Kundi M, Mild K, Hardell L, Mattsson M. 2004 Mobile telephones and cancer – are view of the epidemiological evidence. J Toxicol Env Health, Part B 7:351-384.
9. Kundi M. 2004 Mobile phone use and cancer. Occup Env Med 61:560-570.
10. Behari J, Paulraj R. 2007 Biomarkers of induced electromagnetic field and cancer. Indian J Exp Biol 45:77-85.
11. Hardell L, Carlberg M, Soderqvist F, Hansson Mild K. 2008 Meta-analysis of long-term mobile phone use and the association with brain tumors. Int J Oncol 32:1097-1103.
12. Khurana VG, Teo C, Kundi M, Hardell L, Carlberg M. 2009 Cell phones and brain tumors: a review including the long-term epidemiologic data. Surg Neurol 72:205-214.
13. Desai NR, Kesari KK, Agarwal A. 2009 Pathophysiology of cell phone radiation: oxidative stress and carcinogenesis with focus on the male reproductive system. Reproduct Biol Endocrinol 7:114.
14. Davanipour Z, Sobel E. 2009 Long-term exposure to magnetic fields and the risks of Alzheimer's disease and breast cancer: Further biological research. Pathophysiology 16:149-156.
15. Yakymenko I, Sidorik E. 2010 Risks of carcinogenesis from electromagnetic radiation and mobile telephony devices. Exp Oncol 32:729-736.
16. Carpenter DO. 2010 Electromagnetic fields and cancer: the cost of doing nothing. Rev Environ Health 25:75-80.
17. Giuliani L, Soffritti M (Eds). 2010 NON-THERMAL EFFECTS AND MECHANISMS OF INTERACTION BETWEEN ELECTROMAGNETIC FIELDS AND LIVING MATTER, RAMAZZINI INSTITUTE EUR. J. ONCOL. LIBRARY Volume 5, National Institute for the Study and Control of Cancer and Environmental Diseases "Bernardino Ramazzini" Bologna, Italy 2010, 400 page monograph.
18. Khurana, V. G., Hardell, L., Everaert, J., Bortkiewicz, A., Carlberg, M., Ahonen, M. 2010 Epidemiological evidence for a health risk from mobile phone base stations. Int. J. Occup. Environ. Health 16, 263-267.
19. Yakymenko, I., Sidorik, E., Kyrylenko, S., Chekhun, V. 2011. Long-term exposure to microwave radiation provokes cancer growth: evidences from radars and mobile communication systems. Exp. Oncol. 33(2), 62-70.

20. Bioinitiative Working Group, David Carpenter and Cindy Sage (eds). 2012 Bioinitiative2012: A rationale for biologically-based exposure standards for electromagnetic radiation. <http://www.bioinitiative.org/participants/why-we-care/>
21. Ledoit G, Belpomme D. 2013 Cancer induction molecular pathways and HF-EMF irradiation. *Adv Biol Chem* 3:177-186.
22. Hardell L, Carlberg M. 2013 Using the Hill viewpoints from 1965 for evaluating strengths of evidence of the risk for brain tumors associated with use of mobile and cordless phones. *Rev Environ Health* 28:97-106. DOI: [10.1515/reveh-2013-0006](https://doi.org/10.1515/reveh-2013-0006).
23. Hardell L, Carlberg M, Hansson Mild K. 2013 Use of mobile phones and cordless phones is associated with increased risk for glioma and acoustic neuroma. *Pathophysiology* 2013;20(2):85-110.
24. Carpenter DO. Human disease resulting from exposure to electromagnetic fields. *Rev Environ Health*. 2013;28(4):159-72. DOI: [10.1515/reveh-2013-0016](https://doi.org/10.1515/reveh-2013-0016). PMID: 24280284.
- Davis DL, Kesari S, Soskolne CL, Miller AB, Stein Y. 2013 Swedish review strengthens grounds for concluding that radiation from cellular and cordless phones is a probable human carcinogen. *Pathophysiology* 20:123-129.
26. Morgan LL, Miller AB, Sasco A, Davis DL. 2015 Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A). *Int J Oncol* 46(5):1865-1871.
27. Mahdavi M, Yekta R, Tackalou SH. 2015 Positive correlation between ELF and RF electromagnetic fields on cancer risk. *J Paramed Sci* 6(3), ISSN 2008-4978.
28. Carlberg M, Hardell L. 2017 Evaluation of Mobile Phone and Cordless Phone Use andGlioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation. *BioMed Res Int* 2017, Article ID 9218486, <https://doi.org/10.1155/2017/9218486>
29. Bortkiewicz A, Gadzicka E, Szymczak W. 2017 Mobile phone use and risk for intracranial tumors and salivary gland tumors - A meta-analysis. *Int J Occup MedEnviron Health* 30:27-43.
30. Bielsa-Fernández P, Rodríguez-Martín B. 2017 [Association between radiation from mobile phones and tumour risk in adults]. *Gac Sanit*. 2017 Apr 12. pii: S0213-9111(17)30083-3. DOI: [10.1016/j.gaceta.2016.10.014](https://doi.org/10.1016/j.gaceta.2016.10.014). [Epub ahead of print]
31. Alegría-Loyola MA, Galnares-Olalde JA, Mercado M. 2017 [Tumors of the central nervous system]. *Rev Med Inst Mex Seguro Soc* 55:330-334.
32. Prasad M, Kathuria P, Nair P, Kumar A, Prasad K. 2017 Mobile phone use and risk of brain tumours: a systematic review of association between study quality, source of funding, and research outcomes. *Neurol Sci*. 2017 Feb 17. DOI: [10.1007/s10072-017-2850-8](https://doi.org/10.1007/s10072-017-2850-8). [Epub ahead of print].
33. Miller A. 2017 References on cell phone radiation and cancer. <https://ehtrust.org/references-cell-phone-radio-frequency-radiation-cancer/> (Accessed Sept. 9, 2017)
34. Hardell L. 2017 World Health Organization, radiofrequency radiation and health – ahard nut to crack (Review). *Int J Oncol* 51:405-413.
35. Pall ML. 2018 How cancer can be caused by microwave frequency electromagnetic field (EMF) exposures: EMF activation of voltage-gated calcium channels (VGCCs) can cause cancer including tumor promotion, tissue invasion and metastasis via 15mechanisms. Chapter 7 in: *Mobile Communications and Public Health*, Marko Markov, Ed., CRC Press, pp 163-184.

Sección 16

Autismo:

1. Hallmayer, Joachim, et al. "[Genetic heritability and shared environmental factors among twin pairs with autism.](#)" *Archives of general psychiatry* 68.11 (2011): 1095-1102.
2. Herbert, Martha, and Karen Weintraub. *The Autism Revolution: whole-body strategies for making life all it can be*. Ballantine Books, 2013.
3. Herbert, Martha R., and Cindy Sage. "[Autism and EMF? Plausibility of a pathophysiological link–Part I](#)." *Pathophysiology* 20.3 (2013): 191-209.

4. Herbert, Martha R., and Cindy Sage. "[Autism and EMF? Plausibility of a pathophysiological link Part II.](#)" *Pathophysiology* 20.3 (2013): 211-234.
5. Pall, M.L., [Microwave frequency electromagnetic fields \(EMFs\) produce widespread neuropsychiatric effects including depression](#), *Journal of Chemical Neuroanatomy* (2015).
6. Pall, Martin L. "[Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects.](#)" *Journal of cellular and molecular medicine* 17.8 (2013): 958-965.
7. Windham, Gayle C., Karen Fessel, and Judith K. Grether. "[Autism spectrum disorders in relation to parental occupation in technical fields.](#)" *Autism Research* 2.4 (2009): 183-191.
8. Klinghardt, Dietrich, MD. Pilot Study: "[Autism May Be Linked to Electromagnetic Radiation Levels in Mother's Bedroom During Pregnancy](#)". 2008.
9. Klinghardt, Dietrich, MD. "[Autism: Multifactorial causation and corresponding treatment modalities](#)" (Conference Presentation). 2015.
10. Dunckley, Victoria L. [Reset Your Child's Brain: A Four-Week Plan to End Meltdowns, Raise Grades, and Boost Social Skills by Reversing the Effects of Electronic Screen-Time.](#) New World Library, 2015.

Sección 17

Efecto de los Campos Electromagnéticos en el medio ambiente y la vida silvestre. Daño producido a diferentes animales, aves migratorias, insectos, en particular a los polinizadores y a las plantas.

Trabajo de revisión: *A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF) by S. Cucurachi ^a, W.L.M. Tamis ^a, M.G. Vijver ^a, W.J.G.M. Peijnenburg ^{a,b}, J.F.B. Bolte ^b, G.R. de Snoo ^a*

^a Institute of Environmental Sciences (CML), Leiden University, P.O. Box 9518, 2300 RA Leiden, The Netherlands

^b National Institute for Public Health and the Environment (RIVM), Bilthoven, The Netherlands

Environment International, journal homepage: www.elsevier.com/locate/envint. (Received 18 June 2012

Accepted 24 October 2012, Available online 20 December 2012)

1. Abraçado LG, Esquivel DMS, Alves OC, Wajnberg E. Magnetic material in head, thorax, and abdomen of *Solenopsis substituta* ants: a ferromagnetic resonance study. *J Magn Reson* 2005; 175:309–16.
2. Adair ER. Thermophysiological effects of electromagnetic radiation. In: Gandhi OP, editor. *Biological effects and medical applications of electromagnetic energy*. Englewood Cliffs, NJ: Prentice Hall; 1990.
3. Aldad TS, Gan G, Gao XB, Taylor HS. Fetal radiofrequency radiation exposure from 800–1900 MHz-rated cellular telephones affects neurodevelopment and behavior in mice. *Sci Rep* 2012; 2:312.
4. Balmori A. Possible effects of electromagnetic fields from phone masts on a population of White stork (*Ciconia ciconia*). *Electromagn Biol Med* 2005; 24:109–19.
5. Balmori A. Electromagnetic pollution from phone masts. Effects on wildlife. *Pathophysiology* 2009; 16 (2–3): 191–9.
6. Balmori A. Mobile phone mast effects on common frog (*Rana temporaria*) tadpoles: the city turned into a laboratory. *Electromagn Biol Med* 2010; 29: 31–5.16 – Animales y plantas
7. Balmori A, Hallberg Ö. The urban decline of the house sparrow (*Passer domesticus*): a possible link with electromagnetic radiation. *Electromagn Biol Med* 2007; 26:141–51.
8. Balmori, A. (2008). Amphibians: eggs and tadpoles of common frog. Retrieved 12 May 2010 from: <http://www.hese-project.org/hese-uk/en/issues/nature.php?id>

9. Balmori, A. (2006). The incidence of electromagnetic pollution on the amphibian decline: Is this an important piece of the puzzle? *Toxicol. & Environ. Chem.* 88:287–299.
10. Blaustein, A. R., Johnson, P. T. J. (2003). Explaining frog deformities. *Sci. Am.* 288:60–65.
11. Denegre, J. M., Valles, J. M., Lin, K., Jordan, W. B., Mowry, K. L. (1998). Cleavage planes in frog eggs are altered by strong magnetic fields. *Proc. Nat. Acad. Sci.* 95:14729–14732.
12. Grefner, N. M., Yakovleva, T. L., Boreysha, I. K. (1998). Effects of electromagnetic radiation on tadpole development in the common frog (*Rana temporaria* L.). *Russian J. Ecol.* 29:133–134.
13. Hotary, K. B., Robinson, K. R. (1992). Evidence of a role for endogenous electrical fields in chick embryo development. *Development* 114:985–996.
14. Landesman, R. H., Douglas, W. S. (1990). Abnormal limb regeneration in adult newts exposed to a pulsed electromagnetic field. *Teratology* 42:137–145.
15. Levengood, W. C. (1969). A new teratogenic agent applied to amphibian embryos. *J. Embryol. Exp. Morphol.* 21:23–31.
16. Warnke, U. (2007). Bees, birds and mankind. Destroying nature by “electrosmog.” Competence Initiative, 46 pp.
17. Balodis VG, Brumelis K, Kalviskis O, Nikodemus D, Tjarve VZ. Does the Skrundra radio location station diminish the radial growth of pine trees? *Sci Total Environ* 1996;180: 57–64.
18. Baranski S, Czerski P. Biological effects of microwaves. Stroudsburg: Dowden, Hutchinson & Ross; 1976.
19. Bastide M, Youbicier-Simo BJ, Lebecq JC, Gaimis J. Toxicological study of electromagnetic radiation emitted by television and video display screens and cellular telephones on chickens and mice. *Indoor Built Environ* 2001; 10: 291–8.
20. Batellier F, Couty I, Picard D, Brillard JP. Effects of exposing chicken eggs to a cell phone in ‘call’ position over the entire incubation period. *Theriogenology* 2008;69: 737–45.
21. Beers J. Biological effects of weak electromagnetic fields from 0 Hz to 200 MHz: a survey of the literature with special emphasis on possible magnetic resonance effects. *Magn Reson Imaging* 1989; 7:309–31.
22. Begon M, Townsend CR, Harper JL. Ecology: from individuals to ecosystems. 4th ed. Hoboken, New Jersey, USA: Wiley-Blackwell; 2005.
23. Berman E, Kinn JB, Carter HB. Observations of mouse foetuses after irradiation with 2.45 GHz microwaves. *Health Phys* 1978; 35:791–801.
24. Berman E, Carter HB, House D. Tests of mutagenesis and reproduction in male rats exposed to 2,450-MHz (CW) microwaves. *Bioelectromagnetics* 1980; 1:65–76.
25. Berman E, Weil C, Phillips PA, Carter HB, House DE. Foetal and maternal effects of continual exposure of rats to 970-MHz circularly-polarized microwaves. *Electro Magnetobiol* 1992;11(1):43–54.
26. Bornhausen M, Scheingraber H. Prenatal exposure to 900 MHz cell phone electro-magnetic fields had no effect on operant-behaviour performances of adult rats. *Bioelectromagnetics* 2000; 21:566–74.
27. Bouji M, Lecomte A, Hode Y, de Seze R, Villegier AS. Effects of 900 MHz radiofrequency on corticosterone, emotional memory and neuroinflammation in middle-aged rats. *Exp Gerontol* 2012;47(6):444–51.
28. Bryan TE, Gildersleeve RP. Effects of nonionizing radiation on birds. *Comp Biochem Physiol* 1988; 89:511–30.
29. Byman D, Battista SP, Wasserman FE, Kunz TH. Effect of microwave irradiation (2.45 GHz, CW) on egg weight loss, egg hatchability, and hatching growth of the *Coturnix* quail. *Bioelectromagnetics* 1985; 6:271–82.
30. Cabe PA, McRee DI. Behavioral teratological effects of microwave radiation in Japanese quail (*Coturnix coturnix japonica*). An exploratory study. *Neurobehav Toxicol* 1980;2: 291–6.
31. Cammaerts MC, De Doncker P, Patris X, Bellens F, Rachidi Z, Cammaerts D. GSM 900 MHz radiation inhibits ants' association between food sites and encountered cues. *Electromagn Biol Med* 2012;31(2):151–65.

32. Carpenter RL, Biddle DK, Van Ummersen CA. Biological effects of microwave radiation with particular reference to the eye. Proceedings of the Third International Conference on Medical Electronics. London: Medical Electronics; 1960. p. 401–8.
33. Cassel JC, Cosquer B, Galani R, Kuster N. Whole-body exposure to 2.45 GHz electromagnetic fields does not alter radial-maze performance in rats. *Behav Brain Res* 2004;155: 37–43.
34. Chen G, Lu D, Chiang H, Leszczynski D, Xu Z. Using model organism *Saccharomyces cerevisiae* to evaluate the effects of ELF-MF and RF-EMF exposure on global gene expression. *Bioelectromagnetics* 2012;33(7):550–60.
35. Chernovetz ME, Justesen DR, King NW, Wagner JE. Teratology, survival, and reversal learning after foetal irradiation of mice by 2450-MHz microwave energy. *J Microw Power* 1975;10(4):391–409.
36. Clarke RL, 1978. Behavioral, ethological, and teratological effects of electromagnetic radiation on an avian species. Ph.D. dissertation Department of Psychology, University of Kansas.
37. Cobb BL, Jauchem JR, Adair ER. Radial arm maze performance of rats following repeated low level microwave radiation exposure. *Bioelectromagnetics* 2004; 25:49–57.
38. Cosquer B, Galani R, Kuster N, Cassel JC. Whole-body exposure to 2.45 GHz electromagnetic fields does not alter anxiety responses in rats: a plus-maze study including test validation. *Behav Brain Res* 2005;156(1):65–74.
39. Collins D, Smith C. 3G Wireless Networks. McGraw-Hill; 2001.
40. Crutzen PJ, Stoermer EF. The Anthropocene. *Glob Change Newslett* 2000; 41:17–8.
41. D'Andrea JA, Cobb BL, de Lorge JO. Lack of behavioral effects in the rhesus monkey: high peak microwave pulses at 1.3 GHz. *Bioelectromagnetics* 1989;10(1):65–76.
42. Daniells C, Duce I, Thomas D, Sewell P, Tattersall J, de Pomerai DI. Transgenic nematodes as biomonitoring of microwave-induced stress. *Mutat Res* 1998;399(1): 55–64.
43. Daniels WM, Pitout IL, Afullo TJ, Mabandla MV. The effect of electromagnetic radiation in the mobile phone range on the behaviour of the rat. *Metab Brain Dis* 2009;24(4):629–41.
44. Dasdag S, Akdag MZ, Ulukaya E, Uzunlar AK, Yegin D. Mobile phone exposure does not induce apoptosis on spermatogenesis in rats. *Arch Med Res* 2008;39(1): 40–4.
45. Davidson JA, Kondra PA, Hamid MAK. Effects of microwave radiation on eggs, embryos and chickens. *Can J Anim Sci* 1976; 56:709–13.
46. de Pomerai DI, Dawe A, Djerbib L, Allan J, Brunt G, Daniells C. Growth and maturation of the nematode *Caenorhabditis elegans* following exposure to weak microwave fields. *Enzyme Microb Technol* 2002;30(1):73–9.
47. Dulbinskaya DA. Effect of constant magnetic field on growth of maize seedlings. *Fiziol Rast* 1973;20(1):183–6.
48. Egger M, Davey-Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple graphical test. *BMJ* 1997; 315:629–34.
49. EU. The potential dangers of electromagnetic fields and their effect on the environment — report of the committee on the Environment, Agriculture and Local and Regional Affairs. available online at <http://assembly.coe.int/documents/workingdocs/doc11/edoc12608.pdf> 2011. [last accessed 18 April 2012].
50. EU Commission implantation Reports. Report on the implementation of the Council Recommendation on the limitation of exposure of the general public to electromagnetic fields (0 Hz–300 GHz). available online at 2008. https://ec.europa.eu/health/archive/ph_determinants/environment/emf/implement_rep_en.pdf [last accessed 18 April 2012].
51. Everaert J, Bauwens D. A possible effect of electromagnetic radiation from mobile phone base stations on the number of breeding house sparrows (*Passer domesticus*). *Electromagn Biol Med* 2007; 26:63–72.

52. Favre D. Mobile phone-induced honeybee worker piping. *Apidologie* 2011; 42:270–9. Fisher PD, Lauber JK, Voss WAG. The effect of low-level 2450-MHz CW microwave radiation and body temperature on early embryonic development in chickens. *Radio Sci* 1979; 14:159–63.
53. Foster KR, Repacholi MH. Biological effects of radiofrequency fields: does modulation matter? *Radiat Res* 2004; 162:219–25.
54. Fragopoulou AF, Miltiadous P, Stamatakis A, Stylianopoulou F, Koussoulakos SL, Margaritis LH. Whole body exposure with GSM 900 MHz affects spatial memory in mice. *Pathophysiology* 2010; 17:179–87.
55. Gallai N, Salles JM, Settele J, Vaissieres BE. Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. *Ecol Econ* 2009; 68:810–21. Gathiram P, Kistnasamy B, Laloo U. Effects of a unique electromagnetic field system on the fertility of rats. *Arch Environ Occup Health* 2009;64(2):93-100.
56. Giarola AJ, Krueger WF. Continuous exposure of chicks and rats to electromagnetic fields. *IEEE Trans Microwave Theory Tech* 1974; 22:432–7.
57. Gildersleeve RP, Galvin MJ, McRee DI, Thaxton JP, Parkhurst CR. Reproduction of Japanese quail after microwave irradiation during embryogeny. *Bioelectromagnetics* 1987; 8:9-21.
58. Glaser PE. Power from the sun: its future. *Science* 1968; 162:857–86.
59. Gos P, Eicher B, Kohli J, Heyer WD. No mutagenic or recombinogenic effects of mobile phone fields at 900 MHz detected in the yeast *Saccharomyces cerevisiae*. *Bioelectromagnetics* 2000;21(7):515–23.
60. Grigoryev Y. Biological effects of mobile phone electromagnetic field on chick embryo
61. (risk assessment using the mortality rate). *Radiats Biol Radioecol* 2003; 43:541–3. Grospietsch T, Schulz O, Hoelzel R, Lamprecht I, Kramer KD. Stimulating effects of mod-
62. ulated 150 MHz electromagnetic fields on the growth of *Escherichia coli* in a cavity resonator. *Bioelectrochem Bioenerg* 1995;37(1):17–23.
63. Haider T, Knasmueller S, Kundi M, Haider M. Clastogenic effects of radiofrequency radiation on chromosomes of *Tradescantia*. *Mutat Res* 1994; 324:65–8.
64. Hamrick PE, McRee DI. Exposure of the Japanese quail embryo to 2.45 GHz microwave radiation during the second day of development. *J Microw Power* 1975; 10:211–21.
65. Hao D, Yang L, Chen S, Tong J, Tian Y, Su B, et al. Effects of long-term electromagnetic field exposure on spatial learning and memory in rats. *Neurol Sci* 2012;1–8.
66. Harst W, Kuhn J, Stever H. Can electromagnetic exposure cause a change in behavior? Studying possible non thermal influences on honey bees — an approach within the framework of educational informatics. *Acta Systematica — IIAS Int J* 2006; 6:1–6.
67. M. Hässig¹, F. Jud², H. Naegeli³, J. Kupper³, B. M. Spiess². Prevalence of nuclear cataract in Swiss veal calves and its possible association with mobile telephone antenna base stations 1 Section for Herd Health, 2 Section for Veterinary Ophthalmology and 3 Institute of Veterinary Pharmacology and Toxicology, University of Zürich
68. 1 Section for Herd Health, 2Section for Veterinary Ophthalmology and 3Institute of Veterinary Pharmacology and Toxicology, University of Zürich
69. Higgins JPT, Green S, editors. *Cochrane handbook for systematic reviews of intervention*. Chichester, UK: John Wiley & Sons; 2006.
70. Hills GA, Kondra PA, Hamid MAK. Effects of microwave radiations on hatchability and growth in chickens and turkeys. *Can J Ani Sci* 1974; 54:573–8.
71. ICNIRP (International Commission on Non-ionising Radiation Protection). Statement— guidelines for limiting exposure to time-varying electric, magnetic, and electromag- netic fields (1 Hz–100 kHz). *Health Phys* 2010; 99:818–36.
72. ICNIRP (International Commission on Non-Ionizing Radiation Protection). Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). *Health Phys* 1998;74(4):494–522.

73. Imai N, Kawabe M, Hikage T, Nojima T, Takahashi S, Shirai T. Effects on rat testis of 1.95-GHz W-CDMA for IMT-2000 cellular phones. *Syst Biol Reprod Med* 2011; 57(4):204–9.
74. Inouye M, Galvin MJ, McRee DI. Effects of 2.45 GHz microwave radiation on the development of Japanese quail cerebellum. *Teratology* 1982; 25:115–21.
75. Jensch RP. Behavioral teratological studies using microwave radiation: is there an increased risk from exposure to cellular phones and microwave ovens? *Reprod Toxicol* 1997; 11:601–11.
76. Jensch RP, Weinberg I, Brent RL. Teratologic studies of prenatal exposure of rats to 915-MHz microwave radiation. *Radiat Res* 1982; 92:160–71.
77. Jiang B, Nie J, Zhou Z, Zhang J, Tong J, Cao Y. Adaptive response in mice exposed to 900 MHz radiofrequency fields: primary DNA damage. *PLoS One* 2012;7(2): e32040.
78. Jinapang P, Prakob P, Wongwattananard P, Islam NE, Kirawanich P. Growth characteristics of mung beans and water convolvulus exposed to 425-MHz electromagnetic fields. *Bioelectromagnetics* 2010;31(7):519.
79. JRC WEB (Journal Citation Reports). Thomson Reuters. available online at http://thomsonreuters.com/products_services/science/science_products/a-z/journal_citation_reports/2012 . [last accessed 14 April 2012].
80. Juutilainen J. Developmental effects of electromagnetic fields. *Bioelectromagnetics* 2005; 7:107–15.
81. Keeton WT. Magnets interfere with pigeon homing. *Proc Natl Acad Sci* 1971; 68:102–6. Kesari KK, Kumar S, Behari J. 900-MHz microwave radiation promotes oxidation in rat brain. *Electromagn Biol Med* 2011; 30(4):219–34.
82. Khillare B, Behari J. Effect of amplitude-modulated radiofrequency radiation on reproduction pattern in rats. *Electro Magnetobiol* 1998;17(1):43–55.
83. Kimmel S, Kuhn J, Harst W, Stever H. Effects of electromagnetic exposition on the behavior of the honeybee (*Apis mellifera*). *Environ Syst Res* 2007; 8:1–6.
84. Kirschvink JL, Walker MM, Diebel C. Magnetite-based magnetoreception. *Curr Opin Neurobiol* 2001; 11:462–7.
85. Klein AM, Vaissière B, Cane JH, Steffan-Dewenter I, Cunningham SA, Kremen C, et al. Importance of crop pollinators in changing landscapes for world crops. *Proc R Soc Lond Ser* 2007; 274:303–13.
86. Kleinhaus S, Pinshow B, Frumkin R. Thermal effects of short radio-waves on migrating birds. *Ecol Appl* 1995; 5:672–9.
87. Klug S, Hetscher M, Giles S, Kohlsman S, Kramer K. The lack of effects of nonthermal RF electromagnetic fields on the development of rat embryos grown in culture. *Life Sci* 1997; 61:1789–802.
88. Knight K. Cockroaches use radical pair mechanism to detect magnetism. *J Exp Biol* (2009) 212 (21): iii. <https://doi.org/10.1242/jeb.038935>.
89. Kowalcuk CI, Saunders RD, Stapleton HR. Sperm count and sperm abnormality in male mice after exposure to 2.45 GHz microwave radiation. *Mutat Res Lett* 1983;122(2): 155–61.
90. Krizaj D, Valencic V. The effect of ELF magnetic fields and temperature on differential plant growth. *J Bioelec* 1989;8(2):159–65.
91. Krueger WF, Giarola AJ, Bradley JW, Shrekenhamer A. Effects of electromagnetic fields on fecundity in the chicken. In: Tyler P, editor. *Biologic effects of nonionizing radiation*. Ann. N.Y. Acad. Sci. New York: New York Academy of Sciences; 1975. p. 391–400.
92. Kumar NR, Sangwan S, Badotra P. Exposure to cell phone radiations produces biochemical changes in worker honey bees. *Toxicol Int* 2011;18(1):70–2.
93. Kumlin T, Iivonen H, Miettinen P, Junova A, van Groen T, Puranen L, et al. Mobile phone radiation and the developing brain: behavioral and morphological effects in juvenile rats. *Radiat Res* 2007; 168:471–9.

95. Kwak MM, Velterop O, Van Andel J. Pollen and gene flow in a fragmented habitat. *Appl Veg Sci* 1998; 1:37–54.
96. Lai H, Horita A, Guy AW. Microwave irradiation affects radial-arm maze performance in the rat. *Bioelectromagnetics* 1994; 15:95-104.
97. Lary JM, Conover DL, Johnson PH. Absence of embryo-toxic effects from low-level (nonthermal) exposure of rats to 100 MHz radiofrequency radiation. *Scand J Work Environ Health* 1983;9(2):120–7.
98. Lebovitz RM, Johnson L, Samson WK. Acute, whole-body microwave exposure and testicular function of rats. *Bioelectromagnetics* 1987a; 8(1):37–43.
99. Lebovitz RM, Johnson L, Samson WK. Effects of pulse-modulated microwave radiation
100. and conventional heating on sperm production. *J Appl Physiol* 1987b;62(1):245–52. Lee HJ, Lee JS, Pack JK, Choi HD, Kim N, Kim SH, et al. Lack of teratogenicity after combined exposure of pregnant mice to CDMA and WCDMA radiofrequency electromagnetic fields. *Radiat Res* 2009; 172(5):648–52.
101. Lee HJ, Jin YB, Kim TH, Pack JK, Kim N, Choi HD, et al. The effects of simultaneous com- bined exposure to CDMA and WCDMA electromagnetic fields on rat testicular function. *Bioelectromagnetics* 2012; 33(4):356–64.
102. Liedvogel M, Mouritsen H. Cryptochromes — a potential magnetoreceptor: what do we know and what do we want to know? *J R Soc Interface* 2010; 7(2):147–62.
103. Magone I. The effect of electromagnetic radiation from the Skrunda Radio Location Station on Spirodela polyrhiza (L.) Schleiden cultures. *Sci Total Environ* 1996;180: 75–80.
104. Magras IN, Xenos TD. RF radiation-induced changes in the prenatal development of mice. *Bioelectromagnetics* 1997; 18:455–61.
105. Mailankot M, Kunnath AP, Jayalekshmi H, Koduru B, Valsalan R. Radio frequency elec- tromagnetic radiation (RF-EMR) from GSM (0.9/1.8GHz) mobile phones induces oxidative stress and reduces sperm motility in rats. *Clinics* 2009;6(6):561–5.
106. Maskey D, Kim M, Aryal B, Pradhan J, Choi IY, Park KS, et al. Effect of 835 MHz radiofrequency radiation exposure on calcium binding proteins in the hippocampus of the mouse brain. *Brain Res* 2010; 1313:232–41.
107. Mathur R. Effect of chronic intermittent exposure to AM radiofrequency field on responses to various types of noxious stimuli in growing rats. *Electromagn Biol Med* 2008;27(3):266–76.
108. McRee DI, Hamrick PE. Exposure of Japanese quail embryos to 2.45 GHz microwave radiation during development. *Radiat Res* 1977; 71:355–66.
109. McRee DI, Hamrick PE, Zinki J, Thaxton P, Parkhurst CR. Some effects of exposure of the Japanese quail embryo to 2.45 GHz microwave radiation. *Ann N Y Acad Sci* 1975; 247:377–90.
110. McRee DI, Thaxton JP, Parkhurst CR. Reproduction in male Japanese quail exposed to microwave radiation during embryogeny. *Radial. Res.* 1983; 96:51–8.
111. Michaelson SM. Biological effects of radiofrequency radiation: concepts and criteria. *Health Phys* 1991;61(1):3-14.
112. Michaelson SM, Dodge CH. Soviet views on the biological effects of microwaves and analysis. *Health Phys* 1971; 21:108–11.
113. Morris R. Developments of a water-maze procedure for studying spatial learning in the rat. *J Neurosci Methods* 1984;11(1):47–60.
114. Nawrot PS, McRee DI, Galvin MJ. Teratogenic, biochemical, and histological studies with mice prenatally exposed to 2.45-GHz microwave radiation. *Radiat Res* 1985;102(1): 35–45.
115. NCRP. Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields. National Council for Radiation Protection and Measurements; 1986. 400 pp.

116. Nicholls B, Racey PA. The aversive effect of electromagnetic radiation on foraging bats: a possible means of discouraging bats from approaching wind turbines. *PLoS One* 2009;4(7): e6246. <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0006246>
117. Nikolova T, Czyz J, Rolletschek A, Blysaczuk P, Fuchs J, Jovtchev G, et al. Electromagnetic fields affect transcript levels of apoptosis-related genes in embryonic stem cell-derived neural progenitor cells. *FASEB J* 2005; 19:1686–8.
118. Nittby H, Grafström G, Tian DP, Malmgren L, Brun A, Persson BRR, et al. Cognitive impairment in rats after long-term exposure to GSM-900 mobile phone radiation. *Bioelectromagnetics* 2008; 29:219–32.
119. Nittby H, Moghadam MK, Sun W, Malmgren L, Eberhardt J, Persson BR, et al. Analgetic effects of non-thermal GSM-1900 radiofrequency electromagnetic fields in the land snail *Helix pomatia*. *Int J Radiat Biol* 2012;88(3):245–52.
120. Odemer Richard, Odemer Franziska, Effects of radiofrequency electromagnetic radiation (RF-EMF) on honey bee queen development and mating success. University of Hohenheim, Apicultural State Institute, 70593 Stuttgart, Germany. - Science of the Total Environment/journal homepage: www.elsevier.com/locate/scitotenv - 2019 Elsevier B.V. Editor: Henner Hollert
121. Ozlem Nisbet OH, Nisbet C, Akar A, Cevik M, Onder Karayigit M. Effects of exposure to electromagnetic field (1.8/0.9GHz) on testicular function and structure in growing rats. *Res Vet Sci* 2012;93(2):1001–5.
122. Panagopoulos DJ. Effect of microwave exposure on the ovarian development of *Drosophila melanogaster*. *Cell Biochem Biophys* 2012;63(2):121–32.
123. Panagopoulos DJ, Margaritis LH. The effect of exposure duration on the biological activity of mobile telephony radiation. *Mutat Res* 2010;699(2):17–22.
124. Panagopoulos DJ, Karabarounis A, Margaritis LH. Effect of GSM 900 MHz mobile phone radiation on the reproductive capacity of *Drosophila melanogaster*. *Electromagn Biol Med* 2004; 23:29–43.
125. Panagopoulos DJ, Chavdoula ED, Karabarounis A, Margaritis LH. Comparison of bioactivity between GSM 900 MHz and DCS 1800 MHz mobile telephony radiation. *Electromagn Biol Med* 2007; 26:33–44.
126. Panagopoulos DJ, Chavdoula ED, Margaritis LH. Bioeffects of mobile telephony radiation in relation to its intensity or distance from the antenna. *Int J Radiat Biol* 2010;86(5):345–57.
127. Peters JL, Sutton AJ, Jones DR, Abrams KR, Rushton L. Comparison of two methods to detect publication bias in meta-analysis. *JAMA* 2006; 295:676–80.
128. Peters JL, Sutton AJ, Jones DR, Abrams KR, Rushton L. Contour-enhanced meta-analysis funnel plots help distinguish publication bias from other causes of asymmetry. *J Clin Epidemiol* 2008; 61:991–6.
129. Pittman UJ. Magnetism and plant growth. Effect on germination and early growth of corn and beans. *Can J Plant Sci* 1965; 45:549–55.
130. Pouletier de Gannes F, Haro E, Hurtier A, Taxile M, Athane A, Ait-Aissa S, et al. Effect of in utero Wi-Fi exposure on the pre- and postnatal development of rats. *Res. B. Dev. Reprod. Toxicol.* 2012;95(2):130–6.
131. Pourlis AF. Reproductive and developmental effects of EMF in vertebrate animal models. *Pathophysiology* 2009; 16:179–89.
132. Ratnieks FLW, Carreck NL. Clarity on honey bee collapse? *Science* 2010; 327:152–3. Reijt L, Mazgajski T, Kubacki R, Kieliszek J, Sobczewska E, Szmigelski S. Influence of radar
133. radiation on breeding biology of tits (*Parus sp*). *Electromagn Biol Med* 2007; 26:235–8. Repacholi MH, Cardis E. Criteria for EMF health risk assessment. *Radiat Prot Dosim*
134. 1997; 72:305–12.
135. Ribeiro EP, Rhoden EL, Horn MM, Rhoden C, Lima LP, Toniolo L. Effects of sub chronic exposure to radio frequency from a conventional cellular telephone on testicular function in adult rats. *J Urol* 2007; 177:395–9.
136. Ritz T, Dommer DH, Phillips JB. Shedding light on vertebrate magnetoreception. *Neuron* 2002; 34:503–6.

137. Roux D, Vian A, Girard S, Bonnet P, Paladian F, Davies E, et al. Electromagnetic fields (900 MHz) evoke consistent molecular responses in tomato plants. *Physiol Plant* 2006; 128:283–8.
138. Roux D, Vian A, Girard S, Bonnet P, Paladian F, Davies E, et al. High frequency (900 MHz) low amplitude (5 V m⁻¹) electromagnetic field: a genuine environmental stimulus that affects transcription, translation, calcium and energy charge in tomato. *Planta* 2007; 227:883–91.
139. Ružić R, Jerman I, Gogala N. Water stress reveals effects of ELF magnetic fields on the growth of seedlings. *Electro Magnetobiol* 1998; 17:17–30.
140. Sahib SS. Impact of mobile phones on the density of honeybees. *J Public Adm Policy Res* 2011;3(4):131.
141. Salama N, Kishimoto T, Kanayama HO. Effects of exposure to a mobile phone on testicular function and structure in adult rabbit. *Int J Androl* 2010a;33(1):88–94.
142. Salama N, Kishimoto T, Kanayama HO, Kagawa S. Effects of exposure to a mobile phone on sexual behavior in adult male rabbit: an observational study. *Int J Impot Res* 2010b;22(2):127–33.
143. Salford LG, Brun AE, Eberhardt JL, Malmgren L, Persson BRR. Nerve cell damage in mammalian brain after exposure to microwaves from GSM mobile phones. *Environ Health Perspect* 2003; 7:881–3.
144. Sarookhani MR, Asiabanza Rezaei M, Safari A, Zaroushani V, Ziaeihā M. The influence of 950 MHz magnetic field (mobile phone radiation) on sex organ and adrenal functions of male rabbits. *Afr J Biochem Res* 2011;5(2):65–8.
145. Savostin PW. Magnetic growth relations in plants. *Planta* 1930; 12:327.
146. SCENIHR (Scientific Committee on Emerging and Newly Identified Health Risks). Health effects of exposure to EMF European Commission. Available online at http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_022.pdf_2008. [last accessed: 18 April 2012].
147. Schacker M. A spring without bees: how colony collapse disorder has endangered our food supply. Guilford: Globe Pequot; 2008.
148. Schmutz P, Siegenthaler J, Staeger C, Tarjan D, Bucher JB. Long-term exposure of young spruce and beech trees to 2450-MHz microwave radiation. *Sci Total Environ* 1996;180(1):43–8.
149. Schwartz JL, Philogene BJR, Stewart JG, Mealing GA, Duval FM. Chronic exposure of the tobacco hornworm to pulsed microwaves — effects of development. *J Microw Power* 1985;20(3):85–93.
150. Selga T, Selga M. Response of *Pinus sylvestris* L. needles to electromagnetic fields. Cyto- logical and ultra-structural aspects. *Sci Total Environ* 1996; 180:65–73.
151. Sharma VP, Kumar NR. Changes in honeybee behaviour and biology under the influence of cell phone radiations. *Curr Sci* 2010; 98:1376–8.
152. Sharma VP, Singh HP, Kohli RK, Batish DR. Mobile phone radiation inhibits *Vigna radiata* (mung bean) root growth by inducing oxidative stress. *Sci Total Environ* 2009;407(21):5543–7.
153. Sherry CJ, Blick DW, Walters TJ, Brown GC, Murphy MR. Lack of behavioral effects in non-human primates after exposure to ultra-wideband electromagnetic radiation in the microwave frequency range. *Radiat Res* 1995;143(1):93–7.
154. Sienkiewicz ZJ, Blackwell RP, Haylock RG, Saunders RD, Cobb BL. Low-level exposure to pulsed 900 MHz microwave radiation does not cause deficits in the performance of a spatial learning task in mice. *Bioelectromagnetics* 2000;21(3):151–8.
155. Soltani F, Kashi A, Arghavani M. Effect of magnetic field on *Asparagus officinalis* L seed germination and seedling growth. *Seed Sci Technol* 2006; 34(2):349–53.
156. Sommer AM, Grote K, Reinhardt T, Streckert J, Hansen V, Lerchl A. Effects of radiofrequency electromagnetic fields (UMTS) on reproduction and development of mice: a multi-generation study. *Radiat Res* 2009;171(1):89–95.

157. Stam R. Electromagnetic fields and the blood–brain barrier. *Brain Res Rev* 2010; 65:80–97. Tanner JA. Effect of microwave on birds. *Nature* 1966; 210:636.
158. Tanner JA, Romero-Sierra C. Beneficial and harmful accelerated growth induced by the action of nonionizing radiation. *Ann N Y Acad Sci* 1974; 238:171–5.
159. Thalau P, Ritz T, Stapput K, Wiltschko R, Wiltschko W. Magnetic compass orientation of migratory birds in the presence of a 1.315 MHz oscillating field. *Naturwissenschaften* 2005; 92:86–90.
160. Tkalec M, Malarić K, Pevalek-Kozlina B. Influence of 400, 900 and 1900 MHz electromagnetic fields on *Lemna minor* growth and peroxidase activity. *Bioelectromagnetics* 2005; 26:185–93.
161. Tkalec M, Malarik K, Pevalek-Kozlina B. Exposure to radiofrequency radiation induces oxidative stress in duckweed *Lemna minor*. *Sci Total Environ* 2007; 388:78–89.
162. Urech M, Eicher B, Siegenthaler J. Effects of microwave and radio frequency electromagnetic fields on lichens. *Bioelectromagnetics* 1996; 17:327–34.
163. Ursache M, Mindru G, Creangă DE, Tufescu FM, Goiceanu C. The effects of high frequency
164. electromagnetic waves on the vegetal organisms. *Rom J Physiol* 2009;54(1):133–45. U.S. Department of Energy. A Selective Review of the Literature on Biological Effects of
165. Microwaves in Relation to the Satellite Power System (SPS). USA: U.S. Department of Energy; 1978 (Available online at: <http://www.osti.gov/bridge/index.jsp>, last accessed 12 July 2012).
166. Vacha M, Puzova T, Kvicalova M. Radio frequency magnetic fields disrupt magnetoreception in American cockroach. *J Exp Biol* 2009; 212(Pt 21):3473–7.
167. Van Deventer E, van Rongen E, Saunders R. WHO research agenda for radiofrequency fields. *Bioelectromagnetics* 2011; 32:417–42.
168. Van Ummersen CA. The effect of 2450 MHz radiation on the development of the chick embryo. Proceedings of the 4th tri-service conference biological effects of micro- wave radiation, vol. 1. N. Y: Plenum; 1961. p. 201–19.
169. Van Ummersen CA, 1963. An experimental study of developmental abnormalities induced in the chick embryo by exposure to radio frequency waves. Ph.D. Dissertation, Tufts University, Medford, UK.
170. Verschaeve L, Maes A. Genetic, carcinogenic and teratogenic effects of radiofrequency fields. *Mutat Res* 1998; 410:141–65.
171. Vrhovac R, Hraskan J, Franekic A. Effect of 905 MHz microwave radiation on colony growth of the yeast *Saccharomyces cerevisiae* strains FF18733, FF1481 and D7. *Radiol Oncol* 2010; 44:131–4.
172. Wajnberg E, Acosta-Avalos D, Alves OC, de Oliveira JF, Srygley RB, Esquivel DM.
173. Magnetoreception in eusocial insects: an update. *J R Soc Interface* 2010;7:S207–25. Wasserman FE, Dowd C, Schlinger B, Kunz T, Battista S. The effects of microwave radiation on avian dominance behaviour. *Bioelectromagnetics* 1984; 5:331–9. Weisbrot D, Lin H, Ye L, Blank M, Goodman R. Effects of mobile phone radiation on reproduction and development in *Drosophila melanogaster*. *J Cell Biochem* 2003;89: 48–55.
174. Westerdahl BB, Gary NE. Longevity and food consumption of microwave-treated (2.45 GHz CW) honeybees in the laboratory. *Bioelectromagnetics* 1981a; 2(4):305–14.
175. Westerdahl BB, Gary NE. Flight, orientation, and homing abilities of honeybees following exposure to 2.45-GHz CW microwaves. *Bioelectromagnetics* 1981b; 2:71–5.
176. WHO. Research agenda for radio frequency fields. Geneva Switzerland: WHO Interna- tional EMF Project. Available online at http://www.who.int.ezproxy.leidenuniv.nl:2048/peh-emf/research/rf_research_agenda_2006.pdf 2006. [last accessed 13 December 2011].
177. WHO. Research agenda for radiofrequency fields. Available online at http://whqlibdoc.who.int/publications/2010/9789241599948_eng.pdf 2010. [last accessed: 18 April 2012].
178. Wiltschko W, Wiltschko R. Magnetic orientation in birds. *J Exp Biol* 1996; 199:29–38.

179. Wiltschko R, Denzau S, Gehring D, Thalau P, Wiltschko W. Magnetic orientation of migratory robins, *Erithacus rubecula*, under long-wavelength light. *J Exp Biol* 2001; 214:3096–101.
180. Winklhofer M. Magneto reception. *J R Soc Interface* 2010; 7:131–4.
181. Yamaguchi H, Tsurita G, Ueno S, Watanabe S, Wake K, Taki M, et al. 1439 MHz pulsed TDMA fields affect performance of rats in a T-maze task only when body temperature is elevated. *Bioelectromagnetics* 2003;24(4):223–30.
182. Yan JG, Agresti M, Bruce T, Yan YH, Granlund A, Matloub HS. Effects of cellular phone emissions on sperm motility in rats. *Fertil Steril* 2007; 88:957–64.
183. Yang XS, He GL, Hao YT, Xiao Y, Chen CH, Zhang GB, et al. Exposure to 2.45 GHz electromagnetic fields elicits an HSP-related stress response in rat hippocampus. *Brain Res Bull* 2012;88(4):371–8.
184. Zalasiewicz J, Williams M, Steffen W, Crutzen P. The new world of the Anthropocene. *Environ Sci Technol* 2010; 44(7):2228–31.
185. Zhao R, Zhang S, Xu Z, Ju L, Lu D, Yao G. Studying gene expression profile of rat neuron exposed to 1800 MHz radiofrequency electromagnetic fields with cDNA microassay. *Toxicology* 2007; 235:167–75

Sección 18

Efecto de los Campos Electromagnéticos y la comunicación inalámbrica sobre el Cambio Climático y la Capa de Ozono.

Trabajo básico de revisión: Re-Inventing Wires: The Future of Landlines and Networks, National Institute for Science, Law & Public Policy, Washington, DC (NISLAPP). Timothy Schoechle, PhD <https://electromagnetichealth.org/wp-content/uploads/2018/02/ReInventing-Wires-1-25-18.pdf>

1. Alster, Norm (2015). *Captured Agency: How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates*. Cambridge: Edmond J. Safra Center for Ethics, Harvard University.
2. Background information Climate impact of video streaming. Calculating carbon emissions of data centres and data transmission. Last updated: 7 September 2020 (Bundesweite Erhebung von Daten zum Verbrauch von Getränken in Mehrweggetränkeverpackungen) Federal Environment Agency (UBA) Wörlitzer Platz 1/06844 Dessau-Roßlau. Germany. <https://www.umweltbundesamt.de/en/publications>.
3. Barnes, Frank and Ben Greenbaum (2016). “Some Effects of Weak Magnetic Fields on Biological Systems: RF fields can change radical concentrations and cancer cell growth rates,” *IEEE Power Electronics Magazine*. March 7. <http://ieeexplore.ieee.org/document/7425396/>
4. Barnes, Frank and Ben Greenbaum (2014). “The Effects of Weak Magnetic Fields on Radical Pairs.” *Bioelectromagnetics*. Wiley Periodicals. <https://www.ncbi.nlm.nih.gov/pubmed/25399679>
5. Barr, Alistair (2014). “How Google’s ‘Fiberhood’ Strategy Is Spreading.” *The Wall Street Journal*. August 22 <http://blogs.wsj.com/digits/2014/08/22/googles-fiberhood-strategy-is-spreading/tab/print/>
6. Bell, Tom (2016). “States move toward making endangered landlines extinct.” *Boston Globe*. April 20. <http://www.bostonglobe.com/business/2016/04/19/states-move-toward-making-endangered-landlines-extinct/OiOtelhJnvlXQ425jm1UIM/story.html>
7. Benoit, David (2018). “iPhones and Children Are a Toxic Pair, Say Two Big Apple Investors.” *The Wall Street Journal*. January 8, p. A1. <https://www.wsj.com/articles/iphones-and-children-are-a-toxic-pair-say-two-big-apple-investors-1515358834>
8. Bradshaw, Tim (2016). “Start-up with the right instinct about smart home problems”. *Financial Times*. April 22, p. 10.
9. Brooks, David (2017). “How Evil Is Tech?” *The New York Times*. November 20 <https://www.nytimes.com/2017/11/20/opinion/how-evil-is-tech.html>

10. Carr, Nicholas (2017). "How Smartphones Hijack Our Minds," *The Wall Street Journal*. October 6. <https://www.wsj.com/articles/how-smartphones-hijack-our-minds-1507307811>
11. Carter, Susan Payne, Kyle Greenberg and Michael S. Walker (2017). "The impact of computer usage on academic performance: Evidence from a randomized trial at the United States Military Academy". *Economics of Education Review*. v. 56, February, pp 118-132. <http://www.sciencedirect.com/science/article/pii/S0272775716303454>
12. Cookson, Robert (2016). "Digital advertising: Brands versus bots." *Financial Times*. July 18. <https://next.ft.com/content/fb66c818-49a4-11e6-b387-64ab0a67014c>
13. Cookson, Robert (2016a). "Ad agencies accused of accepting hidden rebates." *Financial Times*. June 8. <https://www.ft.com/content/040901f8-2ca3-11e6-a18d-a96ab29e3c95>
14. Crow, David and Pan Yuk (2016). "Verizon vows to challenge Google in ads." *Financial Times*. July 27, p. 15 <https://www.ft.com/content/56a670f6-5329-11e6-9664-e0bdc13c3bef>
15. CEET, (2013). *The Power of Wireless Cloud: An analysis of the energy consumption of wireless cloud*. Centre for Energy-Efficient Telecommunications (CEET). Bell Labs and University of Melbourne. April. 22 pages <http://www.ceet.unimelb.edu.au>
16. Crawford, Susan (2013). *Captive Audience: The Telecom Industry and Monopoly Power in the Gilded Age*. New Haven & London: Yale University Press. 359 pages.
17. Crawford, Susan and Ben Scott (2015). *Be Careful What You Wish For: Why Europe Should Avoid the Mistakes of US Internet Access Policy*. Beisheim Center Policy Brief, June. http://www.stiftung-nv.de/ites/default/files/broadband.eu_usa.pdf
18. CTC (2015). CTC Technology and Energy, *City of Boulder: Council Broadband Planning Workshop*. (presentation) November 12.
19. CTC (2017). *Mobile Broadband Service Is Not an Adequate Substitute for Wireline*. Kensington, Maryland: Columbia Telecommunications Corporation (CTC Technology & Energy). October. 40 pages. https://www.cwa-union.org/sites/default/files/ctc_mobile_broadband_white_paper - 20171004.pdf
20. Chan, H. Anthony (2016). *5G and Future Wireless Internet: Challenges and Emerging Technologies*. Slide presentation, IEEE Communications Society–Denver Section, May 10. <http://www.comsoc.ieee-denver.org>
21. Dal Bó, Ernesto (2006). "Regulatory Capture: A Review." *Oxford Review of Economic Policy*. Oxford: Oxford University Press, vol. 22, no. 2. pp 203-225.
22. Dash, Anil (2017). "Tech's Moral Reckoning." *On Being*. Interview by Krista Tippett, January 12. www.onbeing.org/programs/anil-dash-techs-moral-reckoning/
23. de Decker, Kris (2015). "Why we need a speed limit for the internet". *Low-tech Magazine*. www.resilience.org/stories/2015-10-21/why-we-need-a-speed-limit-for-the-internet
24. Dellorto, Danielle (2011). "WHO: Cell phone use can increase possible cancer risk." *CNN Health* <http://www.cnn.com/2011/HEALTH/05/31/who.cell.phones/index.html>
25. Dougherty, Conor (2016). "Growing Up Mobile." *The New York Times*. January 3, page BU 1. <https://www.nytimes.com/2016/01/03/business/app-makers-reach-out-to-the-teenager-on-mobile.html?mcubz=0>
26. Electronic Design (2016). "U.S. Opens High-Band Spectrum for 5G Networks." *Electronic Design*, August 5. <http://electronicdesign.com/print/blog/us-opens-high-band-spectrum-5g-networks>
27. Embury-Dennis, Tom (2017). "France to bring in total ban on pupils using mobile phones in school." *Independent*. <http://www.independent.co.uk/news/world/europe/france-school-mobile-phone-ban-use-smartphones-students-study-learn-class-a8105856.html>
28. Erixon, Fredrik and Björn Weigel (2016). *The Innovation Illusion: How So Little is Created by So Many Working So Hard*. New Haven & London: Yale University Press. 297 pages. <https://yalebooks.yale.edu/book/9780300217407/innovation-illusion>
29. Fairchild, Denise and Al Weinrub, eds. (2017). *Energy Democracy: Advancing Equity in Clean Energy Solutions*. Washington DC: Island Press. 272 pages.

30. Farrell, Joseph and Phil Weiser (2003). "Modularity, Vertical Integration, and Open Access Policies: Towards a Convergence of Antitrust and Regulation in the Internet Age." *Harvard Journal of Law and Technology*, Vol. 17, No. 1, Fall. <https://ssrn.com/abstract=452220> or <http://dx.doi.org/10.2139/ssrn.452220>
31. FCC (2010). *Connecting America: The National Broadband Plan*. Federal Communications Commission. <https://www.fcc.gov/general/national-broadband-plan>
32. Frenzel, Lou (2016). "The Future of Wireless." *Electronic Design*, April. <<http://electronicdesign.com>>
33. GAO (2004). U.S. General Accounting Office. *Renewable Energy: Wind Power's Contribution to Electric Power Generation and Impact on Farms and Rural Communities*. September http://www.gao.gov/new_items/d04756.pdf
34. Gatherer, Alan (2017). "Will DSL destroy 5G in the battle over the last mile." *IEEE CommSoc Technology News*. November, https://www.comsoc.org/ctn/will-dsl-destroy-5g-battle-over-last...utm_source=Real%20Magnet&utm_medium=email&utm_campaign=119988156
35. Germanos, Andrea (2016). "Win for Telecom Giants as Court Puts Dagger in Municipal Broadband," *Common Dreams*. August 10 <http://www.commondreams.org/news/2016/08/10/win-telecom-giants-court-puts-dagger-municipal-broadband>
36. Gibson, C. Robert (2015). "How a Mid-Sized Tennessee Town Took on Comcast, Revived Its Economy, and Did It With Socialism." *Huffington Post*. March 6 (updated May 6). http://www.huffingtonpost.com/carl-gibson/chattanooga-socialism_b_6812368.html
37. Glaser, Zorch R. (1971). *Bibliography of Reported Biological Phenomena ("Effects") and Clinical Manifestations Attributed to Microwaves and Radio-Frequency Radiation*. Naval Medical Research Institute. <http://stetzelectriccom/naval-medical-research-institute-research-report>
38. González, Juan (2015). "'A Historic Decision': Tim Wu, Father of Net Neutrality, Praises FCC Vote to Preserve Open Internet." *Democracy Now*, [transcript] February 27 http://www.democracynow.org/2015/2/27/a_historic_decision_tim_wu_father#
39. Gorlick, Adam (2009). "Media multitaskers pay mental price, Stanford study shows." *Stanford News*. August 24 <<https://news.stanford.edu/2009/08/24/multitask-research-study-082409/>>
40. Guynn, Jessica (2016). "Google gets 'serious' about beaming wireless broadband into homes." *USA TODAY*. June 8 <http://www.usatoday.com/story/tech/news/2016/06/08/google-gets-serious-beaming-wireless-broadband-into-homes/85627086/>
41. Hazas, Mike, Janine Morley, Oliver Bates, and Adrian Friday (2016). "Are there limits to growth in data traffic?: On time use, data generation and speed". *Limits '16 conference, June 8-10 Irvine, CA*; ACM 5 pages. <http://dx.doi.org/10.1145/2926676.2926690/>
42. Hecht, Jeff (2014). "Why Mobile Voice Quality Still Stinks." *IEEE Spectrum*, 30 September. <http://spectrum.ieee.org/telecom/wireless/why-mobile-voice-quality-still-stinksand-how-to-fix-it>
43. Hecht, Jeff (2015). "Net Neutrality's Technical Troubles." *IEEE Spectrum*, 12 February. <http://spectrum.ieee.org/telecom/internet/net-neutralitys-technical-troubles>
44. Hess, David C. (2016). "Implications of Higher Data-Rate Ethernet Over Prior Standard Twisted-Pair Data Cabling." *Proceedings of the 65th IWCS Conference. International Wire & Cable Symposium*. pp. 516-524.
45. Horton, Jennifer (2014). "Will the landline phone become obsolete?" *HowStuffWorks*. <http://electronics.howstuffworks.com/landline-phone-obsolete1.html>
46. Hovis, Joanne, et al (2017). *The Emerging World of Broadband Public-Private Partnerships: A Business Strategy and Legal Guide*. Evanston, IL: Benton Foundation, May. 47 pages <http://benton.org/broadband-public-private-partnerships-report/>
47. Hilty, Lorenz M. (2015). Computing Efficiency, Sufficiency, and Self-sufficiency: A model for Sustainability. *Limits '15 conference, June 8-10 Irvine, CA*; 4 pages <http://limits2015.org/papers/limits2015-Hilty.pdf/>
48. Horwitz, Robert (1989). *The Irony of Regulatory Reform: The Deregulation of American Telecommunications*. Oxford, UK: Oxford University Press. 267 pages.
49. Ip, Greg (2016) "Are We Out of Big Ideas?" *The Wall Street Journal*. December 7, p. A1. <https://www.wsj.com/articles/the-economys-hidden-problem-were-out-of-big-ideas-1481042066>

50. Isenberg, David (1996). *The Rise of the Stupid Network: Why the Intelligent Network was once a good idea, but isn't anymore. One telephone company nerd's odd perspective on the changing value proposition.* August 1 <http://www.rageboy.com/stupidnet.html>
51. Isenberg, David S. (1998). "The Dawn of the Stupid Network" *ACM Networker* 2.1. February/March <http://www.isen.com/papers/Dawnstupid.html>
52. Johnson, Jeromy (2015). "Why is Xfinity WiFi Harming People?" *EMF Analysis Blog.* August 18, <https://www.emfanalysis.com/why-is-xfinity-wifi-harming-people/>
53. Jonnes, Jill (2003). *Empires of Light: Edison, Tesla, Westinghouse, and the Race to Electrify the World.* New York: Random House. 397 pages.
54. Kang, Cecilia (2016). "Court Backs Rules Treating Internet as Utility, Not Luxury." *The New York Times.* June 14 <https://www.nytimes.com/2016/06/15/technology/net-neutrality-fcc-appeals-court-ruling.html>
55. Kloc, Joe (2014). "Federal court ruling deals a crushing blow to net neutrality." *The Daily Dot.* 14 January. <http://www.dailycdot.com/layer8/us-court-strikes-down-net-neutrality/>
56. Knutson, Ryan (2014). "AT&T's Plan For the Future: No Landlines, Less Regulation." *The Wall Street Journal.* April 7. http://online.wsj.com/news/articles/SB100014240527023048347045794030901328821_48#printMode
57. Knutson, Ryan (2016). "U.S. Cellphone Study Fans Cancer Worries." *The Wall Street Journal.* May 28. <http://www.wsj.com/articles/u-s-cellphone-study-fans-cancer-worries-1464393051>
58. Knutson, Ryan (2016a). "Sprint's Wireless Fix? More Telephone Poles." *The Wall Street Journal.* June 7. <http://www.wsj.com/articles/sprints-drive-to-improve-coverage-faces-permit-delays-1465337015>
59. Kushnick, Bruce (2015). "Verizon Is 'Killing the Copper' and Is Now Denying It." *Huffington Post.* June 11. http://www.huffingtonpost.com/bruce-kushnick/verizon-is-killing-the-co_b_7562660.html
60. Kushnick, Bruce (2017). "Expose: AT&T California Fiber Optic Scandal: Billions Charged for Broadband that Never Showed Up." *Huffington Post.* August 28 https://www.huffingtonpost.com/entry/expose-att-california-fiber-optic-scandal-billions_us_59a4ce47e4b0b234aecad1c7
61. LaFrance, Adrienne (2017). "The Internet is Mostly Bots," *The Atlantic.* January 31. <https://www.theatlantic.com/technology/archive/2017/01/bots-bots-bots/515043/>
62. Lavoie, Lincoln (2016). "Best Practices for G.fast System Testing." *Electronic Design.* December 2 <http://electronicdesign.com/test-measurement/best-practices-gfast-system-testing/>
63. Lecher, Colin (2016) "How the FCC's massive airwaves auction will change America — and your phone service: The broadcast incentive auction will take years." *The Verge.* April 21 <http://www.theverge.com/2016/4/21/11481454/fcc-broadcast-incentive-auction-explained>
64. Lipset, Seymour Martin (1996). *American Exceptionalism: A Double Edged Sword.* New York: W.W. Norton & Co. 348 pp.
65. Lobello, Carmel (2013). "Your iPhone uses more energy than a refrigerator." *The Week.* August 14 <http://theweek.com/articles/461080/iphone-uses-more-energy-than-refrigerator>
66. Lynch, Michael (2017). "Changing the Mindset in IoT Manufacturing." *Electronic Design.* January. <http://electronicdesign.com/iot/changing-mindset-iot-manufacturing>
67. Marte, Jonnelle (2012). "Ten Things Cable-TV Companies Won't Say," *The Wall Street Journal.* December 2. <http://www.wsj.com/articles/SB10001424127887323751104578149260611152192>
68. McLuhan, Marshall (1964). *Understanding Media: The Extensions of Man.* New York: McGraw-Hill.318 pages.
69. McLuhan, Marshall and Quentin Fiore (1967). *The Medium is the Massage.* UK: Penguin Books. 167 pages.
70. Metz, Rachel (2014). "Securing the Smart Home, from Toasters to Toilets." *MIT Technology Review.* January 21. <http://www.technologyreview.com/news/523531/securing-the-smart-home-from-toasters-to-toilets/>
71. Mills, Mark P. (2013). *The Cloud Begins With Coal: Big Data, Big Networks, Big Infrastructure and Big Power.* Digital Power Group. August, 45 pages https://www.tech-pundit.com/wp-content/uploads/2013/07/Cloud_Begins_With_Coal.pdf
72. MN (2016). "Cell Phone Radiation Boosts Cancer Rates in Animals: \$25 Million NTP Study Finds Brain Tumors: U.S. Government Expected to Advise Public of Health Risk." *Microwave News.* 25 May. (5 pages). <http://microwavenews.com/news-center/ntp-cancer-results/>

73. Morra, James (2016). "Automakers Sprint Toward Self-Driving Cars, But Are Consumers Ready?" *Electronic Design*, May 26. <http://electronicdesign.com/electromechanical/automakers-sprint-toward-self-drivingcars-are-consumers-ready>
74. Moskowitz, Peter (2016). "Chattanooga Was a Typical Postindustrial City. Then It Began Offering Municipal Broadband: Chattanooga's publicly owned Internet service has helped boost its economy and bridge the digital divide." *The Nation*. June 3 <http://www.thenation.com/article/chattanooga-was-a-typical-post-industrial-city-then-it-began-offering-municipal-broadband>
75. Munson, Ben (2015). "Workers allege Verizon abandoning copper landlines." *wwbenmunson*. June 9.
76. Murphy, David (2010). "Verizon Axes FIOS Expansion." *PC Magazine*. March 27. <http://www.pcmag.com/article2/0,2817,2361919,00.asp>
77. Noam, Eli (2011). "Let Them Eat Cellphones: Why Mobile Wireless is No Solution for Broadband." *Journal of Information Policy*. I. p. 470-85. <http://www.jstor.org/stable/10.5325/jinfopoli.1.2011.0470>
78. Nicas, Jack (2016). "Google's High-Speed Web Plans Hit Snags." *The Wall Street Journal*. August 15. <http://www.wsj.com/articles/googles-high-speed-web-plans-hit-snags-1471193165>
79. NIST (2015). *Framework for Cyber-Physical Systems – Release 0.8*. National Institute for Standards and Technology. September. 277 pages. <https://pages.nist.gov/cpspwg/>
80. NTP (2016). *Report of Partial Findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats (Whole Body Exposures)*. National Toxicology Program. 19 May. <https://doi.org/10.1101/055699/>
81. Ortutay, Barbara (2016). "Facebook hates ad blockers so much it now blocks them." *Associated Press: Daily Camera*. p. 5C, August 10.
82. Pall, Martin L. (2013). "Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects." *Journal of Cellular and Molecular Medicine*. June 26, 17:958-965
83. Pall, Martin L. (2016). "Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression." *Journal of Chemical Neuroanatomy*, Vol 75, Part B, September, pp. 43-51. <https://doi.org/10.1016/j.jchemneu.2015.08.001>
84. Patel, Prachi (2016). Cellphone Radiation Linked to Cancer in Major Rat Study. *IEEE Spectrum*. 27 May <http://spectrum.ieee.org/the-human-os/biomedical/ethics/cellphone-radiation-causes-cancer-in-rats>
85. Peltzman, S. (1976). "Toward a More General Theory of Regulation," *Journal of Law and Economics*. 19, pp. 2211-48.
86. Penttinen, Jyrki (2016). "What's the Story with 5G?" *Electronic Design*. June 29. <http://electronicdesign.com/print/communications/what-s-story-5g?>
87. Resende, Patricia (2010). Verizon Blasts 'Outdated' FCC Broadband Plan. *NewsFactor Network*. March 27. http://www.newsfactor.com/news/Verizon-Blasts-Outdated--FCC-Plan/story.xhtml?story_id=1230099R6WV3&full_skip=1
88. Perrow, Charles (1984). *Normal Accidents: Living with High-Risk Technologies*. New York: Basic Books.
89. Perry, Tekla (2016). "The Fathers of the Internet Revolution Urge Today's Software Engineers to Reinvent the Web." *IEEE Spectrum*. 13 June <http://spectrum.ieee.org/view-from-the-valley/telecom/internet/the-fathers-of-the-internet-revolution-urge-todays-pioneers-to-reinvent-the-web>
90. Pinch, Trevor J. and Wiebe E. Bijker. "The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other." *Social Studies of Science* 14 (August 1984): 399-441.
91. Raines, J.K. (1981). *Electromagnetic Field Interactions with the Human Body: Observed Effects and Theories*. Greenbelt, Maryland: National Aeronautics and Space Administration, NASA CR 166661. April.
92. Ramachandran, Shalini (2012). "Why Wi-Fi Is Often So Slow". *The Wall Street Journal*. September 18. <http://online.wsj.com/article/SB10000872396390444233104577595881760532986.html>
93. Rees, Matthew (2016). "Bending the Arc of History." *The Wall Street Journal*. December 13, p. A15. <https://www.wsj.com/articles/bending-the-arc-of-history-1481588883>

94. Riley, Naomi Schaefer (2016). "Teach Your Children Well: Unhook Them From Technology." *The Wall Street Journal*. January 1. <http://www.wsj.com/articles/teach-your-children-well-unhook-them-from-technology-1451683457>
95. Rose, Gregory (2010). *Wireless Broadband and the Redlining of Rural America*. New America Foundation.
96. Rudolph, Richard and Scott Ridley (1986). *Power Struggle: The Hundred-Year War Over Electricity*. New York: Harper & Row. 1986
97. Russell, Cindy (2017). "A 5G Wireless Future: Will it give us a smart nation or contribute to an unhealthy one?" *The Bulletin*. (Santa Clara County Medical Association-Monterey County Medical Association) January/February. p. 20-23. https://issuu.com/18621/docs/bulletin_0217_web
98. Rysavy, Peter (2017). *Broadband Disruption: How 5G Will Reshape the Competitive Landscape*. Version 1.0, Rysavy Research. 26 July. <https://datacommresearch.com/press-release-broadband/>
99. Seattle Times (2017). "Trump should resist those who would gut net neutrality rules." *The Seattle Times*. January 3. <http://www.seattletimes.com/opinion/editorials/trump-should-resist-those-who-would-gut-net-neutrality-rules/>
100. Schoechle, Timothy (1995). "Privacy on the Information Highway: Will My Home Still Be My Castle?" *Telecommunications Policy*. Vol. 19, No 6, August. Pages 435-452.
101. Schoechle, Timothy (1995a). *Emerging Consumer Policy Issues on the Information Highway*. Masters Thesis, University of Colorado. 55+ pages.
102. Schoechle, Timothy (2009). *Standardization and Digital Enclosure: The Privatization of Standards, Knowledge, and Policy in the Age of Global Information Technology*. Hershey, PA: IGI Global. 354 pages.
103. Schoechle, Timothy (2015). "Community Solar: The Utility of the Future" *Solar Today*. May/June, 2015. p. 19-23; 3 pages. <http://www.solartoday.org/digital-issues>
104. Stern, Joanna (2016). "Some Smart Things Turn Out to Be Dumb." *The Wall Street Journal*. May 26.
105. TIA (2014). *TIA's 2014-2017 Market Review and Forecast: Chapter 6 – The International Market*. Arlington, VA: Telecommunication Industries Association. March. Page 8.
106. TIA (2015). *Network of the Future Conference*, Telecommunication Industries Association, Dallas, Texas, June 3.
107. Tilley, Aaron (2016). "This Startup Is Building A Cellular Network For Your Lightbulb And Toaster." *Forbes*. June 1. <http://www.forbes.com/sites/aarontilley/2016/06/01/sigfox-cellular-network/print/>
108. TNI, (2017). *Reclaiming Public Services: How cities and citizens are turning back privatization*. Satoko Kishimoto and Oliver Petitjean, eds. Transnational Institute. Amsterdam. June, 236 pages. https://www.tni.org/publication-downloads/reclaiming_public_services.pdf
109. Tweed, Katherine (2014). "Bell Labs Sets New Record for Internet Over Copper." *IEEE Spectrum*. July 14. < <http://spectrum.ieee.org/tech-talk/telecom/internet/bell-labs-sets-new-record-for-internet-over-copper>>
110. Vara, Vauhini (2015). "Why the F.C.C.'s Municipal-Broadband Ruling Matters, Too." *The New Yorker*. February 28. <http://www.newyorker.com/business/currency/fcc-municipal-broadband-ruling-matters-net-neutrality?intcid=mod-latest>
111. Walenta, Nino, and Lee Osterling (2016). "Quantum Networks: Photons Hold the Key to Data Security". *Photonics Spectra*, May, p. 40-44. <http://www.photonics.com>
112. Ward, Adrian F., Kristen Duke, Ayelet Gneezy, and Maarten W. Bos (2017). "Brain Drain: The Mere Presence of One's Own Smartphone Reduces Available Cognitive Capacity." *Journal of the Association for Consumer Research*, University of Chicago Press, v. 2, no. 2, April <http://www.journals.uchicago.edu/doi/10.1086/691462>
113. Wheeler, Thomas (2016). Spectrum Frontiers: Future of Wireless—Prepared Remarks at National Press Club, FCC June 20 <https://www.fcc.gov/documents/remarks-chairman-wheeler-future-wireless>
114. Wilkerson, David (2011). "Wireless 'Not Enough' to Support Video Future." *Market-Watch*. June 16 http://articles.marketwatch.com/2011-06-16/industries/30869054_1_4g-wireless-platform-panel-discussion
115. Wu, Tim (2003) "Network Neutrality, Broadband Discrimination." *Journal of Telecommunications and High Technology Law*, Vol. 2, p. 141. <https://ssrn.com/abstract=388863> or <http://dx.doi.org/10.2139/ssrn.388863>
116. Wu, Tim (2016). "Network Neutrality FAQ" http://www.timwu.org/network_neutrality.html

Young, Samantha (2016). AT&T Wants to Decommission Landlines in California." *Techwire*. April 7. <http://www.techwire.net/legislation/att-wants-to-decommission-landlines-in-california.html>

Sección 19

Uso de celulares y riesgo de cancer de tiroides, colon, recto, pulmon y cerebro

1. Ahn MY, et al., 2012 Histone deacetylase inhibitor, apicidin, inhibits human ovarian cancer cell migration via class II histone deacetylase 4 silencing. *Cancer Lett.* 325, 189–99. [PubMed: 22781396]
2. Auvinen A, et al., 2002 Brain tumors and salivary gland cancers among cellular telephone users. *Epidemiology*. 13, 356–9. [PubMed: 11964939]
3. Aydin D, et al., 2011 Mobile phone use and brain tumors in children and adolescents: a multicenter case-control study. *J Natl Cancer Inst.* 103, 1264–76. [PubMed: 21795665]
4. Baan R, et al., 2011 Carcinogenicity of radiofrequency electromagnetic fields. *Lancet Oncol.* 12, 624–6. [PubMed: 21845765]
5. Barrett JC, et al., 2005 Haploview: analysis and visualization of LD and haplotype maps. *Bioinformatics*. 21, 263–5. [PubMed: 15297300]
6. Bender R, Lange S, 1999 Multiple test procedures other than Bonferroni's deserve wider use. *BMJ*. 318, 600–1.
7. Benson VS, et al., 2013 Mobile phone use and risk of brain neoplasms and other cancers: prospective study. *Int J Epidemiol.* 42, 792–802. [PubMed: 23657200]
8. Boyd SD, et al., 2000 An intact HDM2 RING-finger domain is required for nuclear exclusion of p53. *Nat Cell Biol.* 2, 563–8. [PubMed: 10980695]
9. Brouwers FP, et al., 2013 Incidence and epidemiology of new onset heart failure with preserved vs. reduced ejection fraction in a community-based cohort: 11-year follow-up of PREVEND. *European heart journal*. 34, 1424–1431. [PubMed: 23470495]
10. Cardis E, et al., 2011 Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five Interphone countries. *Occupational and Environmental Medicine*. 68, 631–640. [PubMed: 21659469]
11. Carlberg M, Hardell L, 2012 On the association between glioma, wireless phones, heredity and ionising radiation. *Pathophysiology*. 19, 243–52. [PubMed: 22939605]
12. Carlberg M, et al., 2016 Increasing incidence of thyroid cancer in the Nordic countries with main focus on Swedish data. *BMC Cancer*. 16, 426. [PubMed: 27388603]
13. Chen J, et al., 2015 PAK6 increase chemoresistance and is a prognostic marker for stage II and III colon cancer patients undergoing 5-FU based chemotherapy. *Oncotarget*. 6, 355–67. [PubMed: 25426562]
14. Chorev M, Carmel L, 2012 The function of introns. *Front Genet*. 3, 55. [PubMed: 22518112]
15. Colarossi L, et al., 2014 Inhibition of histone deacetylase 4 increases cytotoxicity of docetaxel in gastric cancer cells. *Proteomics Clin Appl*. 8, 924–31. [PubMed: 25091122]
16. Conneely KN, Boehnke M, 2007 So many correlated tests, so little time! Rapid adjustment of P values for multiple correlated tests. *Am J Hum Genet*. 81, 1158–68. [PubMed: 17966093]
17. Coureau G, et al., 2014 Mobile phone use and brain tumours in the CERENAT case-control study. *Occup Environ Med*. 71, 514–22. [PubMed: 24816517]
18. Falcioni L, et al., 2018 Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8GHz GSM base station environmental emission. *Environ Res*. 165, 496–503. [PubMed: 29530389]

19. Frei P, et al., 2011 Use of mobile phones and risk of brain tumours: update of Danish cohort study. *BMJ.* 343, d6387. [PubMed: 22016439]
20. Glozak MA, Seto E, 2007 Histone deacetylases and cancer. *Oncogene.* 26, 5420–32. [PubMed: 17694083]
21. Grell K, et al., 2016 The Intracranial Distribution of Gliomas in Relation to Exposure From Mobile Phones: Analyses From the INTERPHONE Study. *Am J Epidemiol.* 184, 818–828. [PubMed: 27810856]
22. Hardell L, Carlberg M, 2015 Mobile phone and cordless phone use and the risk for glioma - Analysis of pooled case-control studies in Sweden, 1997–2003 and 2007–2009. *Pathophysiology.* 22, 1–13. [PubMed: 25466607]
23. Hardell L, et al., 2011 Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects. *Int J Oncol.* 38, 1465–74. [PubMed: 21331446]
24. Hardell L, et al., 2013 Use of mobile phones and cordless phones is associated with increased risk for glioma and acoustic neuroma. *Pathophysiology.* 20, 85–110. [PubMed: 23261330]
25. Hou J, et al., 2013 DACT2 is a candidate tumor suppressor and prognostic marker in esophageal squamous cell carcinoma. *Cancer Prev Res (Phila).* 6, 791–800. [PubMed: 23803417]
26. IARC MPG, 2019 Advisory Group recommendations on priorities for the IARC Monographs. *The Lancet. Oncology.*
27. IARC Working Group, Non-ionizing radiation, Part 2: Radiofrequency electromagnetic fields. IARC monographs on the evaluation of carcinogenic risks to humans, 2013, pp. 1–460. [PubMed: 24772662]
28. Inskip PD, et al., 2001 Cellular-telephone use and brain tumors. *N Engl J Med.* 344, 79–86. [PubMed: 11150357]
29. INTERPHONE Study Group, 2010 Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Int J Epidemiol.* 39, 675–94. [PubMed: 20483835]
30. Kang C, et al., 2015 The DNA damage response induces inflammation and senescence by inhibiting autophagy of GATA4. *Science.* 349, aaa5612. [PubMed: 26404840]
31. Liu T, et al., 2013 p21-Activated kinase 6 (PAK6) inhibits prostate cancer growth via phosphorylation of androgen receptor and tumorigenic E3 ligase murine double minute-2 (Mdm2). *J Biol Chem.* 288, 3359–69. [PubMed: 23132866]
32. Luo J, et al., 2019 Cell phone use and risk of thyroid cancer: a population-based case-control study in Connecticut. *Ann Epidemiol.* 29, 39–45. [PubMed: 30446214]
33. Miller AB, et al., 2018 Cancer epidemiology update, following the 2011 IARC evaluation of radiofrequency electromagnetic fields (Monograph 102). *Environ Res.* 167, 673–683. [PubMed: 30196934]
34. Momoli F, et al., 2017 Probabilistic Multiple-Bias Modeling Applied to the Canadian Data From the Interphone Study of Mobile Phone Use and Risk of Glioma, Meningioma, Acoustic Neuroma, and Parotid Gland Tumors. *Am J Epidemiol.* 186, 885–893. [PubMed: 28535174]
35. Muscat JE, et al., 2000 Handheld cellular telephone use and risk of brain cancer. *JAMA.* 284, 3001–7. [PubMed: 11122586]
36. National Toxicology Program NTP technical report on the toxicology and carcinogenesis studies in B6C3F1/N mice exposed to whole-body radio frequency radiation at a frequency (1,900 MHz) and modulations (GSM and CDMA) used by cell phones NTP TR 596 (Peer review draft). Washington, DC: US Dept. of Health and Human ..., 2018a.
37. National Toxicology Program, 2018b Toxicology and carcinogenesis studies in Hsd: Sprague-Dawley SD rats exposed to whole-body radiofrequency radiation at a frequency (900 MHz) and modulations (GSM and CDMA) used by cell phones. *NTP Tech. Rep* 595, 384.
38. Oliner JD, et al., 1993 Oncoprotein MDM2 conceals the activation domain of tumour suppressor p53. *Nature.* 362, 857–60. [PubMed: 8479525]
39. Perneger TV, 1998 What's wrong with Bonferroni adjustments. *BMJ.* 316, 1236–8. [PubMed: 9553006]

40. Phillips JL, et al., 2009 Electromagnetic fields and DNA damage. *Pathophysiology.* 16, 79–88. [PubMed: 19264461]
41. Sancho E, et al., 1998 Role of UEV-1, an inactive variant of the E2 ubiquitin-conjugating enzymes, in in vitro differentiation and cell cycle behavior of HT-29-M6 intestinal mucosecretory cells. *Mol Cell Biol.* 18, 576–89. [PubMed: 9418904]
42. Sandler JE, et al., 2018 Germline Variants in DNA Repair Genes, Diagnostic Radiation, and Risk of Thyroid Cancer. *Cancer Epidemiol Biomarkers Prev.* 27, 285–294. [PubMed: 29263185]
43. Scherer DA, Federal Communications Commission (FCC) Media Ownership Rules. In: Service CR, (Ed.), 2018.
44. Schuz J, et al., 2006 Cellular telephone use and cancer risk: update of a nationwide Danish cohort. *J Natl Cancer Inst.* 98, 1707–13. [PubMed: 17148772]
45. Shen T, et al., 2018 Ube2v1-mediated ubiquitination and degradation of Sirt1 promotes metastasis of colorectal cancer by epigenetically suppressing autophagy. *J Hematol Oncol.* 11, 95. [PubMed: 30016968]
46. Sinnott B, et al., 2010 Exposing the thyroid to radiation: a review of its current extent, risks, and implications. *Endocr Rev.* 31, 756–73. [PubMed: 20650861]
47. Smith-Roe SL, et al., 2019 Evaluation of the genotoxicity of cell phone radiofrequency radiation in male and female rats and mice following subchronic exposure. *Environ Mol Mutagen.*
48. Söderqvist F, et al., 2012 Review of four publications on the Danish cohort study on mobile phone subscribers and risk of brain tumors. *Reviews on Environmental Health.* 27, 51–58. [PubMed: 22755267]
49. Storey JD, 2002 A direct approach to false discovery rates. *Journal of the Royal Statistical Society: Series B (Statistical Methodology).* 64, 479–498.
50. Storey JD, et al., 2004 Strong control, conservative point estimation and simultaneous conservative consistency of false discovery rates: a unified approach. *Journal of the Royal Statistical Society: Series B (Statistical Methodology).* 66, 187–205.
51. Wang M, et al., 2019 Long noncoding RNA LINC00336 inhibits ferroptosis in lung cancer by functioning as a competing endogenous RNA. *Cell Death Differ.*
52. Wyde ME, et al., 2018 Effect of cell phone radiofrequency radiation on body temperature in rodents: Pilot studies of the National Toxicology Program's reverberation chamber exposure system. *Bioelectromagnetics.* 39, 190–199. [PubMed: 29537695]
53. Xie Y, et al., 2017 The Tumor Suppressor p53 Limits Ferroptosis by Blocking DPP4 Activity. *Cell Rep.* 20, 1692–1704. [PubMed: 28813679]
54. Yakymenko I, et al., 2016 Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation. *Electromagn Biol Med.* 35, 186–202. [PubMed: 26151230]
55. Yuan YC, 2010 Multiple imputation for missing data: Concepts and new development (Version 9.0). SAS Institute Inc, Rockville, MD. 49, 1–11.
56. Zerbino DR, et al., 2018 Ensembl 2018. *Nucleic Acids Res.* 46, D754–D761. [PubMed: 29155950]
57. Zhang Y, et al., 2015 Diagnostic radiography exposure increases the risk for thyroid microcarcinoma: a population-based case-control study. *Eur J Cancer Prev.* 24, 439–46. [PubMed: 25932870]
58. Zhao Z, et al., 2014 Methylation of DACT2 promotes papillary thyroid cancer metastasis by activating Wnt signaling. *PLoS One.* 9, e112336 [PubMed: 25375359].

Sección 20

Estimación de la absorción de la radiación de Campos Electromagnéticos por el cerebro en niños y en adultos.

1. Gandhi, O.P., Lazzi, G., Furse, C.M., 1996. Electromagnetic absorption in the human head and neck for mobile telephones at 835 and 1900 MHz. *IEEE Trans. Microw. Theory Tech.* 44, 1884–1897. <http://dx.doi.org/10.1109/22.539947>.
2. O. P. Gandhi, L. L. Morgan, A. A. de Salles, Y.-Y. Han, R. B. Herberman, and D. L. Davis, 'Exposure Limits: The underestimation of absorbed cell phone radiation, especially in children', *Electromagnetic Biology and Medicine*, vol. 31, no. 1, pp. 34–51, Mar. 2012, <http://dx.doi:10.3109/15368378.2011.622827>.
3. Foster, K.R., Chou, C.K., 2016. Response to "Children Absorb Higher Doses of Radio Frequency Electromagnetic Radiation From Mobile Phones Than Adults" and "Yes the Children Are More Exposed to Radiofrequency Energy From Mobile Telephones Than Adults". *IEEE Access* 4, 5322–5326. <http://dx.doi.org/10.1109/ACCESS.2016.2601490>.
4. C. Fernández, A. A. de Salles, M. E. Sears, R. D. Morris, and D. L. Davis, 'Absorption of wireless radiation in the child versus adult brain and eye from cell phone conversation or virtual reality', *Environmental Research*, vol. 167, pp. 694–699, 2018, <https://doi.org/10.1016/j.envres.2018.05.013>.
5. C. Fernández-Rodríguez, A. A. de Salles, On the sensitivity of the skull thickness for the SAR assessment in the intracranial tissues, *2016 IEEE MTT-S Latin America Microwave Conference (LAMC)*. <https://doi.org/10.1109/LAMC.2016.7851256>.
6. de Salles, A.A., Bulla, G., Fernández-Rodríguez, C.E., 2006. Electromagnetic absorption in the head of adults and children due to mobile phone operation close to the head. *Electromagn. Biol. Med.* 25, 349–360. <http://dx.doi.org/10.1080/15368370601054894>.
7. Christ, A., Gosselin, M.-C., Christopoulou, M., Kühn, S., Kuster, N., 2010. Age-dependent tissue-specific exposure of cell phone users. *Phys. Med. Biol.* 55, 1767. <http://dx.doi.org/10.1088/0031-9155/55/7/001>.
8. Fernández-Rodríguez, C.E., Salles, A.A.A. de, Davis, D.L., 2015. Dosimetric simulations of brain absorption of mobile phone radiation— the relationship between psSAR and age. *IEEE Access* 3, 2425–2430. <http://dx.doi.org/10.1109/ACCESS.2015.2502900>.
9. Peyman, A., Gabriel, C., Grant, E.H., Vermeeren, G., Martens, L., 2009. Variation of the dielectric properties of tissues with age: the effect on the values of SAR in children when exposed to walkie-talkie devices. *Phys. Med. Biol.* 54, 227–241. <http://dx.doi.org/10.1088/0031-9155/54/2/004>

Sección 21:

Efectos biológicos y claramente deterministas de los Campos Electromagnéticos en las cercanías de antenas base, dosimetría biológica y publicaciones recientes.

Trabajo de revisión: Consequences of Chronic Microwave RF Exposure/ ECFS Public API Documentation. US-Federal Communications Commission. <https://ecfsapi.fcc.gov/file/7520940908.pdf>

1. **The chromosomal effects of GSM-like electromagnetic radiation exposure on human fetal cells.** By Nur Uslu¹, Osman Demirhan¹, Mustafa Emre² and Gülsah Seydaoglu³. *Biomed Res Clin Prac*, 2019. Volume 4: 1-6. <https://doi.org/10.15761/BRCP.1000192>
2. **Exposure to Magnetic Field Non-Ionizing Radiation and the Risk of Miscarriage: A Prospective Cohort Study.** By De-Kun Li, Hong Chen, Jeannette R. Ferber, Roxana Odouli & Charles Quesenberry. *Nature, Scientific Reports/Published:13 december,2017*, www.nature.com/scientificreports/
3. **Dosimetría biológica de Rayos X mediante el estudio de micronucleos en sangre periférica** por: Gómez Sánchez, E.; Navlet Armenia, J. Departamento de Ciencias Morfológicas y Cirugía de la Universidad de Alcalá de Henares Silva Mato, A. Departamento de Ciencias Sanitarias y Medicosociales (Bioestadística) de la Universidad de Alcalá de Henares. de Alcalá de Henares. https://inis.iaea.org/collection/NCLCollectionStore/_Public/38/064/38064932.pdf

4. Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations. By Zothansiama, Mary Zosangzuali, Miriam Lalramdinpuui and Ganesh Chandra Jagetia. Received 27 Apr 2017, Published 04 Aug 2017/NIH/National Library of Medicine/National Center for Biotechnology Information. <https://doi.org/10.1080/15368378.2017.1350584>
5. **Health impact of 5G, Study 22-07-2021, by Panel for the Future of Science and Technology (STOA)/ European Parliament.** (Written by Dr. Fiorella Belpoggi, BSC, PhD, International Academy of Toxicologic Pathology Fellow (IATPF), Ramazzini Institute, Bologna (Italy), review was performed by Dr Daria Sgargi, PhD, Master in Biostatistics, and Dr Andrea Vornoli, PhD in Cancer Research, Ramazzini Institute, Bologna) [https://www.europarl.europa.eu/stoa/en/document/EPRS_STU\(2021\)690012](https://www.europarl.europa.eu/stoa/en/document/EPRS_STU(2021)690012)
6. **Genotoxicidad de los campos magnéticos de frecuencia extremadamente baja determinada mediante el ensayo de micronúcleos,** por Dª. Encarnación Olmos Ortíz, 22-nov-2013/ Digitum: Repositorio Institucional de la Universidad de Murcia/ Ciencias de la Salud / Tesis doctorales / Investigación / 10201/36980. <https://digitum.um.es/digitum/handle/10201/36980> / https://emmind.net/openpapers_repos/Applied_Fields-Hazads/ELF_Effects/ELF-EMF/2012_Genotoxicidad_de_los_campos_mag%C3%A1nicos_de_frecuencia_extremadamente_baja_determinada_mediante_el_ensayo_de_micron%C3%BAcleos.pdf
7. **Comparison of cytotoxic and genotoxic effects of plutonium-239 alpha particles and mobile phone GSM 900 radiation in the Allium cepa test,** by Dmitry S. Pesnya, Anton V. Romanovsky, Russian Academy of Sciences, 152742 Borok, Nekouz, Yaroslavl region, Russia / Mutation Research/Genetic Toxicology and Environmental Mutagenesis Journal / www.elsevier.com/locate/gentox / Community address: www.elsevier.com/locate/mutres, <https://www.sciencedirect.com/science/article/pii/S1383571812002914>
8. **DNA effects of low level occupational exposure to extremely low frequency electromagnetic fields (50/60 Hz) May 2019,** Rezvan Zendehdel, Il Je Yu, Behnam Hajipour-Verdom, Zahra Panjali, (Shahid Beheshti University of Medical Sciences, Tehran, Iran, Project: DNA Damage-occupational hazards). Toxicology and Indust. Health 35(2):074823371985169/ <http://dx.doi.org/10.1177/0748233719851697>

