

Listas de estudios que demuestran efectos de radiación electromagnética de radiofrecuencia o microondas en los sistemas vivos.

Todos los estudios compilados aquí encuentran efectos tras la aplicación de radiación no ionizante en intensidades pequeñas que nunca causarán efectos por calentamiento de los tejidos. Los efectos se deben a resonancias con las diferentes estructuras biológicas a diferentes escalas, lo que afecta posteriormente a las diferentes rutas iónicas o químicas de las células y los tejidos, y a la energía celular.

Los estudios se distribuyen en varias secciones, las cuales a su vez pueden contener subsecciones más específicas, como tipos de efectos o la intencionalidad buscada (en caso de aplicaciones terapéuticas). Cada estudio solo aparece una vez y en una sección.

Las secciones son:

- ⦿ **5G & 4G Phone MW Hazards Experiments:** Estudios experimentales en los que se ha usado frecuencias e intensidades habituales para las tecnologías 5G o 4G, de manera extraña solo hay dos estudios que utilicen específicamente una frecuencia de 5G.
- ⦿ **3G & 2G Phone MW Hazards Experiments:** Estudios experimentales en este caso de 3G y 2G clásicos, se recogen cientos de estudios.
- ⦿ **Wi-Fi MW Hazards Experiments:** Estudios experimentales en este caso de la exposición a radiación de Wi-Fi o radiación a una de las frecuencias más clásicas del Wi-Fi (2,4 GHz) y baja intensidad.
- ⦿ **Phone Base Station MW Hazards:** Estudios que muestran daños por radiación desde antenas de telefonía en general.
- ⦿ **Various MW Freq. Hazards Experiments:** Otros estudios que o bien utilizan varias frecuencias para realizar las pruebas o bien utilizan frecuencias no asociadas a una tecnología de telecomunicaciones pero están en su mismo rango, y muestran daños.
- ⦿ **Various MW Freq. Hazards Reviews:** Revisiones, es decir estudios sobre los resultados de conjuntos de estudios, y que señalan también la existencia de distintos efectos.
- ⦿ **High Frequency:** Estudios experimentales y de aplicación terapéutica de frecuencias algo más bajas que las usadas en telecomunicaciones pero que muestran también cómo a intensidades bajas se producen efectos en los sistemas vivos, en este caso intencionadamente.
- ⦿ **Microwave:** Más estudios experimentales o de aplicación terapéutica de radiación, en este caso utilizando frecuencias muy similares a las de uso en telecomunicaciones.
- ⦿ **Millimeter & Submillimeter Wave:** Estudios experimentales o de aplicación terapéutica pero con frecuencias de algunas decenas de GHz, equivalentes a las frecuencias que se quiere hacer funcionar el 5G.

No es un listado exhaustivo, pero para cada una de las categorías se ha dispuesto un amplio porcentaje de los estudios realizados en los últimos 10 años.

ANEXO: ¿Cómo comparar las radiaciones usadas en los experimentos con las radiaciones que encontramos en la vida real?

Para poder contextualizar bien a que intensidades y con que señales de radiación se están encontrando efectos y poder comparar eso con las intensidades que recibimos en los ambientes electromagnéticos de nuestras ciudades o lo que se genera al hablar con el móvil podemos mirar en las listas de "3G & 2G", "5G & 4G" y "Wi-Fi", ente otras, en la segunda columna que tiene cada estudio listado y que tiene el nombre de **"Used freq. and power"**.

En esa columna se ponen más o menos datos, dependiendo de si se ha podido disponer de ellos o no. Pero siempre se utiliza el siguiente orden:

	Used freq. and power	Hours day / days	Authors
...dative Stress Biomarkers in...	900 MHz (100-217 Hz modulated) - 0.000045 mW/cm2	8h/10 d	Nargess M Iraj Alimoh Safari Vari Ashtarinez
...edema and inflammatory cell infiltration were observed at mucosal epith...			
...the rats exposed to electromagnetic exposure: histopathological	900-2100 MHz - 0.0000008-0.0000011 mW/cm2 (SAR 0.4 W/kg)	1h/20 d	Anjali Shar Shrivastav Shukla
...changes in the body weight and hematologic parameters (RBCs, WBCs, p...			
...tion on Oxidant-Antioxidant of Rats	1800 MHz (GSM), 2100 MHz (GSM) - 0.03-0.12 mW/cm2 (SAR 0.2-0.6 W/kg (body))	2h/20 d	Mehmet E. Mehmet Z. Suleyman
...yde, 8-hydroxydeoxyguanosine total oxidant status, oxidative stress in...			
...es on the Prostate in Human	-	-	Madyha H. Mahmoud, Youssef M. Khadiga S. ...

Ahora se comentarán los aspectos más útiles de esos datos, especialmente lo relativo a la potencia utilizada.

1 - Frecuencia utilizada

Puede aparecer en MHz o GHz.

Podéis encontrar las frecuencias que se utilizan en vuestros países para las diferentes tecnologías, menos la de 5G, en esta web: <https://www.worldtimezone.com/gsm.html> (la sección de 5G está sin actualizar), son las que ponen "900" o "1900" o "2100", etc. y se tratan de MHz. No son esas las frecuencias usadas exactamente sino que hay alrededor de ellas varias en uso.

No es el objetivo de este texto reseñar la importancia concreta de una frecuencia, ya que hay muchos factores, y muchos resultados. Pero por lo menos se puede observar que en los estudios de efectos de radiación de telefonía móvil se utilizan las frecuencias típicas de cada tecnología, lo que es lógico. Lo mismo ocurre con el Wi-Fi (en su caso 2.4-2.5 GHz y 5.1-5.9 GHz).

2 - Modulación

Aparece entre paréntesis después de la frecuencia y puede ser algo como "(GSM)" o "(3G UMTS)" u otras. Si se sabe que la señal no está modulada pondrá "(CW)" (de Continuous Wave). Si la señal esta modulada entonces más se parecerá la exposición a una situación real ya que todas las señales de telefonía están moduladas de una u otra manera, además está comprobado que los efectos son diferentes y más fuertes con las señales moduladas.

3 - Densidad de potencia

Se señala con un valor en mW/cm² (milivatios/centímetro cuadrado). Es sumamente importante para poder comparar con situaciones de la vida real como veremos, es la potencia de la señal electromagnética. Se puede utilizar para valorar tanto la radiación que viene desde antenas de telefonía (radiación ambiental) como la radiación que genera un móvil u otro dispositivo inalámbrico.

3.1 - Intensidades recomendadas y "límites" legales.

Diferentes organismos internacionales y organizaciones no gubernamentales han propuesto diferentes límites para minimizar los daños en los seres humanos:

- El Consejo de Europa en la Resolución 1815 elaborada en 2011 [1] recomendó unos límites máximos medios en interiores de 0.0001 mW/cm² (0.6 V/m) para con el tiempo reducirlos a 0.00001 mW/cm² (0.2 V/m).
- El instituto Baubiologie, especialistas en bioconstrucción, recomendaron en una muy conocida guía de 2008 [2] que, para zonas de descanso, a partir de 0.0000001 mW/cm² (aprox.) había que empezar a estar ligeramente preocupado y con una intensidad mayor de 0.0001 mW/cm² extremadamente preocupados.
- Un grupo sin ánimo de lucro IGNIR (no confundir con ICNIRP que veremos después) saca un informe con recomendaciones en 2021 [3] en el que recomiendan durante el día una media máxima de 0.000001 mW/cm² (con picos puntuales de 0.00001 mW/cm²) y durante la noche 10 veces menos.
- El grupo Bioinitiative sacó un informe en 2012 [4] (que han ido actualizando) que dice que el nivel mínimo al que se han encontrado efectos de radiaciones es 0.000003 mW/cm² y que sus recomendaciones, teniendo en cuenta posibles

efectos a largo plazo, no constatados experimentalmente, quedan por debajo de ese límite.

Pero ¿cual es el límite legal en tu país? pues muy muy probablemente tu país siga las recomendaciones de la ICNIRP o de la FCC (en los mapas de [5] podéis ver que recomendación se está aplicando en cada país), ambos organismos establecen un límite máximo igual para las radiaciones ambientales de telefonía: 1 mW/cm².

La razón por la que estos organismos establecen un límite tan alto (hay infinidad de estudios que encuentran efectos a intensidades muchísimo más bajas) es porque solo tienen en consideración como efectos posibles de estas radiaciones los efectos térmicos (es decir efectos derivados del calentamiento de los tejidos). El porqué hacen esto está posiblemente relacionado con conflictos de intereses y el "gobernar" a favor de toda la industria de las telecomunicaciones (y otros sectores que quizás ganen indirectamente). Por ejemplo el ICNIRP (una organización privada con un plantel de unos 14 científicos) es la voz "autorizada" por la OMS para recomendar los límites de radiación electromagnética y que casi todos los gobiernos siguen (el límite de 1 mW/cm²), y ha recibido críticas serias [6] [7] y denuncias de parlamentarios europeos [8].

Conociendo los límites legales y los recomendados podemos mirar cual es la intensidad que tenemos en la vida real para hacernos una idea de donde estamos y además poder comparar con las intensidades usadas en los experimentos de las listas.

3.2 - Intensidades en la vida real: Radiaciones desde antenas de telefonía y ambientes exteriores.

Es imposible decir en general que para todas las antenas a una distancia determinada hay una determinada intensidad de señal, porque las antenas tienen potencias muy variables unas respecto a otras, por ejemplo según [9] a 50 metros dependiendo la potencia de antena encuentra de 0.0003 a 0.001 mW/cm². Según [10] para varios tipos de antenas la mayor intensidad a nivel de suelo se encuentra en la franja de 75-100m ya que los lóbulos de la antena son direccionales y hay una especie de paraguas alrededor de la antena, encuentran máximos de de 0.0004 a 0.0013 mW/cm². En [11] Se señala cómo varía la intensidad de la señal desde las antenas dependiendo de la hora siendo mayores a la noche con intensidades de hasta 0.029 mW/cm² mientras que durante las mañanas apenas alcanzan los 0.001 mW/cm², en este caso además la mayor intensidad media se encuentra en el rango de 150-200m (el "paraguas" a nivel de calle es más amplio).

Pero una cosa es la señal que recibimos desde una antena y otra cosa el ambiente de radiación que puede haber en un punto concreto en una ciudad donde varias fuentes pueden estar actuando. Es recomendable observar mediciones recientes ya que el número de antenas y exposición en general ha crecido posiblemente (impresión personal) al doble de intensidad en los últimos 6-7 años. Por ello recomiendo esta web de mediciones in-situ: globalemf.net [12], donde si nos fijamos en las mediciones, de casi todos los puntos en casi todas las ciudades, las medias varían de 0.0001 mW/cm² a 0.010 mW/cm², con picos que pueden ser 10 veces mayores.

En este estudio [13] de 2019 señalan que en una casa situada a menos de 10 metros de una antena, en su balcón detectan una media de 0.009 mW/cm² y dentro de la casa en una habitación al lado 0.002 mW/cm², mientras que en una casa alejada de la antena encuentran 0.00014 mW/cm² en el balcón y dentro de la casa un máximo de 0.000071

mW/cm² en una habitación colindante y un mínimo de 0.000002 mW/cm² en una habitación interior.

3.3 - Intensidades en la vida real: Radiaciones desde teléfonos móviles.

Para definir con que intensidad nos irradia un teléfono móvil (no una antena de telefonía) se suele utilizar más el llamado SAR, que se señala después en esta explicación, pero a modo de comparación señalaré los mW/cm² que se suelen detectar desde teléfonos móviles.

Cuando utilizamos el móvil para hablar hay factores tanto del propio móvil como del exterior que afectan a cuanto irradia el móvil, uno de ellos es que cuando la señal del entorno es fuerte (cuando hay barras en el móvil, pero también más radiación ambiental) el móvil irradia menos que cuando la señal ambiental es débil, por ejemplo según [14] por esa circunstancia un móvil puede pasar de irradiar, a 4 cm, de 0.000006 mW/cm² (en otros estudios no se ven potencias tan bajas así que tomarlo solo como referencia para esta comparación) a 0.035 mW/cm². Por otro lado también depende del estado del móvil, en concreto un móvil puede emitir una media de 0.030 mW/cm² (a 5 cm), pero si tiene poca batería puede llegar, en momentos, a 0.090 mW/cm² [15].

Lo que viene a continuación es el resultado de un estudio [16] que señala el rango de intensidades medidas en 4 teléfonos móviles a diferentes distancias (como se verá la irradiación se reduce con la distancia) y realizando diferentes actividades:

⊙ Recibiendo llamada (sin contestar):

a 05 cm de 0.011 a 0.080 mW/cm²
a 10 cm de 0.010 a 0.073 mW/cm²
a 15 cm de 0.007 a 0.051 mW/cm²
a 20 cm de 0.006 a 0.044 mW/cm²
a 25 cm de 0.004 a 0.042 mW/cm²
a 30 cm de 0.004 a 0.035 mW/cm²
a 40 cm de 0.002 a 0.022 mW/cm²
a 50 cm de 0.002 a 0.011 mW/cm²

⊙ Llamada contestada:

a 05 cm de 0.026 a 0.052 mW/cm²
a 10 cm de 0.019 a 0.045 mW/cm²
a 15 cm de 0.013 a 0.037 mW/cm²
a 20 cm de 0.005 a 0.032 mW/cm²
a 25 cm de 0.005 a 0.024 mW/cm²
a 30 cm de 0.004 a 0.018 mW/cm²
a 40 cm de 0.002 a 0.014 mW/cm²
a 50 cm de 0.001 a 0.009 mW/cm²

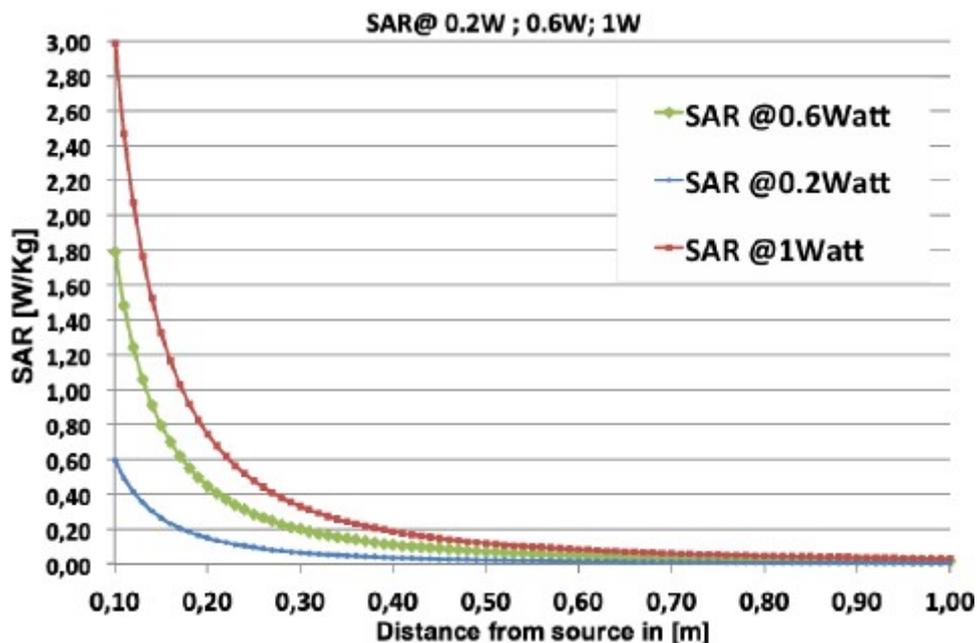
Los ensayos señalan que el utilizar datos (y no voz) es decir navegar, descargar archivos, y otras actividades generan más radiación que la señal de voz clásica [17]. Además es interesante saber que según [18] hay actividades con datos que causan más radiación desde el móvil, por ejemplo para un móvil 4G+ el orden de más a menos emisión de radiación sería: subida de archivos, llamada por internet, videollamada, descarga de archivos, transmisiones (streaming) y por último navegación web.

3.4 - Intensidades en la vida real: Radiaciones desde routers Wi-Fi.

Según la distancia, a 30cm pueden ser 0.0025 mW/cm² y a 1m 0.00025 mW/cm² [19][20].

4 - SAR

Aparece entre paréntesis después de la densidad de potencia, SAR son las siglas de "tasa de absorción específica" (en ingles), es un valor que se pone en W/kg y es el resultado de un calculo, no una medición directa, que señala cuanta energía absorbe el tejido o sujeto expuesto. A parte de calcularse para algunos experimentos es un valor que aparece siempre en las especificaciones de todos los teléfonos y dispositivos móviles (en esos casos el valor se calcula con el tejido/sujeto a 5 mm de la fuente de radiación) [21] y se emplea para poner límites legales a la cantidad de energía que emiten los dispositivo móviles: para los europeos, el límite de la tasa de absorción específica (SAR) para los dispositivos portátiles es de 2,0 W/kg en promedio sobre 10 g de tejido, para los norteamericano es de 1,6 W/kg en promedio sobre 1 g de tejido. Los móviles por lo tanto se supone que emiten por debajo de esos límites. Entonces si tenemos el móvil casi pegado a la oreja nos puede estar afectando al tejido cercano desde algo como 0.2 W/kg [22] pasando por todo el rango hasta los límites [23] y más allá incluso, por ejemplo 8.22 W/kg [24]. Por lo tanto, se puede comparar esos límites con los SAR que aparecen en los listados de estudios. Solo una excepción: si al lado de la palabra SAR aparece la palabra 'specs' entonces es que el estudio no ha hecho un calculo del SAR para sus condiciones de exposición sino que pone el SAR que aparece en las especificaciones del teléfono móvil, la exposición en los estudios muchas veces es a varios cm del móvil (y no a 5 mm que es el SAR del manual) por lo que en realidad este será bastante más bajo, en el siguiente gráfica se ve como puede bajar el SAR con la distancia desde 3 dispositivos con potencias distintas [25]:



Si pone un valor en mW/cm² es mejor que utilizéis ese valor a modo de comparación con los valores ambientales comunes que ya se han señalado en el punto 3, si no aparece ese valor y solo aparece un SAR en W/kg podéis utilizar ese valor para haceros a la idea conociendo los valores límites legales para móviles y sabiendo que la mayoría de los móviles se acercan a esos valores bastante.

Refs.:

- [1] <http://assembly.coe.int/nw/xml/XRef/Xref-XML2HTML-en.asp?fileid=17994&lang=en>
- [2] https://www.baubiologie.de/downloads/english/richtwerte_2008_englisch.pdf
- [3] <https://ignir.org/wp-content/uploads/2020/12/IGNIR-Guidelines-Issue-1.4-Jan-2021.pdf>
- [4] <https://bioinitiative.org/conclusions/>
- [5] <https://www.gsma.com/publicpolicy/emf-and-health/emf-policy>
- [6] <https://www.spandidos-publications.com/ijo/51/2/405/>
- [7] <https://www.mdpi.com/2312-7481/5/2/31>
- [8] https://www.avaate.org/IMG/pdf/icnirp_report-final-june-2020.pdf
- [9] https://www.researchgate.net/publication/326493973_Comparative_Analysis_Of_Base_Transceiver_Station_BTS_and_Power_Transmission_Lines_Effects_On_The_Human_Body_In_the_Lagos_Environ
- [10] <http://article.sapub.org/10.5923.j.biophysics.20170702.01.html>
- [11] <https://iopscience.iop.org/article/10.1088/1742-6596/2034/1/012009/pdf>
- [12] <https://globalemf.net/>
- [13] <https://www.spandidos-publications.com/10.3892/ol.2019.10899>
- [14] <https://ecfsapi.fcc.gov/file/10913296696567/Real-world%20cell%20phone%20radiofrequency%20electromagnetic%20field%20exposures.pdf>
- [15] https://www.researchgate.net/publication/331475361_The_effect_of_battery_charge_levels_of_Mobile_phone_on_the_amount_of_Electromagnetic_waves_emission
- [16] <https://dergipark.org.tr/en/download/article-file/1150501>
- [17] <https://www.sciencedirect.com/science/article/abs/pii/S0263224118311631>
- [18] <https://www.nature.com/articles/jes201474>
- [19] <https://www.mdpi.com/1660-4601/16/6/955>
- [20] <http://www.emfwise.com/distance.php>
- [21] <https://verkotan.com/2020/mobile-sar-value/>
- [22] <https://emfacademy.com/lowest-radiation-cell-phones/>
- [23] <https://www.statista.com/chart/12797/the-phones-emitting-the-most-radiation/>
- [24] <https://www.chicagotribune.com/investigations/ct-cell-phone-radiation-testing-20190821-72qgu4nzlfda5kyuhteieih4da-story.html>
- [25] https://www.researchgate.net/figure/SAR-W-kg-vs-distance-from-the-human-body-for-varying-reader-powers_fig1_261334054

Listados:
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5G & 4G Phone MW Hazards Experiments

/ Papers listed: 29

5G & 4G Phone MW Hazards Experiments

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Biological effects of non-ionizing electromagnetic fields to 27 GHz on sperm quality of <i>Mytilus galloprovincialis</i>	27 GHz (CW)- (SAR 0.11-0.18 W/kg)	10-40 min/1 d	Roberta Pecoraro, Santi Concetto Pavone, Elena Maria Scalisi, Carmen Sica, Sara Ignoto, Martina Contino, Antonio Salvaggio, Gino Sorbello, Loreto Di Donato, Maria Violetta Brundo	2022-(7)
<p>" The experiments were conducted with a no commercial high gain pyramidal horn antenna. Sperm samples, taken from sexually mature males of <i>M. galloprovincialis</i>, were placed in seawater. Once evaluated the number and quality of spermatozoa, sperm cells were exposed to electromagnetic fields. ... A significant decrease (30%) in sperm motility was observed after 10 minutes of exposure and after 30 minutes all sperms were immobile and not vital. The measurement of the Oxidation Reduction Potential (sORP), which evaluates the oxidative damage on spermatozoa, shows how the exposure to 27 GHz has increased the oxidant amount compared to the control groups." {From the publication}</p>				
3.5-GHz radiofrequency electromagnetic radiation promotes the development of <i>Drosophila melanogaster</i>	3.5 GHz (5G) - 0.01-1 mW/cm ²	-	Yahong Wang, Zhihao Jiang, Lu Zhang, Ziyang Zhang, Yanyan Liao, Peng Cai	2021-(1)
<p>" We found that the pupation percentages in the first 3 days and eclosion rate in the first 2 days were increased under exposure to RF-EMF, and the mean development time was shortened. In a study on third-instar larvae, the expression levels of the heat shock protein genes hsp22, hsp26 and hsp70 and humoral immune system genes AttC, TotC and TotA were all significantly increased. In the oxidative stress system, DuoX gene expression was decreased, sod2 and cat gene expression levels were increased, and SOD and CAT enzyme activity also showed a significant increase. According to the 16S rDNA results, the diversity and species abundance of the microbial community decreased significantly, and according to the functional prediction analysis, the genera <i>Acetobacter</i> and <i>Lactobacillus</i> were significantly increased. In conclusion, 3.5 GHz RF-EMF may enhance thermal stress, oxidative stress and humoral immunity, cause changes in the microbial community, and regulate the insulin/TOR and ecdysteroid signalling pathways to promote fly development."</p>				
Ameliorative effect of <i>Punica granatum</i> on sperm parameters in rats exposed to mobile radioelectromagnetic radiation ("chemical remedy")	800-2400 MHz (4G) - (SAR, specs, 0.53 W/kg)	1h/90 d	Anjaneyababu Naik Banavath, Sridevi Nangali Srinivasa	2021-(7)
<p>" Our current study results showed that the chronic exposure [90 days (1 hour/day)] to RF-EMR emitted by 4G mobile leads to decrease of the sperm count, viability, motility, and progressivity in rat semen. In addition, RF-EMR exposure also increased the abnormality of sperm morphology in rat semen. It indicates the chronic exposure of RF-EMR emitted by 4G mobile causes male infertility in rats." {From the publication}</p>				
Effect of 2400 MHz mobile phone radiation exposure on the behavior and hippocampus morphology in Swiss mouse model	2400 MHz (4G) - 0.2 mW/cm ²	100min/60d	Imam Hasan, Mir Rubayet Jahan, Md Nabiul Islam, Mohammad Rafiqul Islam	2021-(9)
<p>" In exposed mice compared to control mice, a significant increase in anxiety-like behavior has been observed. Histological observations have shown many black and dark blue cytoplasmic cells with shrunken morphology degenerative alterations in the neuronal hippocampus in the radiation exposed mice. In the RF-EMR mouse hippocampus, stereological analyses revealed a significant decrease in pyramidal and granule neurons compared to controls. Our findings suggest that 2400-MHz RF-EMR cell phone radiation affects the structural integrity of the hippocampus, which would lead to behavioral changes such as anxiety. However, it alerts us to the possible long-term detrimental effects of exposure to RF-EMR." {From the publication}</p>				
A Study of RFR Effects on the Brain Neurochemistry during Pre- and Postnatal Brain Development	(4G)	6-24h /56d	Joshua Oladele Owolabi, Olayinka Stephen Ilesanmi, Vimla Luximon-Ramma	2021-(11)
<p>" RFR-exposure caused changes in neurotransmitters and enzyme neurochemistry. Cytochrome C oxidase enzyme and neurotransmitters especially dopamine, gamma-amino butyric acid, glutamine and serotonin and their activities levels were significantly altered especially with prolonged duration in RFR exposure. These findings would altogether suggest that radiofrequency radiation exposure might change brain neurochemistry permanently following exposure either during the intrauterine or the postnatal stage of life. The implications of these changes on later life mental health and neurological attributes will require further investigation." {From the publication}</p>				
A Study of 4G Radiofrequency Radiation effects on Juvenile Wistar Rats Cerebellum and Potential Attenuative Properties of Fish Oil Omega-3 Fat ("chemical remedy")	(4G LTE + mobile Wi-Fi) - (SAR, specs, 1.5	24h/1 4-28d	Fabiya Oluwaseyi Sunday, Ogunbiyi Olubunmi, C. Odusotefoluwa,	2021-(14)

	W/kg)		Adelakin Lola, Olanrewaju John Afees, Olatunji Sunday Yinka, Owolabi Joshua Oladele	
<p>" 4G radiofrequency radiation caused distortions in the morphology and spatial arrangement of Purkinje cells in the cerebellar tissues. It also induced neuroinflammation as marked by enhanced astrocyte reactions. Also, behavioural aberrations including negative changes in key memory parameters such as increased latency and error poke in Barnes maze assays, and increased movement parameter errors were attributable to FRR effects. Also, aberrations in neurotransmitters activities levels and vital neurochemistry enzymes were observed." {From the publication}</p>				
Simulated mobile communication frequencies (3.5GHz) emitted by a signal generator affects the sleep of <i>Drosophila melanogaster</i>	3.5 GHz (5G) - 0.01-1 mW/cm ²	24h/3-?d	Yahong Wang, Hongying Zhang, Ziyang Zhang, Boqun Sun, Chao Tang, Lu Zhang, Zhihao Jiang, BoDing, Yanyan Liao, Peng Cai	2021-(1)
<p>Exposed flies (3 days): Increased activity level. Reduced sleep duration. Exposed flies (long term): Reduced activity level. Increased sleep duration. Increased heat stress response-related hsp22, hsp26 and hsp70 genes expression. Altered circadian clock-related per, cyc, clk, cry, and tim genes expression. Altered synthesis, transport and receptor genes expression. Reduced GABA and glutamate content. • Exposure system simulated the representative frequency of 5G construction in China (3.5 GHz).</p>				
Examining changes in sensitivity and functionality of mechanosensitive ion channel protein Piezo 1 exposed to Low-Level Radiofrequency Radiation	845 MHz (4G) - 0.0005-0.0038 mW/cm ²	10m/1d	Azadeh Torkan	2021-(141)
The effect of 4.5 G (LTE Advanced-Pro network) mobile phone radiation on the optic nerve	(4G LTE)	2h/42d	Erkin Özdemira, Ülkü Çömelekoglua, Evren Degirmencib, Gülsen Bayrakc, Metin Yildirimd, Tolgay Ergenoglu, Banu Coşkun Yilmazc, Begüm Korunur Engizf, Serap Yalind, Dilan Deniz Koyuncue, Erkan Ozbayg	2021-(1)
<p>Exposed rats: Decreased mean visual evoked potential amplitudes. Decreased axonal diameter and myelin thickness while there is an increased G-ratio (as is observed performing morphometric analysis). Increased malondialdehyde levels. Decreased superoxide dismutase and catalase activities.</p>				
Hematobiochemical and histopathological alterations of kidney and testis due to exposure of 4G cell phone radiation in mice	2400 MHz (4G) - (SAR 0.087 W/kg)	40-60 min/60d	Imam Hasan, Tanjina Amin, Md. Rafiqul Alam, Mohammad Rafiqul Islam	2021-(10)
<p>" Results of the study showed that the body weight and total erythrocyte count values were significantly ($p < 0.05$) decreased while total leukocyte count, hemoglobin %, and serum creatinine values were significantly ($p < 0.05$) increased in both the radiation exposure groups relative to the control group. Histopathological observation showed the kidney of 60 minutes exposed mice interstitial inflammation that causes marked mononuclear cellular infiltration compared to the 40 minutes and control mice. Compared to control mice, histopathological examinations of testicular tissue from the exposed mice, showed irregular in shapes and non-uniform sizes and fewer spermatogenic cells layer that leads to the larger lumen in the seminiferous tubules. It is concluded that fourth-generation cell phone radiation exposure may affect blood hemostasis and inflammation of mice's kidney and testis tissue. Based on these studies, it is important to increase public consciousness of potential adverse effects of mobile phone radiofrequency electromagnetic radiation exposure." {From the publication}</p>				
Functional and network analyses of human exposure to long-term evolution signal	2753 MHz (4G LTE) - (SAR 0.61 W/kg (10g))	30min/1d	Lei Yang, Chen Zhang, Zhiye Chen, Congsheng Li, Tongning Wu	2020-(19)
<p>First it demonstrates that SAR, that is used for assessing the thermal effect of human exposure, was incongruous to quantify the neurophysiological effect of EMF exposure as effects are clearly caused by other mechanisms. Some of the changes in the brain detected in this study (that includes real or sham exposures blind to the subjects) are: diminished functional connection strength, whereas its diversity is slightly enhanced for most of the 90 regions, increased normalized clustering coefficient, while normalized characteristic path length remained unchanged (that could indicate hyper-connectivity, unnecessarily beneficial to normal information processing). Increased clustering coefficient at the contralateral medial frontal lobes. Suppression of the information exchange ability at the primary visual cortex but increased or unaffected ability at the other hubs in the dorsal visual pathway, etc, etc.</p>				
Continuous Exposure to 1.7 GHz Lte electromagnetic fields increases intracellular Reactive oxygen Species to Decrease Human Cell Proliferation and induce Senescence	1.7 GHz (4G LTE-WCDMA) - (SAR 1-2 W/kg)	24h/3d	Jisu Choi, Kyeongrae Min, Sangbong Jeon, Nam Kim, Jeong-Ki Pack, Kiwon Song	2020-(15)
<p>" ... cell proliferation was consistently decreased in all the human cells. The anti-proliferative effect was higher at 2 SAR than 1 SAR and was less severe in ASCs. The exposure to RF-EMF for 72 h at 1 and 2 SAR did not induce DNA double strand breaks or apoptotic cell death, but did trigger a slight delay in the G1 to S cell cycle transition. Cell senescence was also clearly observed in ASC and Huh7 cells exposed to RF-EMF at 2 SAR for 72 h. Intracellular ROS increased in these cells and the treatment with an ROS scavenger recapitulated the anti-proliferative effect of RF-EMF. These observations strongly suggest that 1.7 GHz LTE RF-EMF</p>				

decrease proliferation and increase senescence by increasing intracellular ROS in human cells." {From the publication}				
Effects of mobile phone radiation on certain hematological parameters	2300-2400 MHz (4G) - (SAR, specs, 1.42 W/kg)	1h/1d	Bindhu Christopher, Y. Sheena Mary, Mayeen Uddin Khandaker, D. A. Bradley, M. T. Chew, P. J. Jojo	2020-(1)
Exposed human blood: Decreased platelet count, and increased hemoglobin level, erythrocytes sedimentation rate and white blood cell count.				
Short- and long-duration exposures to cell-phone radiofrequency waves produce dichotomous effects on phototactic response and circadian characteristics of locomotor activity rhythm in zebrafish, Danio rerio	2300 MHz (4G) - (SAR 0.004 W/kg)	30min-4h/1d, 7d	Shikha Malik, Atanu Kumar, Arti Parganiha	2019-(16)
Exposed fishes: Altered patterns of locomotor activity that were dependent on both time of exposure (morning vs. evening) and duration of exposure, suggesting that RFR affected circadian rhythm. " Results of two-way ANOVA revealed statistically significant effects of the factors exposure time and exposure duration on the PR of zebrafish. Fish exhibited photo-positive response till 2 h following morning exposure, and thereafter, showed photo-negative response with increased duration of exposure. During evening exposure, the fish were mostly photo-negative. However, 1 week exposure to CPR did not produce any significant effects on the circadian characteristics of locomotor activity rhythm."				
Early-Life Exposure to Pulsed LTE Radiofrequency Fields Causes Persistent Changes in Activity and Behavior in C57BL/6J Mice	1846 MHz (4G LTE) - (SAR 0.5-1 W/kg)	30min /22d	Kerry A. Broom, Richard Findlay, Darren S. Addison, Cristian Goiceanu, Zenon Sienkiewicz	2019-(14)
" The exposure caused significant effects on both appetitive behaviors and activity of offspring that depended on the SAR. Compared with sham-exposed controls, exposure at 0.5 W/kg significantly decreased drinking frequency ($P \leq 0.000$) and significantly decreased distance moved ($P \leq 0.001$). In contrast, exposure at 1 W/kg significantly increased drinking frequency ($P \leq 0.001$) and significantly increased moving duration ($P \leq 0.005$). In the absence of other plausible explanations, it is concluded that repeated exposure to low-level RF fields in early life may have a persistent and long-term effect on adult behavior." {From the publication}				
Long-term exposure to 4G smartphone radio frequency electromagnetic radiation diminished male reproductive potential by directly disrupting Spock3–MMP2-BTB axis in the testes of adult rats	2575–2635 MHz (4G) - 2.24 mW/cm ² (SAR 1.05 W/kg)	6h/15 0d	Gang Yu, Zeping Tang, Hui Chen, Zhiyuan Chen, Lei Wang, Hui Cao, Gang Wang, Jiansheng Xing, Haotao Sheng, Qing Cheng, Donghui Li, Guoren Wang, Yang Xiang, Yupeng Guang, Yabing Zhu, Zhenxiang Liu, Zhiming Bai	2019-(1)
Modulation of resting-state brain functional connectivity by exposure to acute fourth-generation long-term evolution electromagnetic field: An fMRI study	2573 MHz - (SAR 0.98 W/kg (10g))	30min /1d	Yiwen Wei, Jiayi Yang, Zhiye Chen, Tongning Wu, Bin Lv	2019-(1)
In this study (having a doubleblind, crossover, randomized, and counterbalanced design) it has been found that the acute LTE-EMF exposure modulated localized intra-regional connectivity and inter-regional connectivity in some brain regions.				
Exposure to mobile phone radiations at 2350 MHz incites cyto- and genotoxic effects in root meristems of Allium cepa	2350 MHz - 0.0492 mW/cm ² (0.31 W/kg)	1-4h/ 1d	Shikha Chandel, Shalinder Kaur, Mohd Issa, Harminder Pal Singh, Daizy Rani Batish, Ravinder Kumar Kohli	2018-(8)
Exposed roots: Increased of mitotic index and chromosomal aberrations (%) upon 4 h, and 2 h of exposure. No specific changes in phase index. The % head DNA and % tail DNA values exhibited significant changes in contrast to that of control upon 2 h and 4 h of exposure. Tail moment and olive tail moment did not change significantly.				
Short-term radiofrequency exposure from new generation mobile phones reduces EEG alpha power with no effects on cognitive performance	1947 MHz (3G UMTS), 1750 MHz (4G LTE-WCDMA) - (SAR max. 1.8 W/kg)	20min /1d	Zsuzsanna Vecsei, Balázs Knakker, Péter Juhász, György Thuróczy, Attila Trunk, István Hernádi	2018-(12)
" Both RF exposure types caused a notable decrease in the alpha power over the whole scalp that persisted even after the cessation of the exposure, whereas no effects were found on any aspects of performance in the Stroop test. The results imply that the brain networks underlying global alpha oscillations might require minor reconfiguration to adapt to the local biophysical changes caused by focal RF exposure mimicking MP use." {From the publication} I have the opinion that most important is the fact of the altered EEG spectra (with the decreased Alpha band activity) than the supposed non effect in cognitive performance. As already is known brain frequencies are specific for multitude of mind functionalities [1], in recent study is found that Alpha band decrease is a symptom of aging [2]. More studies where it's show that EEG is altered when exposed to mobile phones (in 2G, GSM, 3G and others) can be found here [3]. [1] EMMIND > Endogenous Fields & Mind > Endogenous Electromagnetic Fields > Electromagnetic Mind - Other supporting > Brain Frequencies: Various Phase Synchrony				

[2] Lifespan driven reorganization of the global network dynamics unfold on a multifrequency landscape. [3] EMMIND › Applied Fields - Hazards › Microwave Hazards ☐ (Phone, Wi-Fi) › 3G & 2G Phone MW Hazards Experiments › 3G & 2G Phone radiation effects on Brain: EEG Changes				
AB037. Long-term exposure to the mobile phone radiation decreased the sperm quality of Sprague Dawley rats	(4G) - (SAR, specs, 1.58 W/kg)	4h/15 0d	Gang Yu, Zhiming Bai	2018-(1)
Exposed rats (150 days): Decreased sperm concentration, sperm motility and sperm viability. Increased abnormal sperm rate and sperm DNA fragmentation index. Decreased cub weight. Increased testicular malondialdehyde (MDA) and 4-Hydroxynonenal (HNE) levels. Decreased testicular superoxide dismutase (SOD), catalase (CAT) and glutathione (GSH) levels. Etc ...				
The effect of exposure to Wi-Fi 4G electromagnetic wave radiation on the weight of epididymis and morphology of the sperm of male wistar rats (in Indonesian)	(4G)	8-24h/ 44d	Meily Nirnasari	2018-(15)
Exposed rats: Decreased testicular volume, epididymis and sperm morphology value.				
Effect of Electromagnetic Waves from Mobile Phones on Spermatogenesis in the Era of 4G-LTE	2.104 GHz (4G LTE) - (SAR 3.0 W/kg (body))	6-18h /28d	Jong Jin Oh, Seok-Soo Byun, Sang Eun Lee, Gheeyoung Choe, Sung Kyu Hong	2018-(9)
Exposed rats (18h daily): Decreased spermatogenesis (decreased mean spermatid count, mean spermatogonia count, germ cell count and mean Leydig cell count).				
Effect of Electromagnetic Field from 2G, 3G And 4G Mobile Phones on the Organization of Purkinje Cell Layer of Rat Cerebellum	0.9-2.1-2.6 GHz	60m/6 0d	Madiha Ali, Shadab Ahmed Butt, Shabnam Hamid	2017-(5)
" It was observed on microscopic examination that EMF from 2G, 3G and 4G mobile phones effected the organization of Purkinje cell layer of cerebellum; being double cell layer in group B [2G]and multiple cell layers in groups C [3G] and D [4G]."" It was concluded from current results that radiations from 2G, 3G and 4G mobile phones have deleterious effects on the organization of Purkinje cell layer of cerebellum with 3G and 4G causing more harm as compared to EMF from 2G mobile phones." {From the publication}				
A 5G Wireless Future: Will it Give us a Smart Nation or Contribute to an Unhealthy One? (article)	-	-	Cindy Russell	2017-(4)
Long-Term Evolution Electromagnetic Fields Exposure Modulates the Resting State EEG on Alpha and Beta Bands	2.61 GHz (4G LTE) - (SAR 1.34 W/kg (10g) 1.96 W/kg (1g))	-	Lei Yang, Qinghua Chen, Bin Lv, Tongning Wu	2016-(1)
Exposed humans: Decreased spectral power and interhemispheric coherence in the alpha and beta bands of the frontal and temporal brain regions.				
Study of Change in Enzymatic Reaction under Radiowaves/ Microwaves on Lactic Acid Dehydrogenase and Catalase at 2.1, 2.3 and 2.6GHz	2.1-2.3-2.6 GHz - 0.00024 mW/cm2 & 0.6 mW/cm2	-	Sohni Jain, Vuk Vojisavljevic, Elena Pirogova	2015-(1)
Exposed LDH and Catalase enzymes: Changes in the kinetics of the enzymes and in the rate of change of the reactions catalyzed by these enzymes.				
Effects of low power microwaves at 1.8, 2.1, and 2.3 GHz on L-Lactic dehydrogenase and Glutathione peroxidase enzymes	1.8-2.1-2.3 GHz - 0.121 mW/cm2 (SAR 0.841 W/kg)	-	Hamad S. Alsuhaime, Vuk Vojisavljevic & Elena Pirogova	2014-(12)
Exposed LDH and Glutathione peroxidase enzymes: Changes in the kinetics of the enzymes and in the rate of change of the reactions catalyzed by these enzymes.				
Whole Brain EEG Synchronization Likelihood Modulated by Long Term Evolution Electromagnetic Fields Exposure	2.576 GHz (4G LTE)	30m/ 1d	Bin Lv, Chang Su, Lei Yang, Yi Xie, Tongning Wu	2014-(4)
Exposed human brains: Exposure modulated the synchronization patterns of brain activation, both in closer and remote areas, also in the contralateral brain area.				
- Acute LTE Electromagnetic Field Exposure Modulates the Human Resting-state Functional Connectivity- The alteration of spontaneous low frequency oscillations caused by acute electromagnetic fields exposure- The alteration of spontaneous low frequency oscillations caused by acute electromagnetic fields exposure	2.576 GHz (4G LTE) - (SAR 0.9-1.07 W/kg (10g))	30m/ 1d	Bin Lv, Zhiye Chen, Tongning Wu, Qing Shao, Duo Yan, Lin Ma, Ke Lu, Yi Xie	2014-(1)2013-(10)
Exposed human brains: decreased amplitude of low frequency fluctuation value in numerous areas (left superior temporal gyrus, left middle temporal gyrus, right superior temporal gyrus, right medial frontal gyrus and right paracentral lobule). Etc...				

3G & 2G Phone MW Hazards Experiments

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3G & 2G Phone radiation effects on Brain: Various Changes

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Mobile Phone Radiation Deflects Brain Energy Homeostasis and Prompts Human Food Ingestion	900 MHz (GSM) (SAR 0.97-1.33 W/kg)	25m/1d	Ewelina K. Wardzinski, Kamila Jauch-Chara, Sarah Haars, Uwe H. Melchert, Harald G. Scholand-Engler, Kerstin M. Oltmanns	2022-(12)
<p>" Obesity and mobile phone usage have simultaneously spread worldwide. Radio frequency-modulated electromagnetic fields (RF-EMFs) emitted by mobile phones are largely absorbed by the head of the user, influence cerebral glucose metabolism, and modulate neuronal excitability. Body weight adjustment, in turn, is one of the main brain functions as food intake behavior and appetite perception underlie hypothalamic regulation. ... Exposure to both mobile phones strikingly increased overall caloric intake by 22–27% compared with the sham condition. Differential analyses of macronutrient ingestion revealed that higher calorie consumption was mainly due to enhanced carbohydrate intake. Measurements of the cerebral energy content, i.e., adenosine triphosphate and phosphocreatine ratios to inorganic phosphate, displayed an increase upon mobile phone radiation. Our results identify RF-EMFs as a potential contributing factor to overeating, which underlies the obesity epidemic. Beyond that, the observed RF-EMFs-induced alterations of the brain energy homeostasis may put our data into a broader context because a balanced brain energy homeostasis is of fundamental importance for all brain functions. Potential disturbances by electromagnetic fields may therefore exert some generalized neurobiological effects, which are not yet foreseeable." {From the publication}</p>				
Protective effect of Date Palm Fruits (Phoenix Dactylifera L.) versus vitamin C against mobile Phone Radiation-induced Pituitary gland damage in rats ("chemical remedy")	-	1h/28d	Rasha Mohamed, Maha Abdul Rahman, Sahar Ali, Heba Ahmed	2022-(1)
<p>" Mobile phone radiation significantly increased pituitary gland oxidative stress, DNA damage and apoptosis while both vitamin C</p>				

and date palm fruit significantly alleviated these detrimental effects with superior cytoprotective effect for date palm fruit over vitamin C."				
Effects of cellular phone electromagnetic field exposure on the hippocampi of rats in childhood and adolescence	890-915 MHz (GSM) - (SAR, specs, 1.12 W/kg (body))	2h/21 -60d	Zeynep Hatice Okur, Dilek Sağır	2021-(8)
Exposed rats (21, 39 days exposure): Damaged neurons with darkly stained cytoplasm among normal pyramidal cells. Exposed rats (60 days exposure): Decreased number of pyramidal cells and decreased hippocampus volume. Damaged neurons with darkly stained cytoplasm among normal pyramidal cells. Increased caspase 3 immunoreactivity.				
Effect of Lanthanum longiflorus ethanolic Extract on Neuronal Damage Induced by Electromagnetic Radiation in Wistar Rats ("chemical remedy")	900 MHz (GSM)	2h/28 d	Priyadarshini Gouthaman, S. Vijayalakshmi, R. Vijayaraghavan, S. Senthilkumar	2021-(7)
Exposed rats: Decreased cognitive characteristics in rats as revealed by significant changes in their behaviour. Decreased concentration of GABA and dopamine neurotransmitters.				
Evaluation of mobile phone radiation-induced structural changes of rat brain with emphasis on the possible protective role of pomegranate peel extract ("chemical remedy")	900 MHz, 1800 MHz	1h/60 d	S. K. M. Belal, O. K. Afifi, A. A. Afeefy	2020-(12)
Exposed rats: Degenerative changes on the nerve cells of cerebral and cerebellar cortexes (more pronounced with increase in the frequency of radiation). Most of pyramidal and Purkinje cells became irregular in shape, had deeply stained nuclei, and were surrounded with peri-cellular haloes and vacuolated neuropil, being some of them surrounded with neuroglial accumulation.				
Exposure of Radiofrequency Electromagnetic Radiation on Biochemical and Pathological Alterations	1800 MHz - 0.0116 mW/cm ² (SAR 0.43 W/kg (brain))	4h/90 d	Anjali Sharma, Sadhana Shrivastava, Sangeeta Shukla	2020-(9)
" Chronic exposure of MWR may alter GSH homeostasis due to alteration in various GSH cycle regulating enzymes such as GR, GPx, GST, and G6PDH which showed an imbalance in GSH content and causes an increase in the oxidative stress and release of inflammatory cytokines. A remarkable increase in the DNA damage was seen due to disorganization and pyknosis of neurons in exposed animal's brain when compared with the control group (P ≤ 0.05). There was also a significant decline in AChE level." {From the publication} " Conclusion: The study concludes that MWR may cause neurochemical and pathophysiological damage by initiating the inflammatory process in various brain regions, especially in hippocampus and cerebral cortex. These effects are further associated with a remarkable elevation in the genotoxicity of neurons with reference to the control group." {From the publication}				
Neuroprotective efficacy of luteolin on a 900-MHz electromagnetic field-induced cerebellar alteration in adult male rat ("chemical remedy")	900 MHz (SAR, specs, 2 W/kg)	1h/28 d	Ahmad Yahyazadeha, Berrin Zuhal Altunkaynak	2020-(1)
Exposed rats: Decreased total number of Purkinje and granular cells. Destructive damage to the architectures of cerebellar tissues. Increased levels of superoxide dismutase.				
Investigating the impact of mobile range electromagnetic radiation on the medial prefrontal cortex of the rat during working memory	900 MHz	3h/28 d	Shiva Tafakori, Ashkan Farrokhi, Vahid Shalchyan, Mohammad Reza Daliri	2020-(1)
Exposed rats: Increased task completion time. During correctly performed normal tasks an increase in power changes of theta band (4-12 Hz) was observed.				
Effects of Exposures of Mobile Phone Radiation on Cellular Architecture and Redox Status of Mammalian Brain Tissues	900 MHz	4-12h /30d	Faromika Oluwayomi Peace	2020-(6)
Non thermal effects of radiofrequency electromagnetic field exposure on neural cells	900 MHz (CW & 50 Hz modulated) - 0.0095 mW/cm ²	10-20 m/1d	Rosaria Grasso, Rosalia Pellitteri, Santi Armando Caravella, Francesco Musumeci, Giuseppina Raciti, Agata Scordino, Giovanni Sposito, Antonio Triglia, Agata Campisi	2020-(3)
" In this research, we investigated the influence of low-intensity RF-EMFs on Olfactory Ensheathing Cell (OEC) cultures, typical glia cells showing characteristics of stem cells. ... Surprisingly 20 min of exposure to continuous or amplitude modulated 900 MHz EMF induced a different and significant decrease in cell viability, some dynamic changes in the expression of the analysed markers and in the activation of the apoptotic pathway." {From the publication}				
C-glycosyl flavonoid orientin alleviates learning and memory impairment by radiofrequency electromagnetic radiation in mice via improving antioxidant defence mechanism ("chemical remedy")	900 MHz - (SAR, specs, 1.25 W/kg)	1h/28 d	Isaac O. Akefe, Ibrahim L. Yusuf, Victoria A. Adegoke	2019-(6)
Exposed mice: Impairment in learning and memory. Decreased brain antioxidant enzymes activities. Increased lipoperoxidation and corticosterone concentration. Histopathological aberrations in the hippocampal tissues.				

Mobile phone induced cognitive and neurochemical consequences	2100 MHz	4h/60 d	Anjali Sharma, Samta Sharma, Sadhana Shrivastava, Pramod Kumar Singhal, Sangeeta Shukla	2019-(1)
Exposed rats: Alterations in cholinesterase activity, muscular strength, learning ability and anxiety. Altered oxidative defense. Hippocampus degeneration. Neural degeneration (histopathological analysis).				
Changes in pyramidal and granular neuron numbers in the rat hippocampus 7 days after exposure to a continuous 900-MHz electromagnetic field during early and mid-adolescence	900 MHz	1h/25 d	Ayşe İkinci Keleş, Jens Randel Nyengaard, Ersan Odacı	2019-(1)
Exposed rats: Increased pyramidal and granule neurons in the hippocampus. Cytoplasm of these pyramidal and granule neurons is disrupted.				
Investigation of the neuroprotective effects of thymoquinone on rat spinal cord exposed to 900 MHz electromagnetic field ("chemical remedy")	900 MHz	1h/28 d	Ahmad Yahyazadeh, Berrin Zuhal Altunkaynak	2019-(1)
Exposed rats: Decreased motor neuron number. Increased superoxide dismutase levels. Spinal cord architectural alterations (histological analysis).				
The Protective Role of Garlic Aqueous Extract (<i>Allium sativum</i>) against 950MHz Electromagnetic Field Induced Rats Brain Damage ("chemical remedy")	950 MHz	1h/21 d	H. M. Shoman, R. A. El Sayed, N. A. El-Tahawy, E. M. Nasef	2019-(14)
Exposed rats: Oxidative stress (decreased reduced glutathione, increased alondialdehyde and nitric oxide). Alteration of neurotransmitters (decreased dopamine, norepinephrine and serotonin. Histological changes and deposition of B-amyloid in the brain cerebral cortex.				
The Effects of Radiofrequency Electromagnetic Field on Brain-Derived Neurotrophic Factor Protein Expression of Human Astrocytes	900 MHz, 1800 MHz	2h-72 h	Muizudin Mahyudin, Wan Nor Hanis Wan Ahmad, Siti Munirah Md. Noh, Noorul Izzati Hanaf, Mohd Zafran Abdul Aziz, Siti Hamimah Sheikh Abdul Kadir, Sushil Kumar Vasudevan	2019-(10)
The chronic effect of pulsed 1800 MHz electromagnetic radiation on amino acid neurotransmitters in three different areas of juvenile and young adult rat brain	1800 MHz (GSM) - 0.02 mW/cm ² (SAR 0.843 W/kg)	1h/30 -120d	Nawal A. Ahmed, Nasr M. Radwan, Heba S. Aboul Ezz, Yasser A. Khadrawy, Noha A. Salama	2018-(1)
Exposed rats: Significant changes in amino acid neurotransmitters (more prominent in juvenile animals).				
Hippocampal lipidome and transcriptome profile alterations triggered by acute exposure of mice to GSM 1800 MHz mobile phone radiation: An exploratory study	1800 MHz (GSM) - 0.0049-0.081 2 mW/cm ² (SAR 0.022-0.366 W/kg)	2h/1d	Adamantia F. Fragopoulou, Alexandros Polyzos, Maria-Despoina Papadopoulou, Anna Sansone, Areti K. Manta, Evangelos Balafas, Nikolaos Kostomitsopoulos, Aikaterini Skourliakou, Chryssostomos Chatgililoglu, Alexandros Georgakilas, Dimitrios J. Stravopodis, Carla Ferreri, Dimitris Thanos, Lukas H. Margaritis	2018-(18)
" The data analysis of the phospholipid fatty acid residues revealed that the levels of four fatty acids [16:0, 16:1 (6c + 7c), 18:1 9c, eicosapentaenoic acid omega-3 (EPA, 20:5 ω3)] and the two fatty acid sums of saturated and monounsaturated fatty acids (SFA and MUFA) were significantly altered (p < 0.05) in the exposed group. The observed changes indicate a membrane remodeling response of the tissue phospholipids after nonionizing radiation exposure, reducing SFA and EPA, while increasing MUFA residues. The microarray data analysis demonstrated that the expression of 178 genes changed significantly (p < 0.05) between the two groups, revealing an impact on genes involved in critical biological processes, such as cell cycle, DNA replication and repair, cell death, cell signaling, nervous system development and function, immune system response, lipid metabolism, and carcinogenesis." {From the publication}				
Histological study of the effect of cellular phone electromagnetic wave on the neonatal rat cerebellar cortex (in Korean)	0.0045 mW/cm ²	1h/21 d	Jung Mi Han, Jae Hyung Park, Sung Min Nam, Da Eun Lee, Sung Chuel Ahn, Jin Seok Seo, Jong Hwan Lee, Sang Seop Nahm, Nong Hoon Choe, Byung Joon Chang	2018-(6)

<p>" In the EMW exposure group, external granule cells were remained partially in the external granular layer without migrating into the internal granular layer. In addition, dark stained shrunken Purkinje cells with pyknotic nuclei increased and the outline of cells became irregular and showed degenerative signs, such as mitochondrial swelling and disrupted cristae. Moreover, the cisternae of rough endoplasmic reticula and Golgi complex were severely swollen. Bergmann glial cells adjacent to the dark stained Purkinje cells were swollen and cytoplasmic organelles were scant. Dark stained shrunken granule cells were also observed and the outline of cells was irregular. The results of the present study suggest that cellular phone EMW exposure to neonatal Sprague-Dawley rats leads to a partial delay of early migration of cerebellar cortical cells and degenerative changes in Purkinje cells, Bergmann glial cells and granule cells." {From the publication}</p>				
Effects of radio-frequency electromagnetic radiations (RF-EMR) on cerebral cortex of albino rats-a light and electron microscopic study	900-1800 MHz (GSM)	1-2h/45d	Faisal Taufiq, Mohit Srivastava	2018-(7)
<p>" Light microscopic findings of the present study showed that cellular size of neuronal cells in pyramidal layer of cerebral cortex, neurons of hippocampus and some granular layers in cerebral cortex of RF-EMR exposed rats decreased in compare to control groups. Individual cells could be seen with condensed cytoplasm and nucleus. Electron microscopic findings revealed individual shrunken cells with condensed cytoplasm and nucleus." {From the publication}</p>				
Radiofrequency electromagnetic radiation exposure effects on amygdala morphology, place preference behavior and brain caspase-3 activity in rats	900 MHz - (SAR, specs, 1.15 W/kg)	1h/28d	Sareesh Naduvil Narayanan, Nirupam Mohapatra, Pamala John, Nalini K., Raju Suresh Kumara, Satheesha B. Nayakc, P. Gopalakrishna Bhat	2018-(1)
<p>Exposed rats: Decreased healthy neurons in the basolateral amygdala and cortical amygdala. Increased apoptosis in the amygdala. Altered dendritic arborization pattern in basolateral amygdala. Hyperactivity-like behavior. Etc...</p>				
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	900 MHz (GSM), 1800 MHz (GSM) - 0.032 mW/cm ² (SAR 0.15 W/kg (body))	1h/260d	Kemal Ertlav, Fuat Uslusoy, Serdar Ataizi, Mustafa Naziroğlu	2018-(11)
<p>Exposed rats: Increased TRPV1 currents, intracellular free calcium influx, reactive oxygen species production, mitochondrial membrane depolarization, apoptosis, and caspase 3 and 9 activities in the hippocampal and root ganglion neurons (more pronounced in 1800 MHz).</p>				
The effect of mobile phone electromagnetic radiation on brain vessels	900 MHz (GSM)	7min/1d	M. A. Malikova, A. O. Kaliae, A. A. Sukhoruchkin, A. S. Bakhmetev	2017-(3)
<p>" ... the talk for more than 7 minutes on a cell phone in most cases (60%) led to the spasm of the main cerebral artery in the assessed subjects, which indicates the high importance of EMR as a potential risk factor for headaches and other negative psychological factors (i.e. lack of attention, disturbance of the structure of sleep, irritability, memory impairment, etc.)." {From the publication}</p>				
Histopathological, immunohistochemical, and stereological analysis of the effect of Ginkgo biloba (Egb761) on the hippocampus of rats exposed to long-term cellphone radiation ("chemical remedy")	(GSM) - (SAR, specs, 0.89 W/kg)	4h/30d	Fikret Gevrek	2017-(1)
<p>Exposed rats: Increased apoptotic proteins (Bax, Acas-3) immuno-reactivity. Decreased anti-apoptotic protein (Bcl-2) immuno-reactivity. Decreased total granule and pyramidal cell count.</p>				
Effects of acute and chronic exposure to both 900MHz and 2100MHz electromagnetic radiation on glutamate receptor signaling pathway (hippocampus)	900 MHz (GSM), 2100 MHz (UMTS) - 0.33 mW/cm ² (SAR 0.66 W/kg (brain), 0.27 W/kg (brain))	2h/5-50d	Çiğdem Gökçek-Saraç, Hakan Er, Ceren Kencebay Manas, Deniz Kantar Gok, Şükrü Özen, Narin Derin	2017-(1)
<p>Exposed rats: Increased activity of selected enzymes (more pronounced in chronic exposure and in 2100MHz exposure).</p>				
Impact of electromagnetic irradiation produced by 3G mobile phone on brain neurotransmitters in mice during growth and development period	1800 MHz (GSM)	1.5-3h/28d	Fengming Li, Jin Chang, Yinggang Lv, Dianguo Xu, Jianhua Chen, Xuewen Sun	2017-(5)
Effects of 900-MHz radiation on the hippocampus and cerebellum of adult rats and attenuation of such effects by folic acid and Boswellia sacra ("chemical remedy")	900 MHz	1h/21d	Elfide Gizem Kivrak, Berrin Zuhaf Altunkaynak, Isinsu Alkan, Kıymet Kubra Yurt, Adem Kocaman, Mehmet Emin Onger	2017-(9)
<p>" The results showed that EMF caused a significant decrease in total pyramidal and granular cell numbers in the hippocampus, and DG and in Purkinje cell numbers in the cerebellum in the EMF group compared to the other groups." {From the publication}</p>				
Long-term exposure to a continuous 900 MHz electromagnetic field disrupts cerebellar morphology in young adult male rats	900 MHz - 0.045 mW/cm ² (SAR)	1h/45d	A. Aslan, A. İkinci, O. Baş, O.F. Sönmez, H. Kaya, E. Odacı	2017-(1)

	0.01 W/kg (body))			
Exposed rats: Decreased Purkinje cells count. Alteration of normal Purkinje cell arrangement. Pathological changes including intense staining of neuron cytoplasm.				
Cerebellar histopathological and histochemical alterations induced by electromagnetic field exposure of mice	900-1800 MHz - (SAR, specs, 0.78 W/kg)	45min /30d	Somaia A. Negm, Amr M. Abd El-Hady, Noha N. Yassen, Alhusain Nagm	2017-(15)
Exposed mice: Histopathological changes (dystrophic changes in Purkinje cells layer, degenerated and accumulated granular layer cells with edematous spaces which appeared congested with blood). Histochemical and morphometric changes in the cerebellar tissue (alterations in collagen, polysaccharides, total protein, DNA and amyloid- β protein contents).				
Effect of Low Level Subchronic Microwave Radiation on Rat Brain	900-2450 MHz (CW) - (SAR 0.00059-0.00066 W/kg)	2h/65 d	Pravin Suryakantrao Deshmukh, Kanu Megha, Namita Nasare, Basu Dev Banerjee, Rafat Sultana Ahmed, Mahesh Pandurang Abegaonkar, Ashok Kumar Tripathi, Pramod Kumari Mediratta	2016-(10)
Exposed rats: Decreased cognitive function. Increased HSP70 level and DNA damage in brain.				
Age-dependent acute interference with stem and progenitor cell proliferation in the hippocampus after exposure to 1800 MHz electromagnetic radiation	1800 MHz	8h/3d	Falin Xu, Qiongdan Bai, Kai Zhou, Li Ma, Jiajia Duan, Fangli Zhuang, Cuicui Xie, Wenli Li, Peng Zou, Changlian Zhu	2016-(1)
Exposed mice: The developmental stage of the brain is a factor that influences in the interference effect of EM radiation on stem cell proliferation in the hippocampus.				
Effects of Long Term Exposure of 900-1800 MHz Radiation Emitted from 2G Mobile Phone on Mice Hippocampus- A Histomorphometric Study	900-1800 MHz (GSM) - (SAR, specs, 1.6 W/kg (10g))	48m/30-180 d	N. Mugunthan, K. Shanmugasamy, J. Anbalagan, S. Rajanarayanan, S. Meenachi	2016-(6)
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	900 MHz	1h/39 d	Gökçen Kerimoğlu, Hatice Hancı, Orhan Baş, Ali Aslan, Hüseyin Serkan Erol, Alpgiray Turgut, Haydar Kaya, Soner Çankaya, Osman Fikret Sönmez, Ersan Odacı	2016-(1)
Exposed rats: Increased numbers of pyknotic neurons with black or dark blue cytoplasm. Decreased pyramidal neurons. Increased malondialdehyde and glutathione levels. Decreased catalase levels.				
Deleterious impacts of a 900-MHz electromagnetic field on hippocampal pyramidal neurons of 8-week-old Sprague Dawley male rats	900 MHz	1h/30 d	Arzu Şahin, Ali Aslan, Orhan Baş, Ayşe İkinci, Cansu Özyılmaz, Osman Fikret Sönmez, Serdar Çolakoğlu, Ersan Odacı	2015-(1)
Effects of Electromagnetic Radiation from Smartphones on Learning Ability and Hippocampal Progenitor Cell Proliferation in Mice	-	-	Yu-Jin Choi, Yun-Sik Choi	2015-(6)
" ... data indicate that although chronic electromagnetic radiation does not affect spatial working memory and hippocampal progenitor cell proliferation it can mediate astrocyte activation in the hippocampus and delayed hyperactivity-like behavior." (From the publication)				
Exposure to 900MHz electromagnetic fields activates the mcp-1/ERK pathway and causes blood-brain barrier damage and cognitive impairment in rats	900 MHz (CW) - 1 mW/cm ² (SAR 0.016-2 W/kg (body-head))	3h/14-28d	Jun Tang, Yuan Zhang, Liming Yang, Qianwei Chen, Liang Tan, Shilun Zuo, Hua Feng, Zhi Chen, Gang Zhu	2015-(1)
Exposed rats: Decreased percentage of time in the target quadrant and frequency of crossing platforms (more pronounced in 28 days exposure). Cellular edema and neuronal cell organelle degeneration (28 days exposure). Damaged BBB permeability. Increased expression of mcp-1 (28 days exposure).				
Frequent cellular phone use modifies hypothalamic-pituitary-adrenal axis response to a cellular phone call after mental stress in healthy children and adolescents: A pilot study	(GSM & 3G) - (SAR 0.26-0.57 W/kg)	5min/1d	Styliani A. Geronikolou, Aikaterini Chamakou, Aimilia Mantzou, George Chrousos, Christina Kanaka-Gantenbein	2015-(7)

Does the Brain Detect 3G Mobile Phone Radiation Peaks? An Explorative In-Depth Analysis of an Experimental Study	(3G) - (SAR, specs, 0.69 W/kg (head))	15min /1d	Suzanne Roggeveen, Jim van Os, Richel Lousberg	2015-(11)
" ... an increase of the area in the 240-500ms post-stimulus interval, exposure interaction effect was significant for the frontal and central cortical regions, indicating that only in the mobile phone exposure with ear-placement an enlarged cortical reactivity was found .. Post-hoc analyses based on visual inspection of the ERPs showed a second significantly increased area between 500-1000ms post-stimulus for almost every EEG location measured .. It was concluded that, when a dialing mobile phone is placed on the ear, its radiation, although unconsciously, is electrically detected by the brain." (From the publication)				
Effect of Low-Intensity Microwave Radiation on Monoamine Neurotransmitters and Their Key Regulating Enzymes in Rat Brain	900-1800 MHz - (SAR 0.00059 W/kg)	2h/30 d	Kanu Megha, Pravin S. Deshmukh, Alok K. Ravi, Ashok K. Tripathi, Mahesh P. Abegaonkar, Basu D. Banerjee	2015-(8)
Exposed rats: Decreased levels of dopamine, norepinephrine, epinephrine and serotonin in hippocampus. Decreased mRNA expression of enzymes tyrosine hydroxylase and tyrosine hydroxylase.				
The effects of mobile phones on apoptosis in cerebral tissue: an experimental study on rats	1900-2100 MHz - (SAR 0.001-0.081 mW/cm2 (SAR 0.004-0.28 W/kg (brain)))	7 x 5min/ 28d	A. Yilmaz, N. Yilmaz, Y. Serarslan, M. Aras, M. Altas, T. Özgür, F. Sefil	2014-(9)
Exposed rats: Increased p53 protein and Bcl-2 gene expression. Increased apoptosis.				
Biochemical Modifications and Neuronal Damage in Brain of Young and Adult Rats After Long-Term Exposure to Mobile Phone Rasdiations	900 MHz (GSM) - (SAR, specs, 1.13 W/kg)	2h/60 d	Tarek K. Motawi, Hebatallah A. Darwish, Yasser M. Moustafa, Mohammed M. Labib	2014-(11)
Exposed rats: Increased onjugated dienes, protein carbonyls, total oxidant status, and oxidative stress index. Decreased total antioxidant capacity levels. Increased Bax/Bcl-2 ratio, caspase-3 activity, and tumor necrosis factor-alpha level. Altered brain weight of young rats. Neuronal damage (histopathological analysis).				
Evaluation of oxidant stress and antioxidant defense in discrete brain regions of rats exposed to 900 MHz radiation	900 MHz (GSM) - max. 0.146 mW/cm2	1h/28 d	S. N. Narayanan, R. S. Kumar, V. Kedage, K. Nalini, S. Nayak, P. G. Bhat	2014-(7)
Exposed rats: Altered behavioral performances. Increased thiobarbituric acid-reactive substances. Decreased total antioxidant in the amygdala and cerebellum. Decreased glutathione S-transferase activity in the hippocampus.				
Long term and excessive use of 900 MHz radiofrequency radiation alter microRNA expression in brain	900 MHz (GSM) (SAR 0.19-0.14 W/kg (1g-brain))	3h/36 5d	Suleyman Dasdag, Mehmet Zulkuf Akdag, Mehmet Emin Erdal, Nurten Erdal, Ozlem Izci Ay, Mustafa Ertan Ay, Senay Gorucu Yilmaz, Bahar Tasdelen, Korkut Yegin	2014-(1)
Exposed rats: Decreased rno-miR107 expression (other four not altered).				
Effects of cell phone radiation on migration of granule cells in rat cerebellum	900-1800 MHz (GSM)	30min, 2h, 8h/1d	Hiva Mohammadi Bolbanabad, Mohammad Reza Kaffashian, Daryoush Fatehi, Ayoob Rostamzadeh	2014-(8)
Exposed rats (8h exposure): Decreased cell population in internal granular region. Decreased external granular layer thickness. Decreased cerebellar weight to body weight ratio.				
Effects of mobile phone radiation (900 MHz radiofrequency) on structure and functions of rat brain	900 MHz (GSM) - (SAR 0.99 W/kg)	4h/15 d	Nidhi Saikhedkar, Maheep Bhatnagar, Ayushi Jain, Pooja Sukhwai, Chhavi Sharma, Neha Jaiswal	2014-(8)
Exposed rats: Change in behavior (more anxiety and poor learning). Change in the level of antioxidant enzymes and non-enzymatic antioxidants. Increased lipid peroxidation. Neurodegenerative cells in hippocampal sub regions and the cerebral cortex (histological analysis).				
The effect of pulsed electromagnetic radiation from mobile phone on the levels of monoamine neurotransmitters in four different areas of rat brain	1800 MHz (GSM) - 0.02 mW/cm2 (SAR 0.84 W/kg)	1h/30, 60, 120d	H.S. Aboul Ezz, Y.A. Khadrawy, N.A. Ahmed, N.M. Radwan, M.M. El Bakry	2013-(7)
Exposed rats: Changes in concentrations of dopamine, norepinephrine and serotonin in the hippocampus, hypothalamus, midbrain and medulla oblongata.				
Effect of 3G Cell Phone Exposure with Computer Controlled 2-D Stepper Motor on Non-thermal Activation of the hsp27/p38MAPK	2115 MHz (3G) - (SAR	2h/60 d	Kavindra Kumar Kesari, Ramovatar Meena,	2013-(14)

Stress Pathway in Rat Brain	0.26 W/kg)		Jayprakash Nirala, Jitender Kumar, H. N. Verma	
Exposed rats: Increased DNA strand breaks in brain. Increased micronuclei, caspase 3 and apoptosis (mitochondrial dysfunction-mediated).				
InVitro Exposure of Neuronal Networks to a GSM-1800 Signal	1800 MHz (GSM) - (SAR 3.2 W/kg)	3min/1d	Daniela Moretti, Andre Garenne, Emmanuelle Haro, Florence Poullietier de Gannes, Isabelle Lagroye, Philippe Léveque, Bernard Veyret, Noelle Lewis	2013-(8)
Exposed rat cortical cell cultures: A 30% reversible decrease in firing rate and bursting rate during the 3 min exposure period.				
Effects of long-term electromagnetic field exposure on spatial learning and memory in rats	916 MHz (CW) - 1 mW/cm ²	6h/50d	Dongmei Hao, Lei Yang, Su Chen, Jun Tong, Yonghao Tian, Benhang Su, Shuicai Wu, Yanjun Zeng	2013-(8)
Exposed rats: Increased average completion time and error rate (week 4-5 [not week 1-3 or 6-9]). Irregular firing patterns and more spikes with shorter interspike interval in the hippocampal neurons (all weeks).				
Effects of radiofrequency electromagnetic radiations (RF-EMR) on sector CA3 of hippocampus in albino rats- A light and electron-microscopic study	900-1800 MHz (GSM)	20min -2h/28d	Khursheed Faridi, Aijaz Ahmed Khan	2013-(6)
Exposed rats: Few congestion and signs of hemorrhage with enlarged perivascular spaces in CA3 sections. Apparent deformation of neuron nuclei, and shrinkage. Shrunken cells with condensed and increased electron density (in cytoplasm and nucleoplasm). Swollen and condensed mitochondria. Fewer synaptic vesicles in synapses (in presynaptic terminals). Etc...				
Early Postnatal Mobile Phone (900 MHz) Exposure Affects Superoxide and Catalase Enzyme Activity in Rat Brain Tissue (in Farsi)	(GSM)	-	Mohammad Reza Bigdeli, Mehdi Rahnama	2013-(9)
Exposed rats: Increased amount of time to locate the hidden platform and time spent exhibiting freezing behavior. Decreased superoxide dismutase and catalase activities.				
Effects of electromagnetic radiation on spatial memory and synapses in rat hippocampal CA1	900 MHz (GSM)- (SAR 0.52-1.08 W/kg)	2h/30d	Yuhong Li, Changhua Shi, Guobing Lu, Qian Xu, Shaochen Liu	2012-(8)
Exposed rats: Decreased performance. Morphological changes (mitochondrial degenerations, fewer synapses, and shorter postsynaptic densities).				
Effect of Exposure of 900 MHz Radiofrequency Radiation on Rat Brain	900 MHz (2G CDMA) - (SAR, specs, 1.09 W/kg (head))	4h, 8h/60d	M. R. Usikalu, S. O. Rotimi, A. E. Oguegbu	2012-(6)
Exposed rats: Congestion of the cerebral blood vessels and presence of numerous spongiform vacuoles in the neuropil of the brain tissues.				
The effects of long term exposure of magnetic field via 900-MHz GSM radiation on some biochemical parameters and brain histology in rats	900 MHz (GSM)	30min /80d + prenat .	Saadet D. Celikozlu, M. Sabri Ozyurt, Ali Cimbiz, Melda Y. Yardimoglu, M. Kasim Cayci, Yusuf Ozay	2012-(13)
Exposed rats: Decreased weekly weight gain. Decreased pyramidal neuron numbers at cerebral cortex region. Increased ischemic neuron numbers at cortex region. Increased ischemic neuron numbers at hippocampus. Increased vascular dilatations.				
"Non-thermal" Effects on the Blood-Brain Barrier in Fischer rats by exposure to microwaves	915 MHz (CW, GSM, & others)- SAR 0.0002-2 W/kg)	2 to 910min/1d	Bertil Persson, Lars Malmgren, Arne Brun, Jacob Eberhardt, Henrietta Nittby, Leif Salford	2012-(39)
Exposed rats: Increased ratio of albumin extravasations (max. at 0.2 mW/kg [not at 2000 mW/kg]). Opening of the blood brain barrier (max. at 0.1-0.5 mW/kg [less at 50-500 mW/kg]).				
Effects of radiofrequency radiation exposure on blood-brain barrier permeability in male and female rats	900-1800 MHz (CW) - (SAR 0.0042-0.0014 W/kg)	20min /1d	Bahriye Sirav, Nesrin Seyhan	2011-(1)
Exposed rats: Increased albumin extravasation in brain of males rats (not in females).				
Effects of Cell Phone Radiofrequency Signal Exposure on Brain Glucose Metabolism	837 MHz - (SAR, specs, 0.9 W/kg)	50min /1d	Nora D. Volkow, Dardo Tomasi, Gene-Jack Wang, Paul Vaska,	2011-(14)

	(head))		Joanna S. Fowler, Frank Telang, Dave Alexoff, Jean Logan, Christopher Wong	
Exposed human brains: Increased glucose metabolism in the region closest to the antenna.				
Effect of Ginseng on Calretinin Expression in Mouse Hippocampus Following Exposure to 835 MHz Radiofrequency ("chemical remedy")	835 MHz - (SAR 1.6 W/kg (body))	5h/5d	Bijay Aryal, Dhiraj Maskey, Myeung-Ju Kim, Jae-Won Yang, and Hyung-Gun Kim	2011-(11)
Exposed mouse: Decreased Calretinin immunoreactivity. Loss of CA1 and CA3 interneurons and infragranular cells.				
900-MHz microwave radiation promotes oxidation in rat brain	900 MHz (GSM) - (SAR, specs, 0.9 W/kg)	2h/45d	Kavindra Kumar Kesari, Sanjay Kumar, Jitendra Behari	2011-(16)
Exposed rats: Decreased glutathione peroxidase and superoxide dismutase levels. Increased catalase activity. Decreased protein kinase. Decreased pineal melatonin level. Increased creatine kinase and caspase 3. Increased reactive oxygen species level.				
Increased blood-brain barrier permeability in mammalian brain 7 days after exposure to the radiation from a GSM-900 mobile phone	900 MHz (GSM) - (SAR 0.00012-0.12 W/kg)	2h/1d	Henrietta Nittby, Arne Brun, Jacob Eberhardt, Lars Malmgren, Bertil R.R. Persson, Leif G. Salford	2009-(10)
Exposed rats: Increased albumin extravasation (max. at 0.012 W/kg).				
Effects from 884 MHz mobile phone radiofrequency on brain electrophysiology, sleep, cognition, and well-being	884 MHz (GSM) - (SAR 1.4 W/kg (10g))	3h/1d	Bengt B. Arnetz, Lena Hillert, Torbjörn Åkerstedt, Arne Lowden, Niels Kuster, Sven Ebert, Clementine Boutry, Scott Douglas Moffat, Mats Berg, Clairy Wiholm	2009-(4)
Exposed humans: Increased time to reach deep and shortened deep sleep. Increased cognitive performance. More headaches.				

3G & 2G Phone radiation effects on Brain: EEG Changes

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Modulation of magnetoencephalography alpha band activity by radiofrequency electromagnetic field depicted in sensor and source space	900 MHz (GSM) - (SAR 0.49 W/kg (10g))	25m/1d	Jasmina Wallace, Lydia Yahia-Cherif, Christophe Gitton, Laurent Hugueville, Jean-Didier Lemaréchal, Brahim Selmaoui	2021-(17)
<p>" Results in sensor and source space showed a significant modulation of MEG alpha band activity after the radiofrequency exposure, with different involved cortical regions in relation to the eyes condition, probably because of different attention level with open or closed eyes." {From the publication}</p> <p>" Observed results indicated a significant effect of 900 MHz RF-EMF exposure on the alpha band MEG activity detected in sensor and source space, mainly represented as a decrease of spectral power amplitudes. In particular, EO [Eyes open] resting-state sensor analysis revealed a modification of the entire alpha band and both frequency sub-bands after RF-EMF exposure, especially at the parietal cortex. These results were confirmed by analysis at source level, showing an alpha band modulation widespread at the fronto-parietal region. Otherwise, with the sensor space analysis of MEG recordings in EC [Eyes close] condition, results showed a decrease of the entire alpha band power and the upper alpha power after RF-EMF exposure, especially at the temporo-occipital region. The results were supported by source space analysis, which also highlighted the power modulation of the lower alpha band." {From the publication}</p>				
Experimental Study of Potential Adverse Effects on the Auditory System of Rabbits Exposed to Short-Term GSM-1800 Radiation	1800 MHz (GSM)	1-60m /1d	Antigoni E. Kaprana, Ioannis O. Vardiambasis, Theodoros N. Kapetanakis, Melina P. Ioannidou, Christos D. Nikolopoulos, Grigorios E. Lyronis	2020-(1)
Exposed rats: Auditory brainstem response (an auditory evoked potential extracted from ongoing electrical activity in the brain that occur in the first 10 milliseconds after onset of an auditory stimulus) is altered with prolonged latencies of waves I to V, when exposure time is 30 min or longer (with more notable effects with 45 and 60 min exposure times).				
The effect of short-term electromagnetic fields caused by mobile phones on the electrical activity of alpha and beta brain waves	900 MHz - 0.00118 mW/cm2	3min/1d	Mehmet Cihan Yavaş	2020-(5)

	(SAR 0.34 W/kg (10g))			
" ... no statistically significant change was observed in the parameters of the electrical activity of the alpha waves as a result of this short exposure, but as a result of Fast Fourier transform and power spectral density analysis of the electrical activity of the beta waves, there was a statistical difference." {From the publication}				
Effect of Mobile Phone Radiation on EEG Wave	900-1800 MHz	-	D. S. Bhangari, A. C. Bhagali, R. V. Kshirsagar	2019-(5)
Impact analysis of mobile phone electromagnetic radiations on human electroencephalogram	(GSM & 3G WCDMA) - (SAR, specs, 0.67-1.14 W/kg)	-	Suman Pattnaik, Balwinder Singh Dhaliwal, S. S. Pattnaik	2019-(12)
Exposed human brains: Variation in the nonlinear parameters. Increased alpha waves power at T501 channel during 3GRx. Decreased alpha waves power at P402 channel in all modes (more pronounced in the side of mobile phone). Variations at some of the channels in different modes (statistical analysis).				
Decreased spontaneous electrical activity in neuronal networks exposed to radiofrequency 1,800 MHz signals	1800 MHz (GSM & CW) - (SAR 0.01-9.2 W/kg)	15min /17-2 8d	Corinne El Khoueiry, Daniela Moretti, Rémy Renom, Francesca Camera, Rosa Orlacchio, André Garenne, Florence Poullietier De Gannes, Emmanuelle Poque-Haro, Isabelle Lagroye, Bernard Veyret, Noëlle Lewis	2018-(11)
Mobile Phone Chips Reduce Increases in EEG Brain Activity Induced by Mobile Phone-Emitted Electromagnetic Fields ("physical remedy")	-	30min /1d	Diana Henz, Wolfgang I. Schöllhorn, Burkhard Poeggeler	2018-(11)
Energy Changes in Brain Under Mobile Phone Radiation	(GSM & CDMA) - (SAR, specs, 0.84-1.12 W/kg)	5min/ 1d	C. K. Smitha, N. K. Narayanan	2016-(6)
Exposed human brains: Some changes in the energy of some of the EEG bands while mobile phone usage.				
Impacts of radio frequency interference on human brain waves and neuro-psychological changes	1800 MHz (CW) - 0.009 mW/cm2	5min/ 1d	Y. Q. He, S. W. Leung,; Y. L. Diao, W. N. Sun, Y. M. Siu, P. Sinha, K. H. Chan	2015-(6)
" This study investigates the neuro-psychological impacts of radio frequency interference (RFI) by correlating the brain waves under RFI exposure. In our experiments, twelve participants were tested under controlled RF exposure at 1.8 GHz in an anechoic chamber under one-blind condition. ...Statistical tests indicate that theta and alpha waves were able to be characterized, and the significant differences were observed in both alpha waves and theta waves between the data before and after exposure from the consequence of paired t-tests. This initial study indicated that short term exposure to RFI may cause impacts on brain waves, but may not lead to any direct emotional changes by the participants."				
Radiofrequency signal affects alpha band in resting electroencephalogram	900 MHz (GSM) - (SAR 0.49-0.70-0.9 3 W/kg (10g-1g-peak))	26min /1d	Rania Ghosn, Lydia Yahia-Cherif, Laurent Hugueville, Antoine Ducorps, Jean-Didier Lemaréchal, György Thuróczy, René de Seze, Brahim Selmaoui	2015-(8)
Exposed human brains: Alpha band power decrease (during and after exposure) in the eyes-closed condition.				
EEG Changes Due to Experimentally Induced 3G Mobile Phone Radiation	(3G) - (SAR, specs, 0.69 W/kg (head))	15min /1d	Suzanne Roggeveen, Jim van Os, Wolfgang Viechtbauer, Richel Lousberg	2015-(13)
" ... there was evidence that mobile phone radiation is associated with increased activity of the alpha, beta, and gamma frequency bands in nearly every brain region .. The distance of the mobile phone to the brain was relevant, a larger distance resulting in less or no EEG interference." {From the publication}				
Brain Dynamics under Mobile Phone Radiation Using Various Fractal Dimension Methods	(SAR, specs, 0.98-1.3 W/kg)	5 + 5min/ 1d	C.K. Smitha, N.K. Narayanan	2014-(15)
Exposed human brains: Changes in fractal dimension (person specific) while mobile phone usage. Changes in fractal dimension indicates some changes in signal complexity.				
Brain Dynamics under Mobile Phone Radiation – A Wavelet Power Approach	(SAR, specs, 0.98-1.3 W/kg)	5 + 5min/ 1d	C.K. Smitha, N.K. Narayanan	2014-(6)
Non-thermal continuous and modulated electromagnetic radiation fields effects on sleep EEG of rats	900 MHz (8-16 Hz)	1h/30 d	Haitham S. Mohammed, Heba M.	2013-(7)

	modulated) - 0.025 mW/ cm ² (SAR 0.245 W/kg (1g))		Fahmy, Nasr M. Radwan, Anwar A. Elsayed	
Exposed humans brains: Rapid eye movement sleep is more susceptible to modulated radiofrequency radiation fields than slow wave sleep. Increased Latency of REM sleep. Decreases Theta band power (at 8 Hz modulated RFR). Decreased Beta-1 band power (at 16 Hz modulated RFR).				
Classification of brainwave asymmetry influenced by mobile phone radiofrequency emission	(SAR, specs, 0.69 W/kg)	5min/ 1d	R.M. Isa, I. Pasya, M.N. Taib, A.H. Jahidin, W.R.W. Omar, N. Fuad, H. Norhazman, S.B. Kutty, S.F.S. Adnan	2013-(8)
Exposed human brains: Altered Alpha hemisphere dominance (depend on the side of exposure). Altered Alpha power asymmetry ratio during and after exposure (5 min).				
Detecting Effects Of Mobile Phone EMF On Electric Potentials Of The Brain	(GSM)	30min /1d	I.A. Menon, A.A. Menon, N. Channa, I.H. Kalwar	2012-(4)
Exposed human brains: Decreased approximate entropy (a measure of complexity in information process). Increased energy function at frontal position of electrodes.				
Long-term low-level electromagnetic radiation causes changes in EEG of freely-moving rats	900 MHz - 0.02 mW/ cm ² (SAR 1.165 W/kg)	1h/30d , 60d, 120d	H.S. Mohammed, N.M. Radwan, Nawal A. Ahmed	2011-(9)
Exposed human brains: A shift from high frequency (beta) to lower frequency (delta) brainwaves.				
Mobile phone emission modulates event-related desynchronization of alpha rhythms and cognitive-motor performance in healthy humans	902.4 MHz (GSM) - (SAR 0.5 W/kg)	45min /1d	Fabrizio Vecchio, Paola Buffo, Silvia Sergio, Daniela Iacoviello, Paolo Maria Rossini	2011-(8)
Exposed human brains: Less power decrease of widely distributed high-frequency alpha rhythms after exposure. Faster reaction time to go stimuli after exposure.				
Effects of 2G and 3G mobile phones on performance and electrophysiology in adolescents, young adults and older adults	(GSM & 3G)	10-60 m/1d	S. Leung, R.J. Croft, R.J. McKenzie, S. Iskra, B. Silber, N.R. Cooper, B. O'Neill, V. Copley, A. Diaz-Trujillo, D. Hamblin, D. Simpson	2011- (47)
Exposed human brains: Increased N1 (2G, all ages). Decreased accuracy (3G). Delayed ERD/ERS responses of the alpha power (2G and 3G, all ages).				
Mobile phone emission modulates inter-hemispheric functional coupling of EEG alpha rhythms in elderly compared to young subjects	(GSM)	45min /1d	F. Vecchio, C. Babiloni, F. Ferreri, P. Buffo, G. Cibelli, G. Curcio, S. van Dijkman, J.M. Melgari, F. Giambattistelli, P.M. Rossini.	2010-(1)
Exposed human brains: Increased inter-hemispheric coherence of frontal and temporal alpha rhythms during exposure (in elders).				

3G & 2G Phone radiation effects on Behavior and Locomotion

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
The association of smart mobile phone usage with cognitive function impairment in Saudi adult population	-	-	Thamir M. Al-khlaifi, Syed Shahid Habib, Sultan Ayoub Meo, Mohammed S. Alqhtani, Abeer A. Ogailan	2020-(6)
<p>" The present cross-sectional study was conducted in the Department of Physiology, College of Medicine, King Saud University, Riyadh, Saudi Arabia during September 2019 to January 2020. A total of 251 Saudi adults who were using mobile phones were recruited, and knowledge, attitude and practices were assessed by interview using a predesigned proforma. The Montreal Cognitive Assessment (MOCA) tool was employed to assess the cognitive functions, comparison was made between daily mobile phone usage group and their correlated Montreal Cognitive Score (MOCA)." {From the publication}</p> <p>" More than 80% of the participants used their mobile phone for more than two hours daily. About 61% of the participants were not aware of the side effect of the radiation generated from mobile phone. The participants showed a decrease in MOCA score with increased daily mobile phone usage (MOCA=26.8 for <1 hour daily usage, 26.1 for 1-2 hours, and 24.6 for >2 hours with P< 0.05). In addition, participants showed decreased MOCA score by keeping their mobile phone near their pillow while sleeping; MOCA=24.35 for near pillow groups and >25.5 for the groups that placed their mobile phone away from the pillow." {From the publication}</p>				

The Influence of Electromagnetic Fields on the Behavior of Mice	-	70d	Roberto Carlos Vera, Israel Muñoz	2020-(13)
<p>" The presence of electromagnetic fields within the environmental environment has grown progressively according to the human population density. The direct or indirect influence of these fields generates an uncomfortable presence in the habitat of an animal, especially for those animals that are sensitive to the variation of the intensities of static or dynamic electromagnetic fields, proof of this is the behavior of the mice within this study which are sensitive to the increase in the levels of electromagnetic fields." {From the publication}</p> <p>" Mice, without the influence of electromagnetic fields, present an organization within their habitat, which demonstrate dynamic hyperactivity in their life cycle. On the other hand, if the conditions of their habitat are abiotic due to the influence of electromagnetic fields, the mice present different levels of behavior, raising their stress conditions, for example, in aggressiveness and irritation of the eyes." {From the publication}</p>				
The influence of electromagnetic radiation of cell phones on the behavior of animals	-	8h/1d	Innar Sultangaliyeva, Raikhan Beisenova, Rumiya Tazitdinova, Akhan Abzhalelov, Marat Khanturin	2020-(7)
<p>Rats have been exposed to two mobile phones models in this experimental study, which causes:</p> <p>" By the quality of the act of locomotion in the second experimental group is reduced by 30% and also in this group by the time of the act is 23% lower than in the control data. Vertical motor activity, a support stand, is also suppressed in the second experimental group: 61% lower in number and 47.2% lower in act time compared to the control group. Based on the data, we can conclude that the EMR of the phone Samsung Galaxy J1 Mini affects the behavior of animals to a greater extent than Xiaomi Redmi S2. By the frequency of the act, sniffing is 26% lower; by the time of the act, it remained at the level of control data in the second group. In the third group of the animals, the number and time of the act are 15% lower than the control data. The support stands as an indicator of research activity. In the second group the act of stand with support – by number was lower by 57% than the control data, this indicates that research activity is being suppressed." {From the publication}</p> <p>" According to the above changes under the action of EMR from the Samsung Galaxy J1 Mini and Xiaomi Redmi S2 phones, the motor component of behavior is suppressed. The research component of behavior in all groups of animals is enhanced due to high rates of sniffing. It is possible that in animals under stress, the motivation to interact with the environment decreases, leading to an excessive self-accentuation of the animal." {From the publication}</p>				
Sleep loss among Thai high school students smartphone users affected by smartphone electromagnetic pollution: Time series study	-	-	Wanna Chongchitpaisan, Phongtape Wiwatanadate, Assawin Narkpongphun, Surat Tanprawate, Nipapon Siripon	2020-(11)
<p>" Sleep loss in adolescents has an increasing trend of prevalence and has been found to be correlated with the highest SOP [smartphone output power] group ($\geq 2.00 \times 10^5$ mW range). These results confirmed that increased and longer smartphone use result in reduced sleep time. This causes them to be exposed to smartphone electromagnetic radiation and smartphone screen lighting. This disturbs brain waves and nervous system controlling sleep balance mechanisms. The findings recommended parents setting time and boundaries around technology use at home to reduce contact with electromagnetic radiation and smartphone screen lighting, thereby increasing sleeping time in order to create good sleep quality." {From the publication}</p>				
Toxic Systemic Hazards of Radiofrequency Radiation Emitted By Smartphone: A National Survey in Great Cairo Governorate	-	-	Nancy M. Zaghoul, Asmaa S. El Banna	2019-(14)
<p>" There were many statistical significant associations between the appearance of health problems and the average time of smartphone use as eye burning or itching (P-value = 0.019), increased time takes to fall asleep (P-value = 0.036), depression problems (P-value = 0.004), obsession (P-value = 0.001), and increase in the body weight (P-value = 0.020)." {From the publication}</p>				
Mobile phones, user behaviour, radiation effects and cognitive performance	-	-	Jo Fowler	2019-(406)
<p>Exposed human brains: Significant lateralised results in visual tasks. Mood effects.</p>				
Dataset on significant role of Candesartan on cognitive functions in rats having memory impairment induced by electromagnetic waves ("chemical remedy")	900 MHz (GSM) - 0.165 mW/cm ²	24h/3 5d	Mohamad Nasser, Pia Chedid, Ali Salami, Mariam Khalifeh, Said El Shamieh, Wissam H. Joumaa	2018-(5)
<p>Exposed rats: Impaired learning, spatial and short term memory.</p>				
Radiofrequency electromagnetic fields exposure and sleep in adolescents	-	-	Alba Cabré, Martine Vrijheid, Elisabeth Cardis, Maties Torrent, Mònica Guxens	2018-(1)
<p>Exposed humans: Worse subjective sleep quality directly correlated with daily mobile phone usage time.</p>				
Effects of short and long term electromagnetic fields exposure on the human hippocampus	-	-	Omur Gulsum Deniz, Suleyman Kaplan, Mustafa Bekir Selçuk, Murat Terzi, Gamze Altun, Kıymet Kübra Yur, Kerim Asla, Devra Davis	2017-(7)
<p>" Analysis of the spectroscopic results revealed no significant difference in specific metabolites between the groups ($p > 0.05$). There was also no significant difference in terms of hippocampal volume between the groups ($p > 0.05$). In contrast, the results of the stroop and digit span (backward) neurocognitive tests of high exposure group for evaluating attention were significantly poorer</p>				

from low exposure group ($p < 0.05$). Based on these results, we conclude that a lack of attention and concentration may occur in subjects who talk on mobile phones for longer times, compared to those who use phones relatively less." {From the publication}				
Ticks and radio-frequency signals: behavioural response of ticks (<i>Dermacentor reticulatus</i>) in a 900 MHz electromagnetic field	900 MHz - 0.00007 mW/cm ²	15m/1d	Blažena Vargová, Juraj Kurimský, Roman Cimbala, Michal Kostelec, Igor Majláth, Natália Pipová, Piotr Tryjanowski, Łukasz Jankowiak, Viktória Majláthová	2017-(11)
Exposed ticks: Induces an immediate locomotor response manifested either in a previously unreported jerking movement of the whole body (max. in females) or in jerking of the first pair of legs (max. in males).				
Neurobehavioural Changes and Brain Oxidative Stress Induced by Acute Exposure to GSM900 Mobile Phone Radiations in Zebrafish (<i>Danio rerio</i>)	900 MHz (GSM) - (SAR, specs, 1.34 W/kg)	1h/14d	Abhijit Nirwane, Vinay Sridhar, Anuradha Majumdar	2016-(10)
"... significantly decreased time spent near social stimulus zone and increased total distance travelled .. Exposure elicited anxiety as revealed by significantly increased time spent in bottom half; freezing bouts and duration and decreased distance travelled, average velocity, and number of entries to upper half of the tank .. Exposed zebrafish spent less time in the novel arm of the Y-Maze, corroborating significant impairment in learning .. Decreased superoxide dismutase (SOD), catalase (CAT) activities whereas, increased levels of reduced glutathione (GSH) and lipid peroxidation (LPO) was encountered showing compromised antioxidant defense" {From the publication}				
Does the cellphone radio-frequency electromagnetic radiation during ringing or talking modes induce locomotor disturbance in <i>Drosophila melanogaster</i> ?	-	1h, 2h/1d	Mervat A. Seada, Samar E. Elkholy, Wesam S. Meshrif	2016-(1)
Exposed larvae and flies: Increased tendency to crawl in short, random and scattered paths (larvae, after 1 h sending-rings). Decreases movement speed (flies, during talking mode). Irritated zigzag locomotor paths and hyperactivity (flies, after 1 or 2 h sending-talks).				
Cell phone-generated radio frequency electromagnetic field effects on the locomotor behaviors of the fishes <i>Poecilia reticulata</i> and <i>Danio rerio</i>	1800 MHz (GSM) - (SAR, specs, 0.9 W/kg)	3min/1d	David Lee, Joshua Lee, Imshik Lee	2015-(9)
Exposed fishes: Altered locomotion (changes in population and velocity distributions).				
Effect of Short-Term GSM Radiation at Representative Levels in Society on a Biological Model: The Ant <i>Myrmica sabuleti</i>	940 MHz (GSM) - 0.0006 mW/cm ²	10-13 min/1d	Marie-Claire Cammaerts, Guy A. E. Vandenbosch, Vladimir Volski	2014-(13)
Exposed ants: Slightly changed locomotion, lower quality orientation towards the attractive alarm pheromones (less efficient trail following behavior).				
Spatial learning, monoamines and oxidative stress in rats exposed to 900 MHz electromagnetic field in combination with iron overload	900 MHz - (SAR 0.05-0.18 W/kg)	1h/21d	Karima Maaroufia, Laurence Had-Aissouni, Christophe Melon, Mohsen Sakly, Hafedh Abdelmelek, Bruno Poucet, Etienne Save	2014-(10)
Exposed rats: Impaired object exploration task. Alterations of monoamine content in brain (max. in hippocampus). Impact is revealed only in a task exploiting spontaneous exploratory activity.				
Transient and cumulative memory impairments induced by GSM 1.8 GHz cell phone signal in a mouse model	1800 MHz (GSM) - (SAR 0.11 W/kg)	1.5h/6d, 148d	Maria P. Ntzouni, Aikaterini Skouroliakou, Nikolaos Kostomitsopoulos, and Lukas H. Margaritis	2013-(1)
Exposed mouse: Impairments in both transient and cumulative memory (more pronounced on spatial memory) that persist even 2 weeks after the exposure period (but not 4 weeks after).				
Analysis of emotionality and locomotion in radio-frequency electromagnetic radiation exposed rats	900 MHz (GSM) - max. 0.14 mW/cm ²	1h/28d	Sareesh Naduvil Narayanan, Raju Suresh Kumar, Jaijesh Paval, Vivekananda Kedage, M. Shankaranarayana Bhat, Satheesha Nayak, P. Gopalakrishna Bhat	2013-(8)
Exposed rats: Decreased percentage of entries into, percentage of time spent on and distance travelled on the open arm. Decreased rearing frequency and grooming frequency. Increased defecation boli count. Mobile phone radiation could affect the emotionality of rats without affecting the general locomotion.				
Protective effect of <i>Loranthus longiflorus</i> on learning and memory of rats exposed to electromagnetic radiation (EMR) ("chemical remedy")	900-1800 MHz (GSM)	(5 min call/5 min off) 1h/60d	Hemant Nagar, Dilip Kumar Tiwari, Gaurav Dwivedi, Rishi Kant Tripathi, Jitendra Jena	2013-(4)

Loranthus longiflorus protect central nervous system against oxidative damages of electromagnetic radiation on rat ("chemical remedy")	900-1800 MHz (GSM)	(5 min call/5 min off) 1h/60 d	Hemant Nagar, Dilip Kumar Tiwari, Gaurav Dwivedi, Rishi Kant Tripathi, Jitendra Jena	2013-(4)
The Effect of Cell Phone Radiations on the Life Cycle of Honeybees	900-1800 MHz (GSM) 0.015 mW/cm ²	-	Nashaat El Halabi, Roger Achkar, Gaby Abou Haidab	2013-(7)
Exposed honeybees: Increased frequency and intensity of the sound naturally generated by honeybees up to 1.5 KHz and 0.7 normalized amplitude (while normal is 450 Hz and 0.3 normalized amplitude).				
Food collection and response to pheromones in an ant species exposed to electromagnetic radiation	900 MHz (GSM) - 0.00016 mW/cm ²	-	Marie-Claire Cammaerts, Zoheir Rachidi, François Bellens, Philippe De Doncker	2012-(18)
"... ants followed trails for only short distances, no longer arrived at marked areas and no longer orientated themselves to a source of alarm pheromone. Also when exposed to electromagnetic waves, ants became unable to return to their nest and recruit congeners; therefore, the number of ants collecting food increases only slightly and slowly. After 180 h of exposure, their colonies deteriorated."				
916 MHz electromagnetic field exposure affects rat behavior and hippocampal neuronal discharge	916 MHz - 1 mW/cm ²	6h/10d , 45d	Dongmei Hao, Lei Yang, Su Chen, Yonghao Tian, Shuicai Wu	2012-(5)
Exposed rats: Increased average completion times in an eight-arm radial maze. Increased error rates. Irregular firing patterns in hippocampal neurons and decreased spiking activity 6-9 weeks compared with that after 2-5 weeks of exposure.				
Changes in Paramecium caudatum (Protozoa) near a switched-on GSM telephone	900 MHz (GSM)	2min/ 1d	Marie-Claire Cammaerts, Olivier Debeir, Roger Cammaerts	2011-(10)
Exposed paramecium: Altered physiology (broader paramecium itselfs and their cytopharynx, difficulties in their pulse vesicles to expell their content outside the cell, less efficiently moved cilia, more visible trichocysts).				
Short-term memory in mice is affected by mobile phone radiation	1800 MHz (GSM) - (SAR 0.22 W/kg)	90min/ 17d, 31d	M.P. Ntzouni, A. Stamatakis, F. Stylianopoulou, L.H. Margaritis	2011-(7)
Whole body exposure with GSM 900 MHz affects spatial memory in mice	900 MHz - 0.05-0.2 mW/cm ² (SAR 0.41-0.98 W/kg (brain))	2h/3d + 3h45m /1d	A.F. Fragopoulou, P. Miltiadous, A. Stamatakis, F. Stylianopoulou, S.L. Koussoulakos, L.H. Margaritis	2010-(9)
Exposed mice: Deficit in transferring the acquired spatial information across training days. No preference for target quadrant (this indicate deficits in consolidation and/or retrieval of the learned spatial information).				

Prenatal Exposure to 3G & 2G Phone radiation effects on pups Histology

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
The effect of electromagnetic radiation on the development of skin ultrastructural and immunohistochemical evaluation with P63	900 MHz (GSM)	1h/21 d	Leyla Bahar, Ayhan Eralp, Yilmaz Rumevleklioglu, Sema Erden Erturk, Mehmet Yuncu	2018-(8)
Effect of Radiofrequency Radiation Emitted from 2G and 3G Cell Phone on Developing Liver of Chick Embryo – A Comparative Study	(2G & 3G) - (SAR, specs, 0.31 W/kg)	75min /12d	Mary Hydrina D'Silva, Rijied Thompson Swer, J. Anbalagan, Bhargavan Rajesh	2017-(5)
"... the exposure of developing chick embryos to 2G and 3G cell phone radiations caused structural changes in liver in the form of dilated sinusoidal spaces with haemorrhage, increased vacuolations in cytoplasm, increased nuclear diameter and karyorrhexis and significantly increased DNA damage." {From the publication}				
Disruption of the ovarian follicle reservoir of prepubertal rats following prenatal exposure to a continuous 900-MHz electromagnetic field	900 MHz - (SAR 0.01 W/kg (body))	1h/9d	Sibel Türedi, Hatice Hancı, Serdar Colakoglu, Haydar Kaya, Ersan Odacı	2016-(10)
Effects of prenatal exposure to a 900 MHz electromagnetic field on 60-day-old rat testis and epididymal sperm quality	900 MHz - 0.047 mW/	1h/9d	E. Odacı, H. Hancı, E. Yuluğ, S. Türedi, Y.	2015-(12)

	cm2 (SAR 0.024 W/kg (body))		Aliyazıcıoğlu, H. Kaya, S. Çolakoğlu	
Exposed rats (prenatally): Increased apoptotic index and DNA oxidation levels. Decreased perm motility and vitality. Immature germ cells in the seminiferous tubule lumen, and altered seminiferous tubule epithelium and seminiferous tubule structure. Apoptotic cells in the seminiferous tubule epithelium.				
Effects of Cell Phone Radiations on the Metanephros Tubules in a Chick Embryo Model	(GSM) & (GSM + WiFi)	15min, 30min /15d	Sabah Rehman, Shadab Ahmed Butt, Naureen Waseem, Hina Kundi, Abdul Rasool Qamar	2015-(5)
Exposed chick embryos: Decreased mean proximal and distal tubular diameters. Decreased mean proximal and distal luminal diameters.				
Structural changes in the parotid gland of male albino rats following prenatal and postnatal exposure to radiofrequency radiation	900 MHz	30min/14d, 28d	Amira Fathy, Rehab A. Rifaai, Ahmed Said, Saadia Ragab	2015-(1)
Exposed rats (prenatally): Areas of hemorrhage. Increased reativity (immunocytochemical α -amylase test). Decreased number of proliferating cell nuclear antigen-positive cells. Exposed rats (postnatally 14 days): Degeneration of the acini and dilated ducts. number of proliferating cell nuclear antigen-positive cells. Exposed rats (postnatally 28 days): Degeneration of the acini and dilated ducts. Decreased reativity (immunocytochemical α -amylase test).				
The effects of prenatal long-duration exposure to 900-MHz electromagnetic field on the 21-day-old newborn male rat liver	900 MHz - 0.054 mW/cm2 (SAR 0.027 W/kg (body))	1h/9d	Zehra Topal, Hatice Hanci, Tolga Mercantepe, Hüseyin Serkan Erol, Osman Nuri Keles, Haydar Kaya, Sevdegül Mungan, Ersan Odaci	2015-(7)
Exposed rats (prenatally): Increased malondialdehyde and superoxide dismutase values. Decreased glutathione levels. Hydropic degeneration in the parenchyma. Vacuolization in the mitochondria. Expansion in the endoplasmic reticulum. Necrotic hepatocytes.				
Pathological effects of prenatal exposure to a 900 MHz electromagnetic field on the 21-day-old male rat kidney	900 MHz - 0.049 mW/cm2 (SAR 0.024 W/kg (body))	1h/9d	E. Odaci, D. Ünal, T. Mercantepe, Z. Topal, H. Hanci, S. Türedi, H.S. Erol, S. Mungan, H. Kaya, S. Çolakoğlu	2015-(9)
Exposed rats (prenatally): Degenerative changes in the tubule epithelium. Small cystic formations in the primitive tubules. Large cysts formations in the cortico-medullary or medullary regions. Loss of peritubular capillaries. Atypical parietal layer epithelial cells. Increased malondialdehyde levels. Decreased superoxide dismutase and catalase levels.				
The effect of exposure of rats during prenatal period to radiation spreading from mobile phones on renal development	900 MHz (GSM)	24h/20d	Recep Bedir, Levent Tumkaya, İbrahim Şehitoğlu, Yıldray Kalkan, Adnan Yılmaz, Osman Zikrullah Şahin	2014-(5)
Exposed rats (prenatally): Mild congestion and tubular defects. Dilatation of Bowman's capsule in the kidney. Increased apoptosis in the renal tubular cells.				
Effect of Ultrahigh Frequency Radiation Emitted from 2G Cell Phone on Developing Lens of Chick Embryo: A Histological Study	900-1800 MHz (GSM) - (SAR, specs, 2 W/kg)	72min /9-12 d	Mary Hydrina D'Silva, Rijied Thompson Swer, J. Anbalagan, Rajesh Bhargavan	2014-(10)
" ... structural changes in lens epithelial cells, formation of cystic cells and spaces, distortion of lens fibers, and formation of posterior aberrant nuclear layer .. The DNA damage in the developing eyes of the experiment group assessed by comet assay was highly significant." {From the publication}				
Apoptosis resulted from radiofrequency radiation exposure of pregnant rabbits and their infants	1800 MHz (GSM) - 0.051 mW/cm2	15m/7d	Goknur Guler, Elcin Ozgur, Hikmet Keles, Arin Tomruk, Sevil Atalay Vural, Nesrin Seyhan	2011-(8)
Exposed rabbits (prenatally): Histopathological changes in the liver, kidneys, lung, heart, and spleen. Hyperaemia in the liver, kidneys, lung, and heart. Mononuclear cell infiltration in liver, kidneys, and lung. Etc...				

Prenatal Exposure to 3G & 2G Phone radiation effects on embryonic Development

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Morphometric analysis – effect of the radiofrequency interface of electromagnetic field on the size of hatched <i>Dermacentor reticulatus</i> larvae	900 MHz - 0.0001 mW/cm2	30-90 min/1 d	Blažena Vargová, Igor Majlath, Juraj Kurimský, Roman Cimbala,	2021-(7)

			Natalia Pipova, Jozef Živčák, Piotr Tryjanowski, Branislav Peško, Jaroslav Džmura, Gabriela Ižariková, Viktoria Majláthová	
<p>" Eggs were exposed to EMF for different time periods (30, 60 and 90 minutes) in dark, electromagnetically shielded anechoic chamber. After the irradiation eggs were allowed to hatch in climatic chamber. Randomly selected 200 larval individuals were measured to get basic morphological records. Four body traits including the total body length (TBL), length of gnathosoma with scutum (GSL), the total body width (TBW), and the width of basis capituli (BCW) were measured. ... The <i>D. reticulatus</i> larvae hatched from eggs exposed for 60 minutes, had demonstrably larger dimensions of all measured body traits not only as a control unexposed group but also as other experimental groups." {From the publication}</p>				
Mobile phone use during pregnancy: which association with fetal growth?	-	-	Nathalie Boileau, François Margueritte, Tristan Gauthier, Nedjma Boukeffa, Pierre-Marie Preux, Anaïs Labrunie, Yves Aubard	2020-(1)
<p>In this epidemiological study, using human prospective, longitudinal, multicenter cohort data, is concluded that using a mobile phone for calls for more than 30 minutes per day during pregnancy may have a negative impact on fetal growth.</p>				
Effects of Electromagnetic Field on the Development of Chick Embryo: An In Vivo Study	1800 MHz (GSM)	20 min/1 0-15d	Najam Siddiqi, Nasser Al Nazwani	2019-(18)
<p>" This study was conducted to explore the effects of electromagnetic waves on a developing chick embryo. The radiofrequency electromagnetic waves (RFW) emitted by different smart phones was measured by using a TriField meter. Chick fertilized eggs were placed in an egg incubator, divided into control and exposed groups. In the exposed group, a mobile phone was placed inside an incubator in call receiving mode, while in the control group, the mobile phone was not used. Studies were conducted at low and high exposure (dose) of RFW. Chick embryos were sacrificed at day 10 and day 15, and embryos were examined for mortality, gross malformation, weight, and length. Histology, electron microscopy, and Hsp 70 of liver were done for the high dose group. No mortality was observed in the low dose group; however, in the high dose group, the mortality was 14%, and deformities of the limbs and skin abnormalities were observed. Weight and length in the exposed groups were significantly lower than the control at higher dose. Histology and ultrastructure of liver revealed fatty infiltration, increase number of mitochondria, deformation, and disappearance of its cristae. Hsp 70 and mRNA levels were elevated in the exposed groups for high dose group." {From the publication}</p>				
The effect of prenatal exposure to 1800 MHz electromagnetic field on calcineurin and bone development in rats	1800 MHz (GSM)	6h, 12h, 24h / pregnancy	Adem Erkut, Levent Tumkaya, Mehmet Sabri Balik, Yildiray Kalkan, Yilmaz Guvercin, Adnan Yilmaz, Suleyman Yuce, Erkan Cure, Ibrahim Sehitoglu	2016-(10)
<p>" ... increasing the duration of EMF exposure during the prenatal period resulted in a significant reduction of resting cartilage levels and a significant increase in the number of apoptotic chondrocytes and myocytes .. There was also a reduction in calcineurin activities in both bone and muscle tissues .. Development of the femur, tibia, and ulna were negatively affected, especially with a daily EMF exposure of 24 hours." {From the publication}</p>				
Different periods of intrauterine exposure to electromagnetic field: Influence on female rats' fertility, prenatal and postnatal development	1800 MHz (GSM) - 0.396 mW/cm ² (SAR 0.048 W/kg (body))	1h, 2h/ 7d, 14d, 21d	Ali S.H. Alchalabi, Erkihun Akililu, Abd Rahman Aziz, F. Malek, S.H. Ronald, Mohd Azam Khan	2016-(10)
<p>" Prenatal development findings showed uterine congestion, haemorrhage, dead and reabsorbed fetuses were observed in exposure groups during 2nd and 3rd week of pregnancy unlike to control. 1st and 2nd week in-utero irradiation showed significant reduction with unequal and asymmetrical distribution of implantation sites and embryos in exposure groups except the control group. A number of live embryos were significantly reduced with an increasing number of dead and reabsorbed embryos in the 2 h/ day of the 2nd-week exposure group in compared to control group. Malformation, haematoma, and oedematous foetuses in experimental groups were observed unlike control foetuses. A significant decrease in live foetuses and a significant decrease in body mass of foetuses at gestation day 20, unlike control group. Postnatal observations showed haematoma, congestion, short tail, malformation and growth restriction and delay in some growth markers were observed. In-utero irradiation for 2 and three weeks induced oxidative stress in pregnant rats." {From the publication}</p>				
The effect of 900 and 1800 MHz GSM-like radiofrequency irradiation and nicotine sulfate administration on the embryonic development of <i>Xenopus laevis</i>	900-1800 MHz (GSM) - (SAR 1 W/kg (body))	4h, 6h, 8h/1d	Ayper Boga, Mustafa Emre, Yasar Sertdemir, Kubra Akillioğlu, Secil Binokay, Osman Demirhan	2015-(13)
Effects of Mobile Phone 1800 MHz Electromagnetic Field on the Development of Chick Embryos – A Pilot Study	1800 MHz (GSM) - (SAR, specs, 0.47-1.10 W/kg (body-head))	50min /1d	Najam Siddiqi, Muthusami John C, Syed M Saud, Ayesha Shafaq, Marwan Zaki	2015-(5)

Exposed chick embryo: Increased mortality, gross malformations and developmental anomalies. Decreased wet body weight and length. Degeneration of hepatocytes and disruption of architecture in the liver tissue. Etc...				
The Effects of 900 Megahertz Electromagnetic Field Applied in the Prenatal Period on Spinal Cord Morphology and Motor Behavior in Female Rat Pups	900 MHz - 0.026 mW/cm ²	1h/7d	Ersan Odacı, Ayşe İkinci, Mehmet Yıldırım, Haydar Kaya, Metehan Akça, Hatice Hancı, Osman Fikret Sönmez, Ali Aslan, Mukadder Okuyan, Orhan Baş	2013-(9)
Exposed rats (prenatally): Increased motor functions. Pathological changes in the spinal cord.				

Prenatal Exposure to 3G & 2G Phone radiation effects on pups Biochemical parameters

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Effects of Exposure to Electromagnetic Waves from 3G Mobile Phones on Oxidative Stress in Fetal Rats	(2G & 3G)	8h / pregnancy	Indra Fauzi Sabban, Galih Pangesti, Hendry Trisakti Saragih	2018-(5)
" The results showed that exposure to electromagnetic waves from mobile phones in treatment 4 [3G mobile in the active state with both browsing and video streaming activity] negatively affected the fetus in the form of increased levels of ROS in the liver and brain, as well as altered morphology in the liver." {From the publication}				
Exposure to mobile phone (900–1800 MHz) during pregnancy: tissue oxidative stress after childbirth	900-1800 MHz	2h/20d	Mohammad Hossein Bahreyni Toossi, Hamid Reza Sadeghnia, Maryam Mohammad Mahdizadeh Feyzabadi, Mahmoud Hosseini, Mahdiyeh Hedayati, Razieh Mosallanejad, Farimah Beheshti, Zeynab Alizadeh Rahvar	2017-(1)
Monochromatic red light of LED protects embryonic cells from oxidative stress caused by radiofrequency radiation ("physical remedy")	900 MHz (GSM) - 0.014 mW/cm ² (SAR 0.017 W/kg)	158h	Olexandr Tsybulin, Evgeniy Sidorik, Sergiy Kyrylenko, Igor Yakymenko	2016-(7)
" ... rate of somitogenesis decreased [by] RFR exposure; as well as .. increased level of lipid peroxidation and decreased catalase activity in tissues of RFR exposed embryos. In vitro significant suppression of SOD and catalase activities by short-term RFR exposure." {From the publication} One of the groups is also exposed to red light LED and is showed that it protects them in various parameters.				
Plasma thyroid hormones and corticosterone levels in blood of chicken embryos and post hatch chickens exposed during incubation to 1800 MHz electromagnetic fields	1800 MHz (GSM) - 0.009-0.011 mW/cm ²	10 x 4min/ 1-18d	Krzysztof Pawlak, Andrzej Sechman, Zenon Nieckarz	2014-(9)
Effects of Prenatal and Postnatal Exposure to GSM-Like Radiofrequency on Blood Chemistry and Oxidative Stress in Infant Rabbits, an Experimental Study	1800 MHz (GSM)	15min/ 7d, + 15min /7-14d	Elcin Ozzgur, Gorkem Kismali, Goknur Guler, Aytac Akcay, Guzin Ozkurt, Tevhide Sel, Nesrin Seyhan	2013-(9)
Exposed rabbits (prenatally): Altered serum lipid peroxidation level. Oxidative stress. Changes on some blood chemistry parameters.				
Overproduction of free radical species in embryonal cells exposed to low intensity radiofrequency radiation	900 MHz (GSM) - 0.00025 mW/cm ² (SAR 0.000003 W/kg)	38h, 120h, 240h	A. Burlaka, O. Tsybulin, E. Sidorik, S. Lukin, V. Polishuk, S. Tshmistrenko, I. Yakymenko	2013-(7)
Exposed Japanese quails embryos: Increased production of superoxide and nitrogen oxide. Increased levels of thiobarbituric acid reactive substances and 8-oxo-2'-deoxyguanosine antioxidant enzymes. Decreased levels of superoxide dismutase and catalase activities.				

Prenatal Exposure to 3G & 2G Phone radiation effects on pups Brain and Behavior

Title	Used freq. and power	Hours day /	Authors	Year (pages)
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		days		
The effects of different herbals on the rat hippocampus exposed to electromagnetic field for one hour during the prenatal period ("chemical remedy")	900 MHz	1h/ prenat al period	Ömür Gülsüm Deniz, Süleyman Kaplan	2021-(1)
Exposed rats (prenatally): Decreased total pyramidal neuron number in the Cornu Ammonis of the Hippocampus.				
Electromagnetic Waves from Mobile Phones may Affect Rat Brain During Development	1800 MHz (SAR,specs, 1.79 W/kg)	2h/ gestat ional period, 60d	Dilek Akakin, Olgu Enis Tok, Damla Anil, Akin Akakin, Serap Sirvanci, Goksel Sener, Feriha Ercan	2021- (10)
" In comparison to controls, rats exposed to MP in stand-by or talk modes had significantly increased neuronal damage in the cortex and hippocampus. Increased MDA [malondialdehyde] levels in the EMW group and decreased GSH [glutathione] levels in the stand-by, EMW fetal and EMW groups were found compared with controls. Increased GFAP [glial fibrillary acidic protein] content in the EMW group and increased GFAP staining in the EMW fetal and EMW groups compared to controls were observed. EMW group had a significantly decreased number of myelinated axons than control animals."				
Prenatal and early postnatal exposure to radiofrequency waves (900 MHz) adversely affects passive avoidance learning and memory	900 MHz	2-4h/ gestat ional period, 21d	Mansour Azimzadeh, Gholamali Jelodar	2020-(1)
Enriched Environment Decreases Cognitive Impairment in Elderly Rats With Prenatal Mobile Phone Exposure	800–1900 MHz	8-24h /19d	Shanyan Hong, Honghong Huang, Meili Yang, Haining Wu, Lingxing Wang	2020-(9)
"The results demonstrated that prenatal long-term but not short-term exposure to mobile phone lead to cognitive impairment, morphological changes in the hippocampal cells, reduced synaptic number, decreased SYN, PSD-95, and BDNF expression in elderly offspring, which were alleviated by postnatal EE housing. These findings suggest that prenatal long-term mobile phone exposure may pose life-long adverse effects on elderly offspring and impair cognition by disrupting the synaptic plasticity, which may be reversed by postnatal EE housing." {From the publication}				
Alteration of adaptive behaviors of progeny after maternal mobile phone exposure	900 MHz (GSM) (SAR 0.7-2.6 W/kg (body))	45min /19d	Nicolas Petitdant, Anthony Lecomte, Franck Robidel, Christelle Gamez, Kelly Blazy, Anne-Sophie Villégier	2018- (10)
Although other tested impairments are not found, the activity in the open field was reduced at 2.6 W/kg. The authors conclude that maternal immune activation increased the developmental RF exposure-induced long-term neurobiological impairments.				
Maternal cell phone use during pregnancy and child behavioral problems in five birth cohorts	-	-	Laura Birkša, Mònica Guxens, Eleni Papadopoulou, Jan Alexander, Ferran Ballester, Marisa Estarlich, Mara Gallastegi, Mina Ha, Margaretha Haugen, Anke Huss, Leeka Kheifets, Hyungryul Lim, Jørn Olsen, Loreto Santa-Marina, Madhuri Sudan, Roel Vermeulen, Tanja Vrijkotte, Elisabeth Cardis, Martine Vrijheid	2017- (26)
The study uses individual human participant data from 83,884 mother-child pairs of various countries. Concludes that maternal cell phone use during pregnancy may be associated with an increased risk for behavioral problems in the offspring (very specifically hyperactivity and inattention problems).				
Social behavioral testing and brain magnetic resonance imaging in chicks exposed to mobile phone radiation during development	900 MHz (GSM) - 0.003 mW/ cm2	10h/1 5d	Zien Zhou, Jiehui Shan, Jinyan Zu, Zengai Chen, Weiwei Ma, Lei Li, Jianrong Xu	2016-(8)
Exposed chick embryos: Slower aggregation responses. Lower belongingness and weaker vocalization. Smaller cerebellum size.				
Maternal exposure to a continuous 900-MHz electromagnetic field provokes neuronal loss and pathological changes in cerebellum of 32-day-old female rat offspring	900 MHz (CW) - (SAR 0.01 W/kg (body))	1h /8d	Ersan Odacı, Hatice Hancı, Ayşe İkinici, Osman Fikret Sönmez, Ali Aslan, Arzu Şahin, Haydar Kaya, Serdar Çolakoğlu, Orhan Baş	2015-(1)
Neurodegenerative changes and apoptosis induced by intrauterine and extrauterine exposure of radiofrequency radiation	1800 MHz (GSM) - 0.052 mW/ cm2 (SAR	15min/ 7d, 14d	Göknur Güler, Elcin Ozgur, Hikmet Keles, Arin Tomruk, Sevil Atalay Vural, Nesrin	2015-(6)

	0.018 W/kg)		Seyhan	
Exposed rabbits (prenatally): Increased malondialdehyde level on males. Mild lesions in neuronal necrobiosis in brain tissues of females. Gliosis in brain tissues. Exposed rabbits (postnatally): Mild lesions in neuronal necrobiosis in brain tissues of males.				
Maternal mobile phone exposure alters intrinsic electrophysiological properties of CA1 pyramidal neurons in rat offspring	900 MHz	6h/ gestational period	Moazamehosadat Razavinasab, Kasra Moazzami, Mohammad Shabani	2014-(1)
Exposed rats (prenatally): Decreased neuronal excitability. Decreased number of action potentials fired in spontaneous activity and in response to current injection. Increased afterhyperpolarization amplitude. Altered learning acquisition and memory retention.				
Pyramidal Cell Loss in the Cornu Ammonis of 32-day-old Female Rats Following Exposure to a 900 Megahertz Electromagnetic Field During Prenatal Days 13–21	900 MHz (CW) - 0.0265 mW/cm ²	1h/8d	Orhan Baş, Osman Fikret Sönmez, Ali Aslan, Ayşe İkinci, Hatice Hancı, Mehmet Yıldırım, Haydar Kaya, Metehan Akça, Ersan Odacı	2013-(9)
Exposes rats (prenatally): Decreased number of pyramidal cells in the cornu ammonis of female pups. Picnotic cells in the cornu ammonis of female pups.				
Maternal mobile phone exposure adversely affects the electrophysiological properties of purkinje neurons in rat offsprings	900 MHz (GSM) - (SAR 0.5-0.9 W/kg)	6h/ gestational period	M. Haghani, M. Shabani, K. Moazzami	2013-(11)
Exposed rats (prenatally): Decreased neuronal excitability of Purkinje cells. Altered after hyperpolarization amplitude, spike frequency, half width and first spike latency.				
The Effects of Prenatal Exposure to a 900 Megahertz Electromagnetic Field on Hippocampus Morphology and Learning Behavior in Rat Pups	900 MHz (CW)	1h/8d	Ayşe İkinci, Ersan Odacı, Mehmet Yıldırım, Haydar Kaya, Metehan Akça, Hatice Hancı, Ali Aslan, Osman Fikret Sönmez, Orhan Baş	2013-(9)
Exposed rats (prenatally): Compromised learning behavior. Histopathological changes appearing in the hippocampus.				
Mobile phone exposure during pregnancy disrupts learning and memory in rat offsprings (in Farsi)	-	-	Mohammad Shabani, Tayebeh Khezri Fard, Mobin Aghapour, Shahrnaz Parsania	2013-(11)
Exposed rats (prenatally): Decreased step-through latency. Decreased percent time spent in the correct quadrant.				
Fetal Radiofrequency Radiation Exposure From 800-1900 Mhz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice	800-1900 MHz - (SAR, specs, 1.6 W/kg)	9h, 15h, 24h/1 8d	Tamir S. Aldad, Geliang Gan, Xiao-Bing Gao, Hugh S. Taylor	2012-(8)
" ... mice exposed in-utero were hyperactive and had impaired memory as determined using the object recognition, light/dark box and step-down assays. (mEPSCs) revealed that these behavioral changes were due to altered neuronal developmental programming. exposed mice had dose-responsive impaired glutamatergic synaptic transmission onto layer V pyramidal neurons of the prefrontal cortex." {From the publication}				
The influence of microwave radiation from cellular phone on fetal rat brain	-	30min, 90min, 3h/20 d	Ji Jing, Zhang Yuhua, Yang Xiao-qian, Jiang Rongping, Guo Dong-mei, Cui Xi	2012-(1)
Exposed rats (prenatally): Differences in dismutase, glutathione peroxidase, malondialdehyde, noradrenaline, dopamine.				

Prenatal Exposure to 3G & 2G Phone radiation effects on pups (Various changes)

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Effect of the Electromagnetic Field as a Negative Stimulus on the Weight, Number and Development of Newborn Rats	1800 MHz (GSM)	-/ gestational period	Tea Museliani, Marine Nikolaishvili, Gogi Jikia, Khatuna Dondoladze, Davit Natadze	2021-(5)
" Irradiation of rats during pregnancy with an electromagnetic field has shown that GH2 hormone decrease and it causes retardation of offspring, shortening of the limbs and tail of newborn rats compared to controls, and that control rats' eyes open earlier than those of experimental rats and consequently weight loss in rats in the experimental group. The public, especially pregnant women, should be aware that the electromagnetic field negatively affects not only their health, but also the fetus, causing certain changes." {From the publication}				

Histological, Immunohistochemical and Molecular Alterations in Immature Mice Testes Due to Chronic Exposure to Mobile Phone Radiofrequency Radiation	860 MHz (GSM) - (SAR, specs, 1.09 W/kg (head))	30min /45d	Samir A. Nassar, Ahmed Algazeery, Gamal A. Sayed, Ahmed, Wafaa A. Abo El-Maaty	2020-(8)
" Mobile phone radiation affected the testicular structure and function via the degeneration of germ cells and Leydig cells. Moreover, it caused apoptosis of testicular cells as indicated by up regulation of caspase-3 and induced down regulation of PCNA at the immunohistochemical level confirmed by DNA damage at the molecular level. This onset may lead to infertility like condition due to RFR-exposure." (From the publication)				
Does Exposure of Smart Phones during Pregnancy Affect the Offspring's Ovarian Reserve? A Rat Model Study	-	-	Pinar Calis, Merve Seymen, Yagmur Soykan, Kevser Delen, Bahriye Sirav Aral, Gulnur Take Kaplanoglu , Deniz Karcaaltincaba	2019-(1)
Exposed rats (prenatally): Decreased mean number of primordial and secondary follicles. Increased atresia score.				
Prenatal Effects of a 1,800-MHz Electromagnetic Field on Rat Livers	1800 MHz - (SAR 0.12 W/kg)	6-24h /20d	L. Tumkaya, A. Yilmaz, K. Akyildiz, T. Mercantepe, Z. A. Yazici, H. Yilmaz	2019-(9)
Exposed rats: Increased Malondialdehyde levels. Decreased liver tissue glutathione levels. Increased Serum Ca ²⁺ , alanine transaminase, and aspartate aminotransferase levels. Increased total oxidant status levels and decreased total antioxidant status levels in the liver tissue. Extensive vacuolation and degeneration of the hepatocytes in the portal area, as well as those surrounding the sinusoids. Affected hepatocytes had polygonally shaped nuclei and vacuolic cytoplasm imparting eosinophilic staining. Decreased cellular membrane integrity and invaginations, as well as picnotic nuclei.				
Maternal Cell Phone Use During Pregnancy, Pregnancy Duration And Fetal Growth In Four Birth Cohorts	-	-	Ermioni Tsarna, Marije Reedijk, Laura Ellen Birks, Mònica Guxens, Ferran Ballester, Mina Ha, Ana Jiménez-Zabala, Leeka Kheifets, Aitana Lertxundi, Hyung-ryul Lim, Jorn Olsen, Lúcia González Safont, Madhuri Sudan, Elisabeth Cardis, Martine Vrijheid, Tanja Vrijkotte, Anke Huss, Roel Vermeulen	2019-(11)
" The intermediate exposure group had higher risk of giving birth at lower gestational age (Hazard Ratio=1.04, 95%CI 1.01, 1.07), and exposure-response relationships were found for shorter pregnancy duration (P<0.001) and preterm birth (P=0.003)." (From the publication)				
Mobile Phone and its Effect on Foetal Cardiotocography Pattern	(SAR, specs, 0.99 W/kg)	10min /1d	Zaheera Saadia, Robina Farrukh	2018-(5)
Effect of a 1800 MHz electromagnetic field emitted during embryogenesis on chick development and hatchability	1800 MHz - 0.009-0.011 mW/cm ²	-	K. Pawlak, Z. Nieckarz, A. Sechman, D. Wojtysiak, B. Bojarski, B. Tombarkiewicz	2018-(1)
Exposed chicks (during embryogenesis): Decreased duration of embryogenesis (earlier pipping and hatching of chicks, but no effects on the quantity and quality of chicks). Increased plasma corticosterone concentrations (mother). Decreased fat and glycogen in the liver (mother). Exposed chicks embryos: Decreased relative heart weight and right ventricle wall thickness.				
Effects of Simulated Mobile Phone Electromagnetic Radiation on Fertilization and Embryo Development	935 MHz - 0.15-1.4 mW/cm ²	2-4h/ 3d	Hong Chen, Zaiqing Qu, Wenhui Liu	2016-(1)
Exposed mice embryos: Decreased 72-h morula rate and 110-h blastula rate.				
Lasting hepatotoxic effects of prenatal mobile phone exposure	900 MHz	24h/2 0d	A. Yilmaz, L. Tumkaya, K.A. Akyildiz, Y. Kalkan, A.F. Bodur, F. Sargin, H. Efe, H.A. Uydu, Z.A. Yazici	2016-(1)
Exposed rats (prenatally): Increased malondialdehyde levels in the liver. Decreased malondialdehyde levels in the liver. Increased alanine aminotransferase and aspartate aminotransferase serum levels. Intense degeneration in hepatocytes with cytoplasmic eosinophilic structures, pyknotic nuclei, and fibrosis (hisphatological analysis).				
Effects of GSM-like radiofrequency irradiation during the oogenesis and spermiogenesis of Xenopus laevis	900 MHz (GSM) - (SAR 1.0 W/kg)	8h/35 d	Ayper Boga, Mustafa Emre, Yasar Sertdemir, İbrahim Uncu, Secil Binokay, Osman Demirhan	2016-(8)
Can prenatal exposure to a 900 MHz electromagnetic field affect the	900 MHz -	1h/9d	H. Hanci, S. Türedi, Z.	2015-(1)

morphology of the spleen and thymus, and alter biomarkers of oxidative damage in 21-day-old male rats?	0.05 mW/cm ² (SAR 0.025 W/kg body)		Topal, T. Mercantepe, İ. Bozkurt, H. Kaya, Ş. Ersöz, B. Ünal, E. Odacı	
Exposed rats (prenatally): Increased malondialdehyde levels in the thymus tissue. Decreased glutathione levels in the thymus tissue. Increased malondialdehyde and glutathione levels in the splenic tissue. Decreased superoxide dismutase values. Pathological changes in cell morphology in the thymic and splenic tissues.				
Effects of 1800 MHz radiofrequency electromagnetic field of mobile phone on oogenesis in adult female rats	1800 MHz (GSM)	1h, 2h/15 d	Ali Saeed Hammoodi Alchalabi, Erkihum Aklilu, Abd Rahman Aziz, Mohd Azam Khan Goriman Khan, F. Malek, H.A. Rahim	2014-(3)
Exposed rats: Decreases pregnancy rates and number of pups. Decreased number of secondary and Graafian follicles and increased atretic follicle number.				
GSM 900 MHz cellular phone radiation can either stimulate or depress early embryogenesis in Japanese quails depending on the duration of exposure	900 MHz (GSM) - 0.00025 mW/cm ² (SAR 0.00003 W/kg)	38h, 158h	Olexandr Tsybulin, Evgeniy Sidorik, Olga Brieieva, Lyubov Buchynska, Sergiy Kyrylenko, Diane Henshel, Igor Yakymenko	2013-(26)
Exposed Japanese quails (prenatally): Altered number of differentiated somites. Depending on exposure duration increased or decreased number of somites. Depending on exposure duration decreased or increased level of DNA strand breaks.				
Effect of Electromagnetic Mobile Radiation on Chick Embryo Development	900-1800 MHz - (SAR 2 W/kg)	1h/7d, 10d, 14d	Fatma Al-Qudsi, Solafa Azzouz	2012-(9)
Exposed chick embryos: Congenital malformations (bigger embryos, subcutaneous bleeding, and brain malformation). Increased neural retina thickness. Increased retina lipid peroxidase level. Decreased glutathione level.				
Effects of thirty minute mobile phone irradiation on morphological and physiological parameters and gene expression in pregnant rats and their fetuses	1800 MHz (2 phones SAR, specs, 1.01 W/kg)	30min /1d	Ashraf El-Sayed, Hoda S. Badr, Rania Yahia, Salem M. Salem, Asmaa M. Kandil	2011-(11)
Exposed rats (prenatally): Decreased body weights and fetal body length of fetuses. Skeletal system abnormalities (including short and curved tails absent of 13th rib and wavy ribs and absent of caudal vertebrae). Etc...				

Effects of 3G & 2G Phone radiation on Plants Growth

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Exposure Effect of 900 MHz Electromagnetic Field Radiation on Antioxidant Potential of Medicinal Plant Withania Somnifera	900 MHz - 0.853 mW/cm ²	12-72 h	Chandni Upadhyaya, Ishita Patel, Trushit Upadhyaya, Arpan Desai	2021-(13)
" The findings indicated raise in all selected parameters Viz., 20.19% raise in phenolic compounds, 21.27% increase in flavonoid content, 20% increase in DPPA scavenging activity and 19.99% elevation in total antioxidant activity was obtained with initial exposure up to 24 h which shall be due to activation of plant defense system. The prolonged exposure up to 72 h indicated significant detriment in phenolic compounds by 32.12%, Flavonoids by 14.89%, reduction in DPPH radical scavenging activity, by 56.33%, and total antioxidant activity by 42.01%. Such a reduction in antioxidant activity of selected medicinal plants indicates the deteriorative effects of high-frequency Electromagnetic radiation on plant health."				
The hepatotoxic effects of mobile phone radiation (900 MHz) on male mice and the hepatoprotective potentials of architectural shapes of cages ("architectural remedy")	900 MHz (GSM) - 0.223-0.271 mW/cm ² (SAR 0.65-0.84 W/kg)	24h/5 6d	Tarek Mohamed Heikal, Nabil Ashry Ibrahim Elnahas, Mohamed Ahmed Rezk Ali Al-Sherbiny, Samah Ahmed Mohammed Khalil, Mohamed F. Abdelhameed	2020-(11)
Effects of Long-Term Exposure to Low-Power 915 MHz Unmodulated Radiation on Phaseolus vulgaris L.	915 MHz (CW) - 0.001 mW/cm ²	24h/ (from sowing to maturity)	Vasile Surducun, Emanoil Surducun Camelia Neamtu, Augustin C. Mot, Alexandra Ciorîță	2019-(1)
" Significant differences were observed regarding the height of the plants, number of inflorescences, and chlorophyll and carotenoid content, all closely connected with the ultrastructural changes observed in the leaves. The irradiated batch grew higher (19% increase in plant height, 20% increase in stem and leaves' dry mass), with 18% fewer inflorescences, and extremely long roots (34% increase in dry mass). The ultrastructure of the irradiated leaves showed irregular cells and a higher content of plastoglobules in				

the chloroplasts."				
Oxidative stress and an animal neurotransmitter synthesizing enzyme in the leaves of wild growing myrtle after exposure to GSM radiation	1800 MHz (GSM) - 0.193 mW/cm ²	30min /21d	Aikaterina L. Stefi, Dido Vassilacopoulou, Lukas H. Margaritis, Nikolaos S. Christodoulakis	2018-(1)
Exposed plant leaves: Mesophyll cells accumulate large amounts of secondary metabolites. Photosynthetic pigments dramatically reduced. Increased count of reactive oxygen species. Expression of polyclonal L-Dopa DeCarboxylase (otherwise unexpressed).				
To Investigate the Effect of Electromagnetic Radiations on Flavonoids of Lettuce Species	2G, 3G	30min, 2h, 4h, 6h/40 -45d	Vishwasini Sharma, Leena Parihar	2016-(7)
" The present research can be concluded that the cell phones radiations affects the morphological parameters in romaine lettuce and cause increase in the seedling length, fresh weight and dry weight whereas it causes reduction in the germination rate, shoot length, root length and leaf length (Table 1-6). The Rf (retention factor) value was compared with the control and that increased in irradiated samples at different exposure time (Table 8). It also resulted in the increase in concentration of flavonoids which were evaluated by the spectrophotometric analysis and it was observed that the absorbance rate was high in the irradiated samples as compare to the control samples (Fig 3 and Table 9). It can be noted that by exposure to the cell phone radiations there was increase in the concentration of flavonoids (Table 7)." {From the publication}				
Effects of non-ionizing electromagnetic radiation on Capsicum annum seed germination and subsequent sapling growth – A time study	1800 MHz (GSM) - 0.00003-0.002 mW/cm ²	341 min/5 0d	Ardhendu Kundu, Bhaskar Gupta, Amirul I. Mallick, Satya K. Pal	2016-(6)
Exposed plant seeds: Reduced number of germinated Capsicum annum saplings. Taller Capsicum annum saplings and larger leaves.				
Low-amplitude, high-frequency electromagnetic field exposure causes delayed and reduced growth in Rosa hybrida	900 MHz - 0.0066 mW/cm ² (SAR 0.00072 W/kg)	-	Alexandre Grémiaux, Sébastien Girard, Vincent Guérin, Jérémy Lothier, František Baluška, Eric Davies, Pierre Bonnet, Alain Vian	2016-(10)
Exposed plants: Delayed and significant reduced growth (45%) in specific axis.				
EMF radiations (1800 MHz)-inhibited early seedling growth of maize (Zea mays) involves alterations in starch and sucrose metabolism	1800 MHz - 0.0304 mW/cm ² (SAR 0.169 W/kg)	30min, 1h, 2h, 4h/7d	Arvind Kumar, Harminder Pal Singh, Daizy R. Batish, Shalinder Kaur, Ravinder Kumar Kohli	2015-(7)
Exposed plant seeds: Decreased root and coleoptile length. Decreased photosynthetic pigments and total carbohydrates contents. Increased activity of starch-hydrolyzing enzymes- α - and β -amylases. Increased activity of sucrolytic enzymes-acid invertases and alkaline invertases.				
Reduced growth of soybean seedlings after exposure to weak microwave radiation from GSM 900 mobile phone and base station	900 MHz (GSM & CW) - 0.000083-0.445 mW/cm ²	2h/4d, 5d	Malka N. Halgamuge, See Kye Yak, Jacob L. Eberhard	2015-(32)
" ... the exposure to higher amplitude (41 V m ⁻¹) GSM radiation resulted in diminished outgrowth of the epicotyl. the exposure to lower amplitude (5.7 V m ⁻¹) GSM radiation did not influence outgrowth of epicotyl, hypocotyls, or roots. the exposure to higher amplitude CW radiation resulted in reduced outgrowth of the roots whereas lower CW exposure resulted in a reduced outgrowth of the hypocotyl. Soybean seedlings were also exposed for 5 days to an extremely low level of radiation (GSM 900 MHz, 0.56 V m ⁻¹) and outgrowth was studied 2 days later. growth of epicotyl and hypocotyl was found to be reduced, whereas the outgrowth of roots was stimulated."				
Effect of Two Brands of Cell Phone on Germination Rate and Seedling of Wheat (Triticum aestivum)	-	5-30min/-	Rim A. Hussein, Magda A. El-Maghraby	2014-(6)
Exposed plant seeds: Different factors (distance from cell phone, cell phone brand, if cell phone is in talking or non-talking mode) influence in the germination rate and in the embryonic stem length of the seeds.				
Effects of Mobile Phone Radiation on Germination and Early Growth of Different Bean Species	1805-1850 MHz - 0.145 0.481 mW/cm ² (SAR 0.000021-0.000212 W/kg)	4h(on) -4h(off) or 24h(on) -24h(of f) /12 d	Hsuan-Yu Chen, Chiachung Chen	2014-(10)
Seed from five species (red bean, soybean, Mologa bean, Hyacinth bean, mung) are exposed to variable times, with variable results in height and fresh weight or germination differences.				
Effect of Mobile Phone Radiation on Nodule Formation In the Leguminous Plants	850-1850 MHz (2G) & 900-1900 MHz (3G)	30min-8h/ 1d	Sapna Sharma, Leena Parihar	2014-(11)

<p>" ... effect on the early growth and biochemical changes in the emerging seedlings of Pisum sativum (Pea) and Trigonella foenumgraecum (Fenugreek) .. Considerable increase in the germination percentage, seedling length, proteins, lipid and Guaiacol content .. The biochemical parameter increases with increase in the radiation exposure .. The study concluded that radiations emitted from mobile phone interfere with both morphological and the biochemical processes and affect the growth and nodule formation in the plants." {From the publication}</p>				
Effects of Electromagnetic Waves Emitted by Mobile Phones on Germination, Root Growth, and Root Tip Cell Mitotic Division of Lens culinaris Medik	1800 MHz (GSM) - (SAR 0.76 W/kg)	48h/1d	Ayhan Akbal, Yasar Kiran, Ahmet Sahin, Dilek Turgut-Balik, Hasan H. Balik	2010-(8)
<p>Exposed plant seeds: Seeds in the state of dormancy are more affected than those in the state of germination. Decreased root growth. Increased c-mitosis rates (more in the state of dormant seeds).</p>				

Biochemical changes provoked by 3G & 2G Phone radiation: Oxidative Stress

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Exposure to 1.8 GHz radiofrequency field modulates ROS in human HEK293 cells as a function of signal amplitude	1.8 GHz (CW) - 0.00000002 4-0.0017 mW/cm2	15m/1d	Marootpong Pooam, Nathalie Jourdan, Blanche Aguida, Cyril Dahon, Soria Baouz, Colin Terry, Haider Raad, Margaret Ahmad	2022-(13)
<p>" Here, we show that exposure to a 1.8 GHz carrier frequency in the amplitude range of household telecommunications induces the formation of ROS (Reactive Oxygen Species) in human HEK293 cultured cells. The ROS concentrations detected by fluorescent imaging techniques increased significantly after 15 minutes of RF field exposure, and were localized to both nuclear and cytosolic cellular compartments. qPCR analysis showed altered gene expression of both anti-oxidative (SOD, GPX, GPX, and CAT) and oxidative (Nox-2) enzymes. In addition, multiple genes previously identified as responsive to static magnetic fields were found to also be regulated by RF, suggesting common features in response mechanisms. By contrast, many RF effects showed evidence of hormesis, whereby biological responsivity does not occur linearly as a function of signal amplitude. Instead, biphasic dose response curves occur with 'blind' spots at certain signal amplitudes where no measureable response occurs. We conclude that modulation of intracellular ROS can be a direct consequence of RF exposure dependent on signal frequency and amplitude." {From the publication}</p>				
Evaluation of haematological parameters and oxidative stress-induced in rats exposed to radio-frequency radiation from mobile phones	1800-2100 MHz (3G UMTS) 0.00006-0.001 mW/cm2	24h/4 2d	Priscilla Ngozi Ezemelue, D. Ugochukwu Onyegbule, Leona Chika Okoli, Kafilat Olaide Kareem, Olufunsho Awodele, Adebayo Akeem Otitoloju	2021-(7)
<p>" The result of the hematological analysis showed that only granulocytes (neutrophils, basophils, and eosinophils) showed significance (P = 0.04), while for OS [oxidative stress] biomarkers, the result showed that superoxide dismutase and catalase showed significant difference (P = 0.02), respectively, across the two groups. Conclusion: This study concludes that exposure to RF-EMF has an associated effect on hematology and OS induction and therefore recommends the adherence to the precautionary principle while further research has been carried out on their specific mechanism and site of action." {From the publication}</p>				
Hippocampal Oxidative Stress Induced by Radiofrequency Electromagnetic Radiation and the Neuroprotective Effects of Aerobic Exercise in Rats: A Randomized Control Trial	900-1800 MHz	3h/28 d	Mina Rasouli Mojez, Abbas Ali Gaeini, Siroos Choobineh, Mohsen Sheykhloovand	2021-(1)
<p>Exposed rats: Increased hippocampal dead cells. Increased malondialdehyde concentration. Decreased activity of catalase, glutathione peroxidase, and superoxide dismutase.</p>				
The Effect of Mobile Radiation on the Oxidative Stress Biomarkers in Pregnant Mice	900 MHz (100-217 Hz modulated) - 0.000045 mW/cm2	8h/10 d	Nargess Moghadasi, Iraj Alimohammadi, Ali Safari Variani, Azadeh Ashtarinezhad	2021-(7)
<p>" Corrupted gland structure, mucosal edema and inflammatory cell infiltration were observed at mucosal epithelium in the RFR group. An increase in the amount of collagen and fibrosis were detected in the electromagnetic field group. Number of goblet cells showed a statistically significant decrease in electromagnetic field group compared to both the control and sham groups (P<0.05). The increase in the amount of Fusobacterium it was significantly higher in the RFR group compared to the control group. ... But RFR exposure did not caused to KRAS and P53 mutations in colon tissue." {From the publication}</p>				
Oxidative damage in the liver and brain of the rats exposed to frequency-dependent radiofrequency electromagnetic exposure: Biochemical and histopathological evidence	900-2100 MHz - 0.0000008-0.0000011 mW/cm2 (SAR 0.4 W/kg)	1h/20 d	Anjali Sharma, Sadhana Shrivastava, Sangeeta Shukla	2021-(1)
<p>Exposed rats: Frequency-dependent changes in the body weight and hematologic parameters (RBCs, WBCs, platelets, hemoglobin,</p>				

<p>and hematocrit). Increased serum transaminases and bilirubin, urea, uric acid, and creatinine. Decreased albumin. Increased blood glucose, lipid peroxidation, triglycerides, and cholesterol. Decreased adenosine triphosphatases, acetylcholinesterase, and tissue antioxidants such as glutathione, superoxide dismutase, catalase, glutathione reductase, glutathione Peroxidase, glutathione-S-transferase, and glucose-6-phosphate dehydrogenases. Histopathological observations of the liver showed centrilobular mononuclear cell infiltration and swelling in sinusoidal spaces, while in the brain degenerated pyramidal and Purkinje neurons were seen. Brain is more susceptible to oxidative mutilation than the liver.</p>				
Effects of Low-Intensity Microwave Radiation on Oxidant-Antioxidant Parameters and DNA Damage in the Liver of Rats	1800 MHz (GSM), 2100 MHz (GSM) - 0.03-0.12 mW/cm ² (SAR 0.2-0.6 W/kg (body))	2h/21 Od	Mehmet E. Alkis, Mehmet Z. Akdag, Suleyman Dasdag	2020-(10)
<p>Exposed rats: Increased malondialdehyde, 8-hydroxydeoxyguanosine, total oxidant status, oxidative stress index, and comet assay tail intensity. Decreased total antioxidant status levels.</p>				
Impact of Long-Term use of Mobile Phones on the Prostate in Human users	-	-	Madyha Hassan Mahmoud, Nadia Youssef Morcos, Khadiga Salah Ibrahim, Amal Saad-Hussein, Noha Hassan Ibrahim, Ahmed Fathi Soliman	2020-(8)
<p>" The current study investigated some possible effects of long-term use of mobile phones on the oxidative-antioxidants balance and its effect on the prostate. Twenty-eight eligible volunteers frequently use mobile phones and from the same socioeconomic status were enrolled in the study. They were examined according to the effect of time every two years for a follow-up period with four years... At the end of the study, total and free PSA and MDA levels increased significantly compared to the baseline. Compared to the two years of use, total and free PSA level, free PSA/total PSA ratio, MDA and Zn levels were significantly increased after 4 years. In conclusion, the long-term use of cell phones may cause a redox imbalance characterized by increased oxidative stress that eventually affected the prostate gland." {From the publication}</p>				
Oxidative Stress from Low Intensity Electromagnetic Radiation of Wireless Devices: Protective challenges ("physical remedy")	1800 MHz (GSM) - 0.00032 mW/cm ²	19h/1 9d	Igor Yakymenko, Anatoliy Burlaka, Oleksandr Tsybulin, Oksana Salavor	2020-(7)
<p>" In our experiments, the adverse effects under smartphone radiation exposure were persistent during the embryogenesis and included a 2-fold increased level of superoxide generation rate and up to 85% increase in nitrogen oxide generation rate in tissues of 10-day embryos and 1-day old chicks. Also, in 1-day old chicks from the exposed embryos there were detected statistically significant oxidative damages of DNA."</p>				
1800 MHz radio-frequency electromagnetic radiation induces oxidative stress in rat liver, kidney and brain tissues	1800 MHz (GSM) - 0.012 mW/cm ² (SAR 0.06 W/kg (body))	2h/56 d	Mehmet Berköz, Badel Arslan, Metin Yıldırım, Nurcan Aras, Serap Yalın, Ülkü Çömelekoğlu	2018-(8)
Probing the origins of 1800 MHz radio frequency electromagnetic radiation induced damage in mouse immortalized germ cells and spermatozoa in vitro	1800 MHz - (SAR 0.15-1.5 W/kg)	4h/1d	Brendan J. Houston, Brett Nixon, Bruce V. King, R. J. Aitken, Geoffry N. De Iuliiis	2018-(17)
<p>" This study demonstrated that a 4 h exposure is capable of inducing the generation of mitochondrial reactive oxygen species (ROS) in populations of GC1 (7 vs 18 %; p < 0.001) and GC2 cells (11.5 vs 16 %; p < 0.01), identifying Complex III of the electron transport chain (ETC) as the potential source of electrons producing ROS. ... exposure to RF-EMR at 0.15 W/kg for 3 hours did induce significant DNA fragmentation in spermatozoa (that was no longer significant after 4 h), assessed by the alkaline comet assay (p < 0.05). Furthermore, this fragmentation was accompanied by an induction of oxidative DNA damage in the form of 8-hydroxy-2'-deoxyguanosine, which was significant (p < 0.05) after spermatozoa were exposed to RF-EMR for 4 h. At this exposure time point, a decline in sperm motility (p < 0.05) was also observed." {From the publication}</p>				
Aloe arborescens juice prevents EMF-induced oxidative stress and thus protects from pathophysiology in the male reproductive system in vitro ("chemical remedy")	-	-	Przemyslaw Solec, Lena Majchrowicz, Marek Koziorowski	2018-(1)
Exposure to 2100 MHz electromagnetic field radiations induces reactive oxygen species generation in Allium cepa roots	2100 MHz - 0.049 mW/cm ² (SAR 0.28 W/kg)	1-4h/ 1d	Shikha Chandel, Shalinder Kaur, Harminder Pal Singh, Daizy Rani Batish, Ravinder Kumar Kohli	2017-(5)
<p>Exposed onion roots: Increased content of malondialdehyde, H₂O₂ and O₂. Upregulation in the activity of antioxidant enzymes superoxide dismutases and catalase.</p>				
In vitro non-thermal oxidative stress response after 1800 MHz radiofrequency radiation	1800 MHz - 0.239 mW/cm ² (SAR 1.6 W/kg (cell))	10-60 m/1d	Ana Marija Marjanovic, Ivan Paviric, Blanka Tariba, Alica Pizent, Ivancica Trosic	2017-(1)
<p>Exposed fibroblast cells: Increased superoxide radical and glutathione levels.</p>				
Effects of radiofrequency field exposure on glutamate-induced	1950 MHz	-	Jeong-Yub Kim, Hee-	2016-(1)

oxidative stress in mouse hippocampal HT22 cells	(3G W-CDMA)		Jin Kim, Nam Kim, Jong Hwa Kwon, Myung-Jin Park	
Effects of cell phone radiation on lipid peroxidation, glutathione and nitric oxide levels in mouse brain during epileptic seizure	900 MHz (GSM) - 0.054 mW/cm ² (SAR 0.3 W/kg (head))	1h/1d	Meric Arda Esmekaya, Mehmet Zahid Tuysuz, Arin Tomruk, Ayse G. Canseven, Engin Yücel, Zuhail Aktuna, Semih Keskil, Nesrin Seyhan	2016-(1)
Exposed mouse epileptic brain: Increased levels of lipid peroxidation and nitric oxide. Decreased glutathione levels.				
Circadian rhythmicity of antioxidant markers in rats exposed to 1.8 GHz radiofrequency fields	1800 MHz - 0.2 mW/cm ² (SAR 0.05 W/kg (body))	2h/32 d	Honglong Cao, Fenju Qin, Xueguan Liu, Jiajun Wang, Yi Cao, Jian Tong, Heming Zhao	2015-(17)
" The results obtained in the present study indicated significantly decreased levels of Mel in rats exposed to 1.8 GHz RF compared to those in sham-exposed rats. Furthermore, among the six different groups of rats, the levels of Mel [melatonin] were significantly decreased when RF exposures were given at GMT 23:00 and 3:00 when the levels should have been at the highest: thus, the data indicated alteration in amplitude and peak phase of Mel synthesis .. The results of the present study showed decreased levels of GSH-Px [glutathione peroxidase] and SOD [superoxide dismutase] levels in rats exposed to 1.8 GHz, especially at 3:00 GMT (RF 3). In addition, the circadian rhythm of GSH-Px and SOD were disrupted in RF-exposed rats, with a distinct disorder of peak phase (from GMT 2:39 to 7:35 or from GMT 5:03 to 3:12 respectively)" {From the publication}				
Evaluation of selected biochemical parameters in the saliva of young males using mobile phones	1800 MHz (GSM & CW) - (SAR, specs, 1.09 W/kg)	15m, 30min /1d	Khalid M. Abu Khadra, Ahmad M. Khalil, Mahmoud Abu Samak, Ahmad Aljaberi	2014-(5)
Exposed humans: Increased superoxide dismutase and oxidative stress on human cells (increased concentration of the superoxide radical anion in saliva).				
Antioxidant Profile of Saliva among Young Men Using Mobile Phones	900-1800 MHz (GSM)	-	Khalid M. Abu Khadra, Ahmad M. Khalil, Mahmoud Abu Samak, Ahmad Aljaberi	2014-(6)
" ... significant increase in the activity of SOD but a significant decrease in that of amylase in the saliva of people after using mobile phones, a true correlation between the salivary antioxidant biomarkers and the number of calling min., rather than the number of calls, was found."				
Effect of Mobile Phone Usage Time on Total Antioxidant Capacity of Saliva and Salivary Immunoglobulin A	-	-	Fateme Arbabi-Katali, Saeedeh Salimi, Ali Vaziry-Rabiee, Mohammad Noraei	2014-(5)
" ... speaking on the mobile phone over an hour will decrease total antioxidant capacity of saliva and salivary IgA levels more than those speaking less than 20 minutes." {From the publication}				
Cell oxidation–reduction imbalance after modulated radiofrequency radiation	1800 MHz - 0.238 mW/cm ² (SAR 1.6 W/kg)	10min, 30min, 1h/1d	Ana Marija Marjanovic, Ivan Pavicic, Ivancica Trosic	2014-(1)
High-frequency electromagnetic radiation and the production of free radicals in four mouse organs	900 MHz - (SAR 0.45-1.6 W/kg (body))	3h/14 d	Jan Barkal, Pavel Stopka, Jana krizová, Jan Vrba, Frantisek Vozeh	2014-(6)
" ... in all four tissue samples (brain, liver, heart, kidney) of irradiated animals, a statistically significant increase (p<0.0025) of hydroxyl radicals concentration was found." {From the publication}				
Vitamin C Protects Rat Cerebellum and Encephalon from Oxidative Stress Following Exposure to Radiofrequency Wave Generated by BTS Antenna Model ("chemical remedy")	900 MHz - 0.67 mW/cm ²	4h/45 d	Abolfazl Akbari, Gholamali Jelodar, Saeed Nazifi	2014-(6)
Exposed rats: Decreased antioxidant enzymes activity of glutathione peroxidase, superoxide dismutase and catalase. Increased malondialdehyde as lipid peroxidation product.				
The Prophylactic Effect of Vitamin C on Oxidative Stress Indexes Following Exposure to Radio Frequency Wave Generated by a BTS Antenna Model in Rat Liver and Kidney("chemical remedy")	900 MHz - 0.67 mW/cm ²	4h/45 d	Abolfazl Akbari, Gholamali Jelodar, Saeed Nazifi	2014-(5)
Exposed rats: Decreased antioxidant enzymes activity of glutathione peroxidase, superoxide dismutase and catalase. Increased malondialdehyde as lipid peroxidation product.				
Effects of Vitamin C on Oxidative Stress in Erythrocytes Following Exposure to Radiofrequency Waves Generated by a BTS Antenna Model ("chemical remedy")	900 MHz - 0.67 mW/cm ²	4h/45 d	Abolfazl Akbari, Gholamali Jelodar, Saeed Nazifi	2014-(5)
Exposed rats: Decreased antioxidant enzymes activity of glutathione peroxidase, superoxide dismutase and catalase. Increased malondialdehyde as lipid peroxidation product.				

Biochemical changes provoked by 3G & 2G Phone radiation: Various

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Effect of the Electromagnetic Field Radiation of Cell Phones on the Level of Blood Glucose in Rats	-	15-60min/90d	Salome Zenaishvili, Marine Nikolaishvili, Davit Zurabashvili, Marine Nebieridze, Davit Natadze	2021-(7)
" Wistar line albino rats, exposed to cell phone radiation for more than 15 minutes per day for 3 months, had fasting blood glucose levels ($p < 0.015$) and serum insulin levels ($p < 0.01$) higher than those in control groups. Insulin resistance was significantly increased ($p < 0.003$) in the affected groups at 15-30 and 46-60 min/day compared to the control rats. These studies have found an association between prolonged exposure to cell phones and increased blood glucose and serum insulin levels in Wistar line rats." (From the publication)				
Effects of exposure to electromagnetic field from mobile phone on serum hepcidin and iron status in male albino rats	-	30-60 min/1d	Nanees F. El-Maleky, Reham H. Ebrahim	2018-(1)
Exposed rats (30 min): Increased serum hepcidin, IL6 and TLC values. Exposed rats (1 h): Increased serum hepcidin, TLC, IL6 and serum ferritin values. Decreased serum iron, TIBC, UIBC, 1.25 dihydroxycholecalciferol, plasma Hb, Hct, MCV and MCH values.				
Effects of Electromagnetic Radiation of Mobile Phones on Hematological and Biochemical Parameters in Male Albino Rats	900 MHz (GSM), 1300 MHz (GSM or 3G)	1-5h/28d	Ali Sani, Maryam Muhammad Labaran, Bilkisu Dayyabu	2018-(5)
" The values of RBC, HGB and MCH in 100% of the experimental animals in all groups of low and high EMR have exceeded that of the control. However, the values of WBC in 100% of experimental animals have not exceeded that of the control group. The mean values of AST and ALT in 30% of high EMR exposed rats has exceeded the control groups. There is no significant difference between high and low EMR exposed rats in terms of hematological parameters (RBC, MCV, WBC, HGB, MCH, MCHC, LYM, LYM %) and biochemical parameters (ALT, AST and ALP) ($P > 0.05$). " (From the publication)				
Evaluation of the mobile phone electromagnetic radiation on serum iron parameters in rats	890-915 MHz (GSM) - (SAR, specs, 0.96 W/kg)	2h/70d	Murat Çetkin, Can Demirel, Neşe Kızıllkan, Nur Aksoy, Hülya Erbağcı	2017-(5)
" The unsaturated iron binding capacity and total iron capacity values of the rats in the speech and stand by groups were significantly lower in comparison to the control group ($p < 0.01$). " (From the publication)				
Effect Of Electromagnetic Radiation On Vital Organs In Rats	900 MHz (GSM) - (SAR, specs, 1.1 W/kg)	2h/90d	Samta Sharma, Anjali sharma, Sangeeta Shukla	2017-(4)
" ... mobile phone radiation significantly increased the levels of lipid peroxidation and suppressed the activity of reduced glutathione, glutathione peroxidase, superoxide dismutase. A mixed trend was observed in the activity of catalase, while an increase was observed in the levels of serum transaminases, uric acid, urea, creatinine and bilirubin. A significant alteration in blood components of rats was observed. This study provides considerable damage in liver, kidney and brain tissue following electromagnetic radiations." (From the publication)				
Biochemical effects of electromagnetic waves on rats	2100 Mhz (3G WCDMA) - (SAR, specs, 1.25 W/kg (body))	10min / prenatal + 35d	Doaa Abdelrahman Hamed Ibrahim	2016-(16)
Effect of Cell Phone Use on Salivary Total Protein, Enzymes and Oxidative Stress Markers in Young Adults: A Pilot Study	-	-	Arnadi Ramachandrayya Shivashankara, Jasmi Joy, Venkatesh Sunitha, Manoj P. Rai, Suresh Rao, Shafeeque Nambranathayil, Manjeshwar Shrinath Baliga	2015-(4)
High mobile users had significantly higher levels of amylase ($p = 0.001$), lactate dehydrogenase ($p = 0.002$) and malondialdehyde ($p = 0.002$) in saliva.				
Fourier Self-Deconvolution Analysis of β -Sheet Contents in the Amide I Region of Hemoglobin Aqueous Solutions under Exposure to 900 MHz Microwaves and Bioprotective Effectiveness of Sugar and Salt Solutions ("chemical remedy")	900 MHz - 0.066 mW/cm ²	4h/1d	Emanuele Calabrà, Salvatore Magazù	2015-(1)
Exposed water solutions: Increased β -sheet contents in the Amide I region of hemoglobin samples in bidistilled water solution.				
Effects of 900 MHz Radiofrequency Radiation on Skin Hydroxyproline Contents	900 MHz (GSM) - 0.446 mW/	20min /21d	Semra Tepe Çam, Nesrin Seyhan, Cengiz Kavaklı, Ömür Çelikbiçık	2014-(7)

	cm2 (SAR 1.32 W/kg (body))			
Exposed rats: Increased skin hydroxyproline level.				
Effect of exposure and withdrawal of 900-MHz-electromagnetic waves on brain, kidney and liver oxidative stress and some biochemical parameters in male rat	900 MHz (CW)	1h/60 d	Merhan Mamdouh Ragy	2014-(1)
Exposed rats: Increased malondialdehyde levels. Decreased total antioxidant capacity levels. Increased sera activity of alanine transaminase, aspartate aminotransferase, urea, creatinine and corticosterone. Alterations were corrected by withdrawal.				
Effects of Garlic (<i>Allium sativum</i> L.) Hydroalcoholic Extract on Estrogen, Progesterone and Testosterone Levels in Rats Exposed to Cell Phone Radiation ("Chemical remedy")	900 MHz (GSM)	12 x 10min /30d	Behnaz Hajioun	2014-(8)
"... in male the mean body weight showed a significant decrease, in male and female mean serum levels of estrogen showed a significant decrease, in male rats mean serum levels of progesterone were significantly increased." {From the publication}				
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	900-1800 MHz	1h/28d , 35d, 42d	Hasan Çetin, Mustafa Nazıroğlu, Ömer Çelik, Murat Yüksel, Nural Pastacı, Mehmet Okan Özkaya	2014-(1)
Exposed rats (and their prenatal fetuses): Decreased brain and liver glutathione peroxidase activities. Decreased liver vitamin A and β-carotene concentrations. Decreased selenium concentrations in the brain.				
Is Human Saliva an Indicator of the Adverse Health Effects of Using Mobile Phones?	-	-	Yaniv Hamzany, Raphael Feinmesser, Thomas Shpitzer, Aviram Mizrahi, Ohad Hilly, Roy Hod, Gideon Bahar, Irina Otradnov, Moshe Gavish, Rafael M. Nagler	2013-(6)
Exposed humans: Increased salivary oxidative stress indices. Decreased salivary flow, total protein, albumin, and amylase activity.				
Biochemical Changes in The Intervertebral Discs After Electromagnetic Radiation: An Experimental Study	900-1800-24 50 MHz (CW) - 1.04 mW/cm2 (SAR 1.04 W/kg)	1h/30 d	Olçay Eser, Ahmet Songur, Veli Çağlar, Huseyin Vural, Ergun Karavelioglu, Hakan Mollaoglu, Fehmi Ozguner	2012-(9)
Exposed rats: Increased intervertebral disc Interleukin-1β levels. Increased total antioxidative capacity and total oxidative capacity.				
Effects of Exposure to Cellular Phones 950 MHz Electromagnetic Fields on Progesterone, Cortisol and Glucose Level in Female Hamsters (<i>Mesocricetus auratus</i>)Glucose	Mesocricetus auratus950 MHz	3h/10d , 60d	Reza Seyednour, Vahid Chekaniazar	2011-(6)
"... significantly higher blood glucose rate in long-term 60 day 3 h/d exp. group. stressful condition, cortisol releasing and subsequent hyper-glycemia in long-term exposing. short-or long-term exposure may cause progesterone suppressing and cortisol releasing but this frequency only in long-term exposure could cause hyper-glycemia."				

Proteome changes provoked by 3G & 2G Mobile Phone radiation

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
One-time Electromagnetic Irradiation Modifies Stress-sensitive Gene Expressions in Rice Plant	1837.5 MHz (CW) - 0.000275 mW/cm2	150m/ 1d	Ardhendu Kundu, Sathish Vangaru, Sucharita Bhowmick, Somnath Bhattacharyya, Amirul I. Mallick, Bhaskar Gupta	2021-(1)
Exposed rice plants: Significant upregulation in calmodulin and phytochrome B gene expressions. This suggested that plants perceive electromagnetic irradiation similar to other injurious stimuli.				
Non-ionizing radiofrequency fields induces unfolded protein response (UPR) in endoplasmic reticulum (ER) of mouse neuronal cells	900 MHz (CW) - (SAR 0.00025 W/kg)	4h/5d	Zhen Gao, Wen Xie, Caiyun Fan, Yi Cao	2020-(16)
Increased Hippocampal Level of Kinases after Long-term Exposure to GSM-2100 Cell Phone Radiation	2100 MHz (GSM)	2h/50 d	Çiğdem Gökçek-Saraç, Şükrü Özen, Narin Derin	2019-(1)
Immological Effects of Electromagnetic Radiation of the Cellular	-	-	Talib Jawad Kadhim,	2018-(7)

Phone Among Young Females			Munther Hamza Rathi, Qatralnada Ahmed Khalaf	
More mobile phone usage is associated with a decrease in the level of serum interferon β in blood.				
The effect of exposure to 1800 MHz radiofrequency radiation on epidermal growth factor, caspase-3, Hsp27 and p38MAPK gene expressions in the rat eye	1800 MHz (GSM) - 0.012 mW/cm ² (SAR 0.06 W/kg)	2h/56 d	E. D. Eker, B. Arslan, M. Yildirim, A. Akar, N. Aras	2018-(5)
Exposed rats: Increased caspase-3 and p38MAPK gene expression in the ocular tissues.				
Electromagnetic Radiation Disturbed the Photosynthesis of <i>Microcystis aeruginosa</i> at the Proteomics Level	1800 MHz (CW) - 0.42 mW/cm ²	24h/1 d	Chao Tang, Chuanjun Yang, Hui Yu, Shen Tian, Xiaomei Huang, Weiyi Wang, Peng Cai	2018-(8)
" A total of 30 differentially expressed proteins, including 15 up-regulated and 15 down-regulated proteins, were obtained in this study. The differentially expressed proteins were significantly enriched in the photosynthesis pathway, in which the protein expression levels of photosystems II cytochrome b559 α subunit, cytochrome C550, PsbY, and F-type ATP synthase (a, b) decreased. Our results indicated that electromagnetic radiation altered the photosynthesis-related protein expression levels, and aimed at the function of photosynthetic pigments, photosystems II potential activity, photosynthetic electron transport process, and photosynthetic phosphorylation process of <i>M. aeruginosa</i> ." (From the publication)				
Proteomic analysis of continuous 900-MHz radiofrequency electromagnetic field exposure in testicular tissue: a rat model of human cell phone exposure	900 MHz - (SAR 0.19-1.22 W/kg (body))	1h, 2h, 4h/30 d	Masood Sepehrimanesh, Nasrin Kazemipour, Mehdi Saeb, Saeed Nazifi, Devra Lee Davis	2017-(8)
Exposed rats: Differential overexpression of two protein spots in intensity and volume with induction factors 1.7 times greater. Increased ATP synthase beta subunit and hypoxia up-regulated protein 1 precursor (affecting signaling pathways in rat testes and spermatogenesis and playing a critical role in protein folding and secretion in the endoplasmic reticulum).				
Analysis of rat testicular proteome following 30-day exposure to 900 MHz electromagnetic field radiation	900 MHz	1h, 2h, 4h/30 d	Masood Sepehrimanesh, Nasrin Kazemipour, Mehdi Saeb, Saeed Nazifi	2014-(1)
Exposed rats: Thirteen proteins have been found to be expressed or no expressed depending on exposure, among them heat shock proteins, superoxide dismutase, peroxiredoxin-1, and other proteins related to misfolding of proteins and/or stress.				
Studying the protein expression in human B lymphoblastoid cells exposed to 1.8-GHz (GSM) radiofrequency radiation (RFR) with protein microarray	1800 MHz (GSM) - (SAR, specs, 2 W/kg)	24h/1 d	Chen Zhijiana, Li Xiaoxue, Zheng Wei, Lu Yezhen, Lou Jianlin, Lu Deqiang, Chen Shijie, Jin Lifeng, He Jiliang	2013-(1)
Exposed human cells: Differential expression of 27 proteins, among them those related to DNA damage repair, apoptosis, oncogenesis, cell cycle and proliferation. Down regulated RPA32. Up-regulated p73.				
Effects of 1.8 GHz radiofrequency radiation on protein expression in human lens epithelial cells	1800 MHz (GSM) - (SAR, specs, 2-4 W/kg)	2h/1d	Shuang Ni, Yibo Yu, Yidong Zhang, Kairan Lai, Ke Yao, L. Zhang, W. Wang	2013-(10)
Study of Oxidative Stress in Human Lens Epithelial Cells Exposed to 1.8 GHz Radiofrequency Fields	1800 MHz (GSM) - (SAR, specs, 2-4 W/kg)	30min, 60min, 90min /1d	Shuang Ni, Yibo Yu, Yidong Zhang, Wei Wu, Kairan Lai, Ke Yao	2013-(9)
" The ROS and MDA levels significantly increased ... Cellular viability, mRNA expression of four genes, and expression of four proteins [SOD1, SOD2, CAT, and GPx1] significantly decreased." (From the publication)				
Brain proteome response following whole body exposure of mice to mobile phone or wireless DECT base radiation	900 MHz (GSM) & 1880-1900 MHz (DECT) - 0.059-0.128 mW/cm ² & 0.004-0.009 mW/cm ² (SAR 0.17-0.37 W/kg & 0.012-0.028 W/kg (body))	3h, 8h/24 5d	Adamantia F. Fragopoulou, Athina Samara, Marianna H. Antonelou, Anta Xanthopoulou, Aggeliki Papadopoulou, Konstantinos Vougas, Eugenia Koutsogiannopoulou, Ema Anastasiadou, Dimitrios J. Stravopodis, George Th. Tsangaris, Lukas H. Margaritis	2012-(25)
" ... altered significantly the expression of 143 proteins in total (as low as 0.003 fold downregulation up to 114 fold overexpression). Several neural function related proteins (i.e., Glial Fibrillary Acidic Protein (GFAP), Alpha-synuclein, Glia Maturation Factor beta (GMF), and apolipoprotein E (apoE)), heat shock proteins, and cytoskeletal proteins (i.e., Neurofilaments and tropomodulin) are included in this list as well as proteins of the brain metabolism (i.e., Aspartate aminotransferase, Glutamate dehydrogenase) to				

nearly all brain regions studied."				
Potential Protection of Green Tea Polyphenols Against 1800 MHz Electromagnetic Radiation-Induced Injury on Rat Cortical Neurons ("chemical remedy")	1800 MHz (GSM) - 0.21-2.24 mW/cm2	24h/1 d	Mei-Li Liu, Jian-Qiang Wen, Yu-Bo Fan	2011-(7)
Exposed rat neurons: Increased content of active Bcl-2 Associated X protein (Bax).				
Mobile phone radiation might alter protein expression in human skin	900 MHz (GSM) - (SAR 1.3 W/kg)	1h/1d	Anu Karinen, Sirpa Heinävaara, Reetta Nylund, Dariusz Leszczynski	2008-(6)

Histopathological and Ultrastructural changes provoked by 3G & 2G Phone radiation

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Effect of Mobile Phone Electromagnetic Field Radiation on Rat Masseter Muscle: Histological and Immunohistochemical Study	900 MHz (GSM) - (SAR 0.025-0.05 W/kg (body))	1h/60 d	Nesreen M. Omar, Mohamed Abdel-Rahman, Fatma M. Ibrahim	2022-(10)
" Exposure to EMF radiation resulted in histopathological changes in the masseter muscle such as hypostained fibres with disorganized myofibrils and indistinct or lost striations, muscle degeneration, mononuclear cell infiltration, vascular congestion and condensation of connective tissue. Pyknotic nuclei sometimes surrounded by perinuclear spaces and significant increase in the number of P53- positive myonuclei were also demonstrated."				
Effect of mobile frequencies exposure on histology of retina and cornea in pregnant albino mice	900-1800 MHz (GMS) - (SAR, specs, 0.78 W/kg)	3h/30 d	Rawah N. Alshammary, Zeena D. Mohammed, Zaki Ammar G. Al-Haak	2021-(5)
" Microscopic examination showed, that there are significant effects on the cornea and retina of the eye, especially in pregnant females, which supports the current studies conducted on the effect of mobile phones on the eyes represented by vascularization where some sections showed newly formed blood vessels in stroma layer just beneath bowman's membrane and retina degeneration. This study concluded that the exposure to the mobile radiation led to serious histological changes in the tissues of eye which may lead to blindness." (From the publication)				
Biochemical and Pathological Effects on the Male Rat Hepatic Tissue After Exposure to 900MHz Electromagnetic Field During Adolescent Period	900 MHz - 0.024 mW/cm2 (SAR 0.009 W/kg)	1h/25 d	Ayşe İki nci Keleş, Hüseyin Serkan Erol, Tuğçe Sapmaz, Tolga Mercantepe, Gökhan Keleş, Burcu Bi tterge Süt, Ersan Odaci, Mesut Bünyamin Halici, Sait Polat	2021-(22)
" Biochemical analyses revealed increased lipid peroxidation and glutathione values while catalase and superoxide dismutase values were decreased in electromagnetic field group. Electron microscopy evaluations identified necrotic hepatocytes with numerous cytoplasmic and mitochondrial vacuoles in electromagnetic field group sections. We also observed an enlarged endoplasmic reticulum and loss of mitochondrial matrix, in addition to the presence of vacuoles. Also, loss of inner and outer mitochondrial membrane integrity was observed. Light microscopy evaluations revealed sinusoidal capillary dilatation and degeneration in hepatocytes with cytoplasmic swelling, vacuolar degeneration and pyknotic nuclei in electromagnetic field group sections. Deterioration in the integrity of the collagen fibers was also present around the vena centralis. Additionally, electromagnetic field had no effect on body weight. Therefore, we conclude that continuous 900-megahertz electromagnetic field treatment may cause changes in oxidative stress biomarkers and the morphology of the adolescent rat liver." (From the publication)				
Does GSM-like 1800 MHz radiofrequency cause KRAS and p53 mutations in colon?: Histopathologically and microbiologically changes in colon	1800 MHz (GSM)	45min /84d	Ezgi Ece Sag, Saadet Celikozlu, Hayri Dayioglu, Sibel Kokturk, Cengiz Ozzaim, Sinan Darcan	2021-(6)
" Corrupted gland structure, mucosal edema and inflammatory cell infiltration were observed at mucosal epithelium in the RFR group. An increase in the amount of collagen and fibrosis were detected in the electromagnetic field group. Number of goblet cells showed a statistically significant decrease in electromagnetic field group compared to both the control and sham groups (P<0.05). The increase in the amount of Fusobacterium it was significantly higher in the RFR group compared to the control group. ... But RFR exposure did not caused to KRAS and P53 mutations in colon tissue." (From the publication)				
Protective effect of melatonin on the rat lung following exposure to a 900-MHz electromagnetic field: a stereological and histopathological study ("chemical remedy")	900 MHz - 1 mW/cm2 (SAR, specs, 2.0 W/kg)	24h/2 1d	Ahmad Yahyazadeh, Elfide Gizem Kivrak, Gülüna Erdem Koç, Berrin Zuhail Altunkaynak	2021-(6)
Exposed rats: Decreased alveoli, bronchioles and blood vessels mean volume. Marked histopathological changes in the lung tissues.				
The Adverse Effect of Mobile Phone Radiations on Dorsal Root Ganglion of Albino Rats	900-1800 MHz (GSM)	-/28d	Faisal Taufiq, Mohammed Bhilal	2021-(7)

			Babu, Aqeel Ahmad, Mohammed Eajaz Ahmed Shariff, Noureldaim Elnoman, Elbadawi, Semmal Syed Meerasa	
" Dorsal root ganglions of exposed rats showed considerable histological changes like reduction in cell size, condensation of cytoplasm, peripherally located heterochromatin nucleus, loss of nucleolus and densely packed myelinated nerve fibers. No such changes were observed in control rats." {From the publication}				
Ameliorative Effect of Vitamin E against Radiofrequency Radiation Emitted from Mobile Phone-Induced Hematological and Histopathological Alterations in Male Albino Mice ("chemical remedy")	900-1800 MHz (GSM) - 0.0001 mW/cm ² (SAR 0.4 W/kg (body))	2h/21 d	Mona H. Ibraheim, Aziza Amin	2020-(13)
Exposed mice: Changes hematological parameters (red blood cell, hemoglobin, mean corpuscular volume, mean corpuscular hemoglobin concentration, platelets count, ...) Variable histopathological alterations in the liver, kidney, lung, heart, spleen, and brain of the rats.				
The toxic effect of mobile phone radiation on rabbit organs	1800 MHz (GSM) - (SAR, specs, 0.7 W/kg (body) 1 W/kg (head))	6h/96 d	Shudong Zhu, Yan Zhu, Hao Li, Doudou Zhang, Dianzheng Zhang	2020-(7)
" There is no apparent change at the organ level. However, H&E staining showed that radiation-exposure significantly increased inflammatory cell infiltration in the liver and the lungs with a lesser degree of myocardial cell cytoplasmic vacuolation. In addition, results from γ -H2AX staining suggest that radiation can also cause DNA damage in the brain. Of note, no apparent activation of Caspase-3 in the organs examined. Our data altogether suggest that mobile phone radiation may be more hazardous to both the liver and the lungs, and less toxic to the brain and heart." {From the publication}				
The Effect of 900-Megahertz Electromagnetic Field Exposure in the First and Middle Adolescent Period on the Spleen in Male Rats: A Biochemical and Histopathological Study	900 MHz (CW) - 0.021 mW/cm ² (SAR 0.039 W/kg)	1h/25 d	Ayşe İkinci Keleş, Tuğçe Sapmaz, Hüseyin Serkan Erol, Burcu Biterge Süt, Gökhan Keleş, Ersan Odacı, Sait Polat, Mesut Bünyami Halici	2019-(5)
The Effects of Electromagnetic Fields on Mitochondria: An Ultra-structural and Biochemical Study	1800 MHz (GSM) - (SAR, specs, 1.10 W/kg)	50min /10d	Najam Siddiqi, Naseer Salem Al Nizwani, Zoya Shaikh, Asem Shalaby, Yahyah Tamimi	2019-(1)
Effects of Acute and Chronic Exposure to 900 Mhz Electromagnetic Field on the Rat Liver Microarchitecture	900 MHz	24h/1d , 1h/30 d	Elvan Şahin, Derya Güzel, Şadiye Açıkgöz, Nihal Tufan	2018-(4)
" ... displayed many histopathological alterations in both of the EMF-exposed groups, including foci of necrosis, inflammation, excessive vacuolar degenerations and apoptosis in hepatocytes, apparent vascular expansions and haemorrhage. Additionally, mononuclear cell infiltrations, biliary hyperplasia, fibrosis in periportal and centrilobular areas and decreased Kupffer cell population were determined in the chronic EMF exposure group. In contrast, the amount of the Kupffer cells were much more in the acute exposure group. Our findings suggested that both acute and chronic exposure to 900 MHz EMFs can lead to hepatic injury in rats." {From the publication}				
Quantitative changes in testicular structure and function in rat exposed to mobile phone radiation	890-915 MHz (GSM) - (SAR, specs, 0.96 W/kg)	2h/70 d	M. Çetkin, N. Kızıllan, C. Demirel, Z. Bozdağ, S. Erkiş, H. Erbağcı	2017-(8)
Exposed rats: Decreased testis weight and volume. Increased volume fraction of interstitial tissue. Decreased volume fraction of tubular tissue. Decreased mean tubular and germinal tissue volume, seminiferous tubule diameter and germinal epithelium height. Increased cortisol levels.				
Effects of long-term exposure to 900 megahertz electromagnetic field on heart morphology and biochemistry of male adolescent rats	900 MHz (CW) - 0.0187 mW/cm ² (SAR 0.0093 W/kg)	1h/38 d	G. Kerimoğlu, T. Mercantepe, H.S. Erol, A. Turgut, H. Kaya, S. Çolakoğlu, E. Odacı	2016-(1)
Exposed rats: Structural changes and capillary congestion in the myocardium. Altered structure of Z bands, decreased myofilaments and pronounced vacuolization. Increased levels of malondialdehyde and superoxide dismutase. Decreased levels of glutathione and catalase.				
Histopathological changes associated with oxidative stress induced by electromagnetic waves in rats' ovarian and uterine tissues	1800 MHz (GSM) - 0.21 mW/cm ² (SAR 0.97 W/kg (body))	2h/30d , 60d	Ali S.H. Alchalabi, Hasliza Rahim, Erkihun Aklilu, Imad I. Al-Sultan, Abd Rahman Aziz, Mohd F. Malek, Suzanna H. Ronald,	2016-(10)

			Mohd Azam Khan	
<p>" The histopathological changes were more prominent in experimental groups, in the ovary were included vacuolation in interstitial, granulosa, luteal cells and ooplasm. Other histopathological changes are disorientation of corona radiata, disruption and thinning of the zona pellucida. Cellular nucleus changes similar to fragmentation of the nucleus indicate the start of a degeneration process at Graafian follicles as well as micronuclei formation in oocyte nucleus and in some luteal cells. Histopathological changes in uterine tissue confined to increase height of luminal epithelium cells, sever apoptosis of glandular and luminal epithelium cells, and sever eosinophils, polymorphonucleocyte lymphocytes and macrophage's infiltration in myometrium and endometrium layers. Vascular congestion points out for the existence of inflammatory response changes in the endometrium." {From the publication}</p>				
Histological and histochemical study of the protective role of rosemary extract against harmful effect of cell phone electromagnetic radiation on the parotid glands ("chemical remedy")	-	-	Fatma M. Ghoneim, Eetmad A. Arafat	2016-(1)
<p>The authors conclude that the exposure of parotid gland of rat models to radiation from mobile phone resulted in structural changes at the level of light and electron microscopic examination.</p>				
Placental histomorphology and morphometry in the pregnant mice treated with cell phone radiation	915 MHz	4h/13 d	Ali Louei Monfared, Aaref Noorai, Morteza Shamsi	2015-(10)
<p>" Ultrastructural results of the treated group revealed a slight elevation in the number of intra cytoplasmic droplets in the labyrinth interhemal membrane. In addition, in the electromagnetic fields (EMFs) exposed mice, the nucleus of the cytotrophoblast cells occasionally was large in the size and irregular in the shape and also had compact nucleoli." {From the publication}</p>				
Histological changes in albino rat hippocampus following postnatal exposure to radiofrequency electromagnetic field emitted from mobile phones	900-1800 MHz	-/120 d	Hussein Abd El Raouf, Hoda H.; Mohammed Ali, Mona H.	2015-(1)
The effect of 2100 MHz radiofrequency radiation of a 3G mobile phone on the parotid gland of rats	2100 MHz (3G) - 0.067 mW/cm ² (SAR 0.4 W/kg (body))	6h/10d , 40d	Filiz Aydogan, Ilhan Unlu, Emine Aydin, Nihat Yumusak, Erdinc Devrim, Ethem Erdal Samim, Elcin Ozgur, Velid Unsal, Arin Tomruk, Goknur Guler Ozturk, Nesrin Seyhan	2015-(8)
<p>Exposed rats: Numerous histopathological changes regarding salivary gland damage including acinar epithelial cells, interstitial space, ductal system, vascular system, nucleus, amount of cytoplasm and variations in cell size.</p>				
The effects of 2100-MHz radiofrequency radiation on nasal mucosa and mucociliary clearance in rats	2100 MHz (3G)	6h/10d , 40d	Filiz Aydođan, Emine Aydın, Gökhan Koca, Elçin Özgür, Pergin Atilla, Arzu Tüzüner, Şule Demirci, Arin Tomruk, Göknur Güler Öztürk, Nesrin Seyhan, Meliha Korkmaz, Sevda Müftüođlu, Ethem Erdal Samim	2015-(1)
<p>" ... differences in mucociliary clearances. A number of degenerated and apoptotic cells, ciliary disorganization and ciliary loss in the epithelial cells, epithelial metaplasia, alteration of normal chromatin distribution and karyolysis in nuclei, changes in the basal cells, and lymphocytic infiltration. Damaged the nasal septal mucosa, and disturbed the mucociliary clearance. Ciliary disorganization and ciliary loss in the epithelial cells resulted in deterioration of nasal mucociliary clearance."</p>				
Morphological aspects of poly-organic impact of radio frequency electromagnetic radiation in experiment	1800 MHz - 0.05-1 mW/cm ²	-/30d, 90d	Tashpulatova Guzal Alievna, Mavlyan Hodzhaev Ravshan Shukhratovich	2015-(3)
<p>" The RFEMR effect was shown to manifest itself by pathological changes in the structure of the majority of organs and tissues with the critical impact of the micro-vascular bed impairment on not only morphological, metabolic but also many other homeostasis shifts that occurred."</p>				
The Possible Rescue Effect of Vitamin E or Silymarin on Lung Tissue of Male Albino Rats Exposed to Electro-Magnetic Field ("chemical remedy")	900 MHz (SAR, specs, 1.2 W/kg)	2h/3d x 8	Abir Khalil Mohamed	2014-(12)
<p>" ... many pathological changes; the lungs had dilated bronchioles with corrugated walls and thickened epithelial lining, also, the lumen of the bronchioles contained degenerated epithelial cells, the alveolar septa had congested and thickened walls, areas of lymphocytic infiltration were observed around the bronchioles, the lung arteries of the irradiated animals were dilated and had corrugated walls. Some alveolar blood vessels were obliterated and some arteries had thickened walls with narrow lumen, haemorrhagic areas were observed." {From the publication}</p>				
GSM 900 MHz Microwave Radiation Induced Alterations of Insulin Level and Histopathological Changes of Liver and Pancreas in Rat	900 MHz (GSM) - (SAR, specs, 2 W/kg)	3h, 6h/7d	S.M.J. Mortazavi, S.M. Owji, M.B. Shojaie-fard, M. Ghader-Panah, S.A.R. Mortazavi, A. Tavakoli-Golpayegani, M. Haghani, S. Taeb, N. Shokrpour, O. Koohi	2014-(8)
Effects of prenatal 900 MHz electromagnetic field exposures on the	900 MHz	1h/all	Mahmut Ulubay,	2014-

histology of rat kidney	(CW) - (SAR, specs, 2 W/kg)	gestation days	Ahmad Yahyazadeh, Ö. Gülsüm Deniz, Elfide Gizem Kıvrak, B. Zuhail Altunkaynak, Gülünar Erdem, Süleyman Kaplan	(25)
" mean volume of the kidneys and cortices significantly increased, number of glomeruli decreased."				
Histological Study of Prolonged Exposure to Mobile Phone Radiations on Young Male Albino Rats' Cerebellar Cortex and the Role of Ginkgo Biloba Supplementation ("chemical remedy")	-	2h/60 d	Abeer M. Azmy, Maha A. Abd Allah	2013-(11)
"... cerebellum of the mobile phone exposed rats showed that most of Purkinje neurons appeared shrunken and deeply stained. they were surrounded by perineuronal spaces. Purkinje neurons had corrugated cell boundaries with indistinct nuclear profile. they were arranged in more than one layer rather than the one row in the control group. numerous Bergmann astrocytes with pale stained nuclei and clear cytoplasm were observed among these Purkinje cells. Granular layer contained closely related neurons. some of them had deeply stained nuclei. numerous GFAP positive cells were seen in the three layers of cerebellar cortex. numerous distorted Purkinje neurons, this distortion had different ultrastructural features, some of them had electron dense cytoplasm containing fragmented Golgi complex and rough endoplasmic reticulum, ill-defined nuclear membranes leaving nuclear ghosts were observed, others had irregular shrunken heterochromatic nuclei. their cytoplasm contained dilated cisternae of rough endoplasmic reticulum, distorted mitochondria; abnormal shapes, variable sizes, ruptured cristae, swollen ones and secondary lysosomes. some of the distorted Purkinje cells with highly corrugated nuclear envelope were shifted among the granular neurons. many granular neurons had shrunken heterochromatic nuclei with indistinct cell membranes."				
Exposure of mice to 900 - 1900 MHz radiations from cell phone resulting in microscopic changes in the kidney	900-1900 MHz (GSM) - (SAR, specs, 1.69 W/kg (10g))	48min / 30-18 0d	N. Mugunthan, J. Anbalagan, S. Meenachi, A. Shanmuga Samy	2012-(6)
"... the kidney weight and volume was significantly reduced in the first month. Kidney weight alone was significantly increased in the fifth month. Glomerulus showed dilated capillaries and increased urinary space. Proximal convoluted tubule showed wider lumen with reduced cell size. Brush border interrupted at places and vacuolated cytoplasm and pyknotic nuclei. Wider lumen with decreased cell size and marked basal striations were found in the distal convoluted tubule." {From the publication}				
Effects of Mobile Phone Induced Electromagnetic Field on Height of Follicular Cells in Thyroid Gland of Mice	900-1800 MHz (GSM)	50 missed call/6 0d	Farheen Shaukat, Khadija Qamar, Shadab Ahmed Butt	2011-(3)
"... the lobes in the exposed group showed numerous micro follicles with less colloid content, mean height of follicular epithelium is higher, the thyroid stroma in exposed mice consisted of wider connective tissue septa and more dilated blood capillaries." {From the publication}				

3G & 2G Phone radiation damage on Sperm, Testis and Ovaries

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Acute and Chronic Exposure to 900 MHz Radio Frequency Radiation Activates p38/JNK-mediated MAPK Pathway in Rat Testis	-	-	Hakan Er, Gizem Gamze Tas, Bikem Soygur, Sukru Ozen, Leyla Sati	2022-(1)
The detrimental effect of cell phone radiation on sperm biological characteristics in normozoospermic	-	1h/-	Mohammadmehdi Hassanzadeh-Taheri, Mohammad Ali Khalili, Ali Hosseinejad Mohebbati, Mahmood Zardast, Mehran Hosseini, Maria Grazia Palmerini, Mohammad Reza Doostabadi	2021-(1)
Microarray profiling of LncRNA expression in the testis of pubertal mice following morning and evening exposure to 1800 MHz radiofrequency fields	1800 MHz - (SAR 0.5 W/kg)	-	Fenju Qin, Honglong Cao, Chuhan Feng, Tianyuan Zhu, Bingxu Zhu, Jie Zhang, Jian Tong, Hailong Pei	2021-(1)
" We identified 615 and 183 differentially expressed lncRNAs that were associated with morning and evening exposure to RF, respectively. From 15 differential expression lncRNAs both in morning RF group and evening RF group, we selected 6 lncRNAs to be validated by quantitative reverse transcription PCR (qRT-PCR). The differentially expressed lncRNAs induced by morning RF exposure were highly correlated with many different pathways, including Fanconi syndrome, metabolic processes, cell cycle, DNA damage, and DNA replication. Trans-regulation analyses further showed that differentially expressed lncRNAs were involved in multiple transcription factor-regulated pathways, such as TCFAP4, NFkB, HINFP, TFDP2, FoxN1, and PAX5. These transcription factors have all been shown to be involved in the modulation of testis development, cell cycle progression, and spermatogenesis. These findings suggest that the extent to which 1800 MHz RF induced toxicity in the testes and changed the expression of lncRNAs				

showed differences between morning exposure and evening exposure."				
Modulatory effects of Punica granatum L juice against 2115 MHz (3G) radiation-induced reproductive toxicity in male Wistar rat ("chemical remedy")	2115 MHz (3G) - 0.63 mW/cm ² (SAR 0.16 W/kg)	2h/45 d	Rohit Gautam, Eepsita Priyadarshini, Jay Prakash Nirala, Ramovatar Meena, Paulraj Rajamani	2021-(10)
Exposed rats: Changes in sperm parameters (reduction in sperm count, motility, viability, and HOS % coiling) and slight alterations in sperm head morphology along with a decrease in seminiferous tubule diameter. Significant alteration in oxidative parameters along with an enhanced free radical generation.				
Moderate exercise training as an effective strategy to reduce the harmful effects of cell phone radiation on Wistar rat's semen quality	900-1800 MHz (GSM)	3h/28 d	H. A. Akbari, A. A. Gaeini	2021-(8)
Exposed rats: Decreased sperm count, progressivity, and normal morphology.				
Morphological and Biochemical Changes in the Rat Ovaries Following Electromagnetic Field Exposure	900 MHz	1h/28 d	Savaş Kanbu, Mehmet Emin Önger	2020-(16)
" Concerning the GSI values, there are statistical differences between the Control and EMF (p=0.001), and Sham and EMF (p=0.001) groups, respectively. There are also statistical differences between Control and EMF groups in terms of volumetric parameters including medullary, and follicular antral volumes. Regarding the biochemical parameters, there are statistically differences between the Control and EMF (p=0.000), and Sham and EMF (p=0.000) groups, respectively." {From the publication}				
Effect of Mobile Phone Radiation on Reproductive System and Behavior Using Female Albino Mice	-	1h/90 d	Suhera Aburawi, Hana Abusaida, Habiba El Jaafari, Feras Alkayed, Naema Shibani, Arwa Dali, Suliman Shalabi, Marwa Ayad, Omima Altaboni	2020-(9)
" Mice exposed to mobile phone radiation did not show any changes in behavior. While, mice exposed to electromagnetic radiation from mobile phone showed ovarian cortex reduction in number of primordial and primary follicles, absence of oocyte inside the follicle, and large amount of vacuolated cytoplasm in Corpus luteum. In addition, mobile phone radiation exposed mice uterus showed abnormal histological features of the inner mucosa, or endometrium. Glands appears as focal inactive atrophic glands with hyperchromatic nuclei; atrophy of the uterine glands, and number of glands reduction in the stroma were observed. In myometrium, large blood vessels were observed." {From the publication}				
Study the electromagnetic radiation effects on testicular function of male rats by biochemical and histopathological	-	30m-2 h/14d	Ban Mohammed Hussein Ali	2020-(5)
" Serum levels of male sex hormones (follicle-stimulating hormone and testosterone) decreased significantly (P <0.05) in the exposure groups 1/2 H and 1 H compared to the sham-exposed group. The study shows that chronic exposure to RF-EMR from a cell phone causes the impaired testicular function accompanied by a decrease in the value of sexual hormones. Sperm microscopy also showed a decrease in sperm count, altered shape and development in the experimental groups. Also, changing histological parameters showed a change in cross-section, luminal and bacterial epithelium diameter in all experimental groups." {From the publication}				
Microscopic Changes of Radiations and Combined Effect of 2G Mobile Phone Radiations with Turmeric (Curcuma Longa) On Germ Cells of Testis in Albino Rats ("chemical remedy")	900-1900 MHz (GSM)	24h/6 0d	Santosh Kumar, Ankur K. Bichhwaliya	2020-(3)
" In contrast to control group, all (100.00%) of subjects of EMR group showed decreased germ cells and on applying chi square test, this difference was found significant (p<0.05)." {From the publication}				
To study the abnormalities of spermatozoa exposed by mobile radiations	900-1800 MHz (GSM) - (SAR, specs, 1.87 W/kg)	5h/60 d	Ashok Kumar Srivastava, Priyanka Singhal, Navneet Chauhan, Nityanand Srivastava, Jayant Kumar Verma, Adil Asghar	2018-(8)
Exposed rats: Increased percentage of abnormal sperms. Decreased sperm count. Abnormalities in morphology of sperms have a broad spectra of characteristics: double head, banana head, amorphous head, defective head, headless, bent neck, bent tail, double tail, defective tail and looped tail etc.				
[Cellphone electromagnetic radiation damages the testicular ultrastructure of male rats] (in Chinese)	900 MHz	2-4h	X.H. Gao, H.R. Hu, X.L. Ma, J. Chen, G.H. Zhang	2017-(1)
Micronuclei Formation and 8-Hydroxy-2-Deoxyguanosine Enzyme Detection in Ovarian Tissues After Radiofrequency Exposure at 1800 MHz in Adult Sprague–Dawley Rats	1800 MHz (GSM) - 0.2 mW/cm ² (SAR 0.974 W/kg)	2h/15 -60d	Ali Saeed Hammoodi Alchalabi, Hasliza Rahim, Mohamed Fareq AbdulMalek, Erkihun Aklilu, Abd Rahman Aziz, Suzanna Harun Ronald, Mohd Azam Khan	2017-(8)
" The results showed an induced oxidative stress via an increase in lipid peroxidation and decreased antioxidant enzyme activity. There was also an elevation in the 8-hydroxy-2-deoxyguanosine enzyme and an increased rate of micronuclei formation in ovarian tissues of exposed animals with 60-day exposure compared with control animals. Cytological changes were recorded such as				

micronuclei formation, vacuolation, degeneration and impaired folliculogenesis. The study suggests that GSM frequency at 1800 MHz was negatively impacted on female reproductive performances mediated by oxidative stress induction and 8-hydroxy-2-deoxyguanosine formation leading to overall impaired ovarian function." {From the publication}				
Radiofrequency electromagnetic radiation from cell phone causes defective testicular function in male Wistar rats	-	1-3h/ 28d	A. O. Oyewopo, S. K. Olaniyi, C. I. Oyewopo, A. T. Jimoh	2017-(1)
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	900 MHz (CW)	1h/24 d	Derya Öztürk Okatan, Haydar Kaya, Yüksel Aliyazıcıoğlu, Selim Demir, Serdar Çolakoğlu, Ersan Odacı	2017-(1)
Mobile phone (1800 MHz) radiation impairs female reproduction in mice, <i>Mus musculus</i> , through stress induced inhibition of ovarian and uterine activity	1800 MHz	-	Saba Shahin, Surya Pal Singh, Chandra Mohini Chaturvedi	2017-(1)
Exposed mice: Decreased number of developing and mature follicles and also corpus lutea. Decreased serum levels of pituitary gonadotrophins, sex steroids and expression of SF-1, StAR, 17 β -HSD, cytochrome P-450 aromatase, P-450scc, 3 β -HSD, ER- α and ER- β .				
Effect of Electromagnetic Radiation of Mobile Phone on Sperm Count in Albino Rats	900-1800 MHz (GSM) - (SAR, specs, 1.87 W/kg)	5h/60 d	Priyanka Singhal, Urvashi Singh	2016-(2)
Exposed rats: Decreased sperm count.				
Radiofrequency radiation (900 MHz)-induced DNA damage and cell cycle arrest in testicular germ cells in swiss albino mice	900 MHz	4-8h/ 35d	Neelam Pandey, Sarbani Giri, Samrat Das, Puja Upadhaya	2016-(1)
Exposed mice: Depolarization of mitochondrial membranes. Increased damage index in germ cells. Sperm head defects. Increased spermatogonial populations. Decreased spermatids population. Other data that brings to the conclusion that there is an arrest in the premeiotic stage of spermatogenesis. Histological alterations such as sloughing of immature germ cells into the seminiferous tubule lumen, epithelium depletion and maturation arrest.				
Effects of cell phone use on semen parameters: Results from the MARHCS cohort study in Chongqing, China	-	-	Guowei Zhang, Huan Yan, Qing Chen, Kaijun Liu, Xi Ling, Lei Sun, Niya Zhou, Zhi Wang, Peng Zou, Xiaogang Wang, Lu Tan, Zhihong Cui, Ziyuan Zhou, Jinyi Liu, Lin Ao, Jia Cao	2016-(1)
In Vitro Effect of Cell Phone Radiation on Motility, DNA Fragmentation and Clusterin Gene Expression in Human Sperm	850 MHz - (SAR, specs, 1.46 W/kg)	60min /1d	Adel Zalata, Ayman Z. El-Samanoudy, Dalia Shaalan, Youssef El-Baiomy, Taymour Mostafa	2015-(8)
" There was a significant decrease in sperm motility, sperm linear velocity, sperm linearity index, and sperm acrosin activity, whereas there was a significant increase in sperm DNA fragmentation percent, CLU gene expression and CLU protein levels." {From the publication}				
Electromagnetic radiation at 900 MHz induces sperm apoptosis through bcl-2, bax and caspase-3 signaling pathways in rats	900 MHz (50 Hz modulated) - 1 mW/cm ² (SAR 0.66 W/kg)	2h/50 d	Qi Liu, Tianlei Si, Xiaoyun Xu, Fuqiang Liang, Lufeng Wang, Siyi Pan	2015-(9)
" ... the percentage of apoptotic sperm cells in the exposure group was significantly increased by 91.42 % compared with the control group. The reactive oxygen species (ROS) concentration in exposure group was increased by 46.21 %, while the total antioxidant capacity (TAC) was decreased by 28.01 %. Radiation also dramatically decreased the protein and mRNA expression of bcl-2 and increased that of bax, cytochrome c, and caspase-3." {From the publication}				
Exposure to a 900 MHz electromagnetic field for one hour a day over 30 days does change the histopathology and biochemistry of the rat testis	900 MHz - 0.026 mW/cm ² (SAR 0.025 W/kg (body))	1h/30 d	Ersan Odacı, Cansu Özyılmaz	2015-(8)
Exposed rats: Edema in the intertubular space. Vacuoles in seminiferous tubules basal membrane. Decreased seminiferous tubule diameters. Decreased germinal epithelium thickness. Increased apoptotic index. Decreased malondialdehyde, superoxide dismutase, catalase and glutathione levels.				
Effects of chronic exposure to 2G and 3G cell phone radiation on mice testis - A randomized controlled trial	900-1800 MHz (GSM) & 1900-2200 MHz (3G) - (SAR, specs, 1.69 W/kg (10g))	48min / 30-18 0d	N. Mugunthan, J. Anbalagan, A. Shanmuga Samy, S. Rajanarayanan, S. Meenachi	2015-(12)

Exposed mice: Vacuolar degeneration and desquamation of seminiferous epithelium. Reduced thickness of seminiferous epithelium. Decreased serum testosterone level. Etc.				
Effects of Long Term Exposure to a 2G Cell Phone Radiation (900 - 1900 MHz) on Mouse Testis	900-1900 MHz (GSM) - (SAR, specs, 1.69 W/kg (10g))	48min / 30-18 0d	N. Mugunthan, J. Anbalagan, S. Meenachi	2014-(7)
" In 2G exposed group animal weight was lower at first, second and fourth month. The mean testis weight was significantly reduced in all months except fourth month and the mean testis volume was significantly reduced in the first three months.the mean seminiferous tubule density per unit area was significantly lower value. The mean seminiferous tubule diameter was significantly reduced except the second month. the mean number of Sertoli cells and Leydig cells were significantly reduced. Mean serum testosterone level were significantly lower. Microscopic changes: 1. the interstitium appeared wide 2. Sertoli cells and spermatogonia were detached from the basal lamina. 3. vacuolar degeneration and desquamation of seminiferous epithelium. Most of the peripheral tubules showed maturation arrest in the spermatogenesis. Seminiferous tubules scored between 8 and 9 using Johnson testicular biopsy score count." (From the publication)				
Effect of electromagnetic irradiation produced by 3G mobile phone on male rat reproductive system in a simulated scenario	1910 MHz (GSM or 3G HSDPA) - (SAR 0.022-0.28 W/kg)	2h/60 d	Sanjay Kumar, Jay Prakash Nirala, J. Behari, R. Paulraj	2014-(8)
" Reports of declining male fertility have renewed interest in assessing the role of electromagnetic fields (EMFs). Testicular function is particularly susceptible to the radiation emitted by EMFs. Significant decrease in sperm count, increase in the lipid peroxidation damage in sperm cells, reduction in seminiferous tubules and testicular weight and DNA damage were observed following exposure to EMF in male albino rats. The results suggest that mobile phone exposure adversely affects male fertility." (From the publication)				
The influence of direct mobile phone radiation on sperm quality	900-1800 MHz (GSM)	5h (10min calls) /1d	Igor Gorpichenko, Oleg Nikitin, Oleg Banyra, Alexander Shulyak	2014-(7)
" Results: The number of spermatozoa with progressive movement in the group, influenced by electromagnetic radiation, is statistically lower than the number of spermatozoa with progressive movement in the group under no effect of the mobile phone. The number of non-progressive movement spermatozoa was significantly higher in the group, which was influenced by cell phone radiation. The DNA fragmentation was also significantly higher in this group. Conclusions: A correlation exists between mobile phone radiation exposure, DNA-fragmentation level and decreased sperm motility." (From the publication)				
New Electromagnetic Radiations Effects on Ultra Structure of Adult Bovine Sperm	900 MHz (GSM)	5min/ 1d	Mohammad Hassan Heidari, Mehran Farhodi, Ehsan Pashaeiahei, Hassan Mahbouobipour, Matine Heidari, Maryam Tadayon, Hamid Reza Fayazi, Abdollah Amini	2014-(3)
" The increase of electromagnetic radiations in the environment cause to growing public concern on the effects of them on human being health. The main purposes of many studies have recently been on these topics. Here we aimed to evaluate possible effects of electromagnetic radiations on ultra- structure of sperm. A healthy normal Holstein race bovine was selected for study. A total seminal fluid of a normal ejaculation obtained from normal ejaculation was divided equally into two sample groups. First control group (C1) and experimental group which exposed to electromagnetic radiations (E). At the end of test the ultra-structures of the sperms in all specimens was studied using transmission electron microscopy. Ultra structural changes were observed in the experimental groups comparing to control group (C1). Our data suggest that, electromagnetic radiation have harmful effects on ultra-structure of bovine sperm and is a potential factor which can result in short term dysfunction of sperm in the various stages of fertilization. These effects may be observed later in life." (From the publication)				
[Chronotoxicity of 1800 MHz microwave radiation on sex hormones and spermatogenesis in male mice] (in Chinese)	1800 MHz - 0.2 mW/cm2 (SAR 0.22 W/kg)	2h/32 d	L. Chen, F. Qin, Y. Chen, J. Sun, J. Tong	2014-(1)
Exposed mice: Decreased testicular sperm head count and serum testosterone levels. Increased serum estradiol level. Circadian rhythms of testicular sperm head count and estradiol disappeared.				
[Influence of Imitated 900 MHz Cellular Radiation on the Form and Function of Ovarian Tissues in Rat] (in Chinese)	900 MHz	4h/30 d	Hui-rong Ma, Jing-wei Chen, Jing-jing Li, Yan-nan Zhao, Jia Zhang, Jin-de Yu, Le-le Guo, Xue-lian Ma	2013-(1)
Exposed rats: Decreased serous E2 levels. Shortered ovarian follicle and luteum diameters. Decreased layer and amount of granulosa cells.				
The Effects of Cell Phone Waves (900 MHz-GSM Band) on Sperm Parameters and Total Antioxidant Capacity in Rats	915-950 MHz (GSM) - 1.6 mW/cm2	8h/14d , 21d	Masoud Ghanbari, Seyed Bagher Mortazavi, Ali Khavanin, Mozafar Khazae	2013-(8)
" The results indicated that sperm viability, motility, and total antioxidant capacity in all exposure groups decreased significantly compared to the control group (p<0.05). Increasing the duration of exposure from 2 to 3 weeks caused a statistically significant decrease in sperm viability and motility (p<0.05)." (From the publication)				

Effects of exposure to electromagnetic field (1.8/0.9 GHz) on testicular function and structure in growing rats (some positive results)	900 MHz (GSM), 1800 MHz (GSM) - (SAR <0.0001 W/kg)	2h/90 d	H. Ozlem Nisbet, Cevat Nisbet, Aysegul Akar, Mesut Cevik, M. Onder Karayigit	2011-(7)
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Consequences of 3G & 2G Mobile Phone radiation on Heart

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Mobile Phone Radiations Effect on the Synchronization Between Heart and Brain	(2G & 3G)	-	Suman Pattnaik, Balwinder Singh Dhaliwal, Shyam Sundar Pattnaik	2022-(1)
" The findings of the presented work show that there exists a strong coherence between various heart and brain waves and the coherence strength is significantly affected under the impact of RF radiations for most of the heart and brain waves' pairs."				
The Effects of Heart-to-Mobile Phone Distance on the Circulatory System	-	-	Fatih Aydin, Ercan Aksit, Ayse Huseyinoglu Aydin, Ozge Turgay Yildirim	2021-(5)
Evaluation of heart rate variability, blood pressure and lipid profile alterations from dual transceiver mobile phone radiation exposure	900-1800 MHz (GSM) - (SAR, specs, 0.81 W/kg (body))	42d	Jamil Dauda Usman, Mikail Umar Isyaku, Adesoji Adedipe Fasanmade	2020-(7)
" There was significant (p<0.05) increase in systolic, diastolic, mean arterial BP and a decrease in HRV. Serum high density lipoproteins decreased, while total cholesterol, atherogenic indices, and heart NO levels increased significantly in the radiation exposed animals. The alterations observed in exposed animals remained unchanged even after the recovery period." {From the publication}				
Spectral Analysis of Heart Rate Variability During Mobile Phone Usage in First Year Medical Students	(SAR, specs, 0.75 W/kg)	3min/ 1d	Rekha, Rashmi Ramanathan, Jency Sekar, Ram Mohan, Kalpaka, S. Jeevithan	2020-(6)
An Observational Study of Effect of Mobile Phone Radiation on Heart Rate Variability	-	5min/ 1d	Neelam Choudhary, Paras Nath Mahto	2019-(5)
Aluminium foil dampened the adverse effect of 2100 MHz mobile phone-induced radiation on the blood parameters and myocardium in rats ("physical remedy")	2100 MHz (3G UMTS) - (SAR 0.84-1.86 W/kg)	4h/30 d	Viskasari P. Kalanjati, Kusuma E. Purwantari, Lucky Prasetiowati	2019-(4)
Effect of Stress and Radiation of Mobile Phones on Heart and its Capabilities	-	-	Ali Hussein F. Al-Nasraui	2018-(10)
" Different types of phone modes and the stress generated by them which affects the heart are analysed. It is noted that human heart is sensitive to stress generated by Electromagnetic Fields (EMF) emitted from cellular phones in normal mode rather any other modes resulting in drastic changes of heart rate. Strong artificial EMFs can enter the body and interfere with the natural way the body works. This can affect virtually any system within the body from stress levels to DNA. The investigations are done by an electrocardiogram unit which depicts the Heart Rate Variability (HRV) i.e., the fluctuations in the heart rate from the average heart rate. HRV is regulated by the autonomous nervous system which decreases as the heart rate increases. The variation in heart rate is determined by means of ECG which records the electrical activity of the heart. Based on the results, significant analysis of stress recovery factors is performed."				
Cellular Phone Irradiation of the Head Affects Heart Rate Variability Depending on Inspiration/Expiration Ratio	1800 MHz (GSM) - (SAR, specs, 0.70 W/Kg (head))	20min /1d	Szabolcs Béres, Ádám Németh, Zénó Ajtay, István Kiss, Balázs Németh, László Hejjele	2018-(9)
Heart rate variability affected by radiofrequency electromagnetic field in adolescent students	1788 MHz (10 MHz pulse modulated) - 0.77 mW/cm ² (SAR 0.405 W/kg (10g))	18min /1d	Jakub Misek, Igor Belyaev, Viera Jakusova, Ingrid Tonhajzerova, Jan Barabas, Jan Jaku	2018-(12)
" RF exposure decreased heart rate of subjects in a lying position, while no such change was seen in standing students. After exposure while lying, a rise in high frequency band of HRV and root Mean Square of the Successive Differences was observed, which indicated an increase in parasympathetic nerve activity."				
Calculation of Heart Rate Variation Owing to the Effect of	-	-	Mohammed Yahya H.,	2018-(6)

Electromagnetic Fields Waves (EMF)			Ali Adil Turki, Ali H. F. Alnasraui, Qasim shaker K.	
Effect of Electromagnetic Radiation Emitted from Mobile Phone on Electrocardiographic Variables and Rate Pressure Product	1800 MHz (GSM)	30min /1d	K. Singh, S. Das	2017-(1)
A Comprehensive Study of Change in Heart Rate Variability Parameters Due to Radiations Emitted from GSM and WCDMA Cellular Phones	(2G GSM & 3G WCDMA) - (SAR, specs, 0.67-1.14 W/kg)	-/1d	Suman, Shyam S. Pattnaik, Harish K. Sardana, Nakul Bansal	2017-(14)
Immediate effects of mobile phone radiations on heart rate variability in college going students	850-2100 MHz (3G WCDMA) - (SAR, specs, 1.04 W/kg (body))	2min/ 1d	Juveriya Yasmeen, Mehnaaz Sameera Arifuddin, Nazema Khatoon, Umaima Mahveen, Mohammed Abdul Hannan Hazari	2017-(6)
" There was a significant increase in mean HR and decrease in mean RR interval from baseline through Phase 3 to Phase 2. This study shows that there was statistically significant change in root of the mean of the sum of the squares of differences, low frequency (LF), high frequency (HF), and LF/HF ratio between basal recording and during active call (direct contact of mobile phone to the ear and also with use of earphones). ... We also observed gender differences in some of the HRV parameters." {From the publication}				
Effects of mobile phone radiation on heart rate variability of healthy young subjects	850-1900 MHz (GSM) - (SAR, specs, 0.82 W/kg)	5min/ 1d	Anup M. Vegad, Yogesh K. Kacha, Maulik S. Varu, Hemant B. Mehta, Chinmay J. Shah	2015-(6)
" Increase in the sympathetic tone concomitant with the decrease in the parasympathetic tone was observed during the MP usage in female subjects. However, only the parasympathetic tone may be reduced in male subjects while using MPs." {From the publication}				
Physiological and Histological Studies on The Heart of Male Albino Rats Exposed to Electromagnetic Field and The Protective Role of Silymarin and/or Vitamin E ("chemical remedy")	900 MHz (CW) - 1.4 mW/cm ² (SAR, specs, 1.2 W/kg)	2h/3d x 8	A. Zahkouk Samir, M. El-Gendy Ahkam, A. Eid Fatma, A. El-Tahway Nomaan, A. El-Shamy Sawsan	2015-(15)
" Exposure to mobile phone causes increases in activities of CPK, CK-MB and LDH enzymes in serum and heart tissue and oxidative stress markers (MDA and H ₂ O ₂), while antioxidants (CAT and GSH) were decreased in the heart tissue. Sodium (Na) and calcium (Ca) levels were decreased While, K level showed non-significant change in serum. Numerous histopathological changes were detected in the heart tissue of rats of the irradiated group with altered collagen fibres, polysaccharides in the cardiac muscle fibres of the exposed group." {From the publication}				
The effects of prenatal exposure to a 900-MHz electromagnetic field on the 21-day-old male rat heart	900 MHz - 0.05 mW/cm ² (SAR 0.025 W/kg (body))	1h/8d	Sibel Türedi, Hatice Hancı, Zehra Topal, Deniz Ünal, Tolga Mercantepe, İlyas Bozkurt, Haydar Kaya, Ersan Odacı	2014-(8)
Exposed rats: Increased malondialdehyde, superoxide dismutase and catalase values. Decreased glutathione values. Irregularities in heart muscle fibers and apoptotic changes. Crista loss and swelling in the mitochondria, degeneration in myofibrils and structural impairments in Z bands.				
Study the Effect of Mobile (Cell Phone) on the Heart Electricity	900-1800 MHz (GSM)	5-35m /1d	Daeser Hussain, Alyaa H. Ali, Sabah N. Mazhir, Aya Juma	2014-(4)
A Pilot Study on Long Term Effects of Mobile Phone Usage on Heart Rate Variability in Healthy Young Adult Males	-	-	Bhagyalakshmi Kodavanji, Venkappa Siddappa Mantur, Nayanatara Arun Kumar, Sheila Ramesh Pai	2012-(4)
" In the time domain analysis, the HRV showed no statistically significant difference in between the two groups. But in the frequency domain analysis, the total power (TP), the very low density frequency (VLF) power and the low frequency (LF) power were found to be statistically significantly high in the mobile users. The high frequency normalized unit (HF nu) was low and the LF normalized unit (LF nu) and the LF: HF ratio were high in the mobile users." {From the publication}				

Cancer as side effect of 3G & 2G Mobile Phone radiation

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
The Association Between Smartphone Use and Breast Cancer Risk	-	-	Ya-Wen Shih, Chin-Sheng Hung, Cheng-	2020-(9)

Among Taiwanese Women: A Case-Control Study			Chiao Huang, Kuei-Ru Chou, Shu-Fen Niu, Sally Chan, Hsiu-Ting Tsai	
<p>" This was a case-control study comprising 894 healthy controls and 211 patients with breast cancer." {From the publication}</p> <p>" Participants with smartphone addiction had a significantly higher 1.43-fold risk of breast cancer. Individuals with the habitual behavior of smartphone use > 4.5 minutes before bedtime had a significantly increased 5.27-fold risk of breast cancer compared to those who used a smartphone for ≤ 4.5 minutes before bedtime. Additionally, a closer distance between the smartphone and the breasts when using the smartphone exhibited a significantly increased 1.59-fold risk. Participants who carried their smartphone near their chest or waist-abdomen area had significantly increased 5.03-fold and 4.06-fold risks of breast cancer, respectively, compared to those who carried the smartphone below the waist. Moreover, there was a synergistic effect of smartphone addiction and smartphone use of > 4.5 minutes before bedtime which increased the breast cancer risk." {From the publication}</p>				
Central nervous system lymphoma and radiofrequency radiation – A case report and incidence data in the Swedish Cancer Register on non-Hodgkin lymphoma	-	-	Lennart Hardell, Michael Carlberg, Tarmo Koppel, Marie Nordström, Lena K. Hedendahl	2020-(6)
The Association between Mobile Phones and the Risk of Brain Cancer Mortality: A 25-Year Cross-Country Analysis	-	-	Hugo M. Mialon, Erik Nesson	2020-(1)
<p>" We find that mobile phone subscription rates are positively and statistically significantly associated with death rates from brain cancer 15–20 years later. In falsification tests, we find few positive associations between mobile phone subscription rates and deaths from rectal, pancreatic, stomach, breast or lung cancer or ischemic heart disease. Finally, differential effects models suggest that mobile phone subscription rates are associated with brain cancer deaths 15–19 years later relative to deaths from other causes."</p>				
Genetic susceptibility may modify the association between cell phone use and thyroid cancer: A population-based case-control study in Connecticut	-	-	Jiajun Luo, Hang Li, Nicole C. Deziel, Huang Huang, Nan Zhao, Shuangge Ma, Xin Ni, Robert Udelsman, Yawei Zhang	2019-(1)
<p>Very importantly they have discovered that when some genetic variants are present is more probably that phone use can result in the formation of thyroid cancer, this is not the first study that associate the genetic specificity to the intensity of the effects of microwave radiation, for example in [1] apart from the environmental factors genetic factors make the difference in the percentages of chromatid-type aberrations (gaps and breaks) on exposed human cells.</p> <p>[1] Panagopoulos, D. J. (2019). Chromosome damage in human cells induced by UMTS mobile telephony radiation. <i>Gen. Physiol. Biophys.</i> 38, 445-454.</p>				
Cancer epidemiology update, following the 2011 IARC evaluation of radiofrequency electromagnetic fields (Monograph 102)	-	-	Anthony B. Miller, L. Lloyd Morgan, Iris Udasin, Devra Lee Davis	2018-(11)
<p>" When considered with recent animal experimental evidence, the recent epidemiological studies strengthen and support the conclusion that RFR should be categorized as carcinogenic to humans (IARC Group 1)."</p>				
Wireless Phone Use and Risk of Adult Glioma: Evidence from Meta-analysis	-	-	Peng Wang, Chongxian Hou, Yanwen Li, Dong Zhou	2018-(1)
<p>" Ever use of wireless phones was not significantly associated with risk of adult glioma, but there could be increased risk in long-term users."</p>				
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	1800 MHz (GSM) - 0.07-0.66 mW/cm2 (SAR 0.001-0.1 W/kg (body))	19h/ (lifetime +2 years)	L. Falcioni, L. Bua, E. Tibaldi, M. Lauriola, L. De Angelis, F. Gnudi, D. Mandrioli, M. Manservigi, F. Manservigi, I. Manzoli, I. Menghetti, R. Montella, S. Panzacchi, D. Sgargi, V. Strollo, A. Vornoli, F. Belpoggi	2018-(8)
NTP Technical Report on the Toxicology and Carcinogenesis Studies in B6C3F1/N Mice Exposed to Whole Body Radio Frequency Radiation At Frequency (1,900 MHz) and Modulations (GSM and CDMA) used by Cell Phones (Expert Panel Vote found more effects)	1900 MHz (GSM & CDMA) - 2.65-16.6 mW/cm2 (SAR 2.5-10 W/kg (body))	9h/73 0d	(National Toxicology Program)	2018-(270)
<p>" The combined incidences of fibrosarcoma, sarcoma, or malignant fibrous histiocytoma of the skin were increased in 5 and 10 W/kg males, although not significantly or in an exposure concentration-related manner; however, the incidences exceeded the overall historical control ranges for malignant fibrous histiocytoma. In the lung, there was a significant positive trend in the incidences of alveolar/bronchiolar adenoma or carcinoma (combined) in males. Compared to the sham controls, all exposed groups of females had increased incidences of malignant lymphoma and the incidences in the 2.5 and 5 W/kg groups were significantly increased. The sham control group had a low incidence of malignant lymphoma compared to the range seen in historical controls."</p>				
Report of Partial findings from the National Toxicology Program	900 MHz (GSM), 900	9h/74 0d	Michael Wyde, Mark Cesta, Chad Blystone,	2018-(74)

Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats (Whole Body Exposure)	MHz (CDMA) - (SAR 1.5-6 W/kg (body))		Susan Elmore, Paul Foster, Michelle Hooth, Grace Kissling, David Malarkey, Robert Sills, Matthew Stout, Nigel Walker, Kristine Witt, Mary Wolfe, John Bucher	
<p>" In the heart, exposure to GSM or CDMA modulations of RFR in male rats resulted in a statistically significant, positive trend in the incidence of schwannomas. There was also a statistically significant, pairwise increase at the highest CDMA exposure level tested compared to controls. Schwann cell hyperplasias also occurred at the highest exposure level of CDMA- modulated RFR. Schwann cell hyperplasia in the heart may progress to cardiac schwannomas." {From the publication}</p> <p>" In the brain, there was a significant, positive trend in the incidences of malignant gliomas in males exposed to CDMA-modulated RFR, and a low incidence was observed in males at all exposure levels of GSM-modulated RFR that was not statistically different than in control males. Glial cell hyperplasia, a preneoplastic lesion distinctly different from gliosis, was also observed at low incidences in rats exposed to either GSM or CDMA modulation. Glial cell hyperplasia may progress to malignant glioma. Neither of these lesions was observed in the control group of male rats." {From the publication}</p> <p>Here it can be found a review of this paper.</p>				
Probabilistic multiple-bias modelling applied to the Canadian data from the INTERPHONE study of mobile phone use and risk of glioma, meningioma, acoustic neuroma, and parotid gland tumors	-	-	F. Momoli, J. Siemiatycki, M.L. McBride, M.-É. Parent, L. Richardson, D. Bedard, R. Platt, M. Vrijheid, E. Cardis, D. Krewski	2017-(9)
Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation	-	-	Michael Carlberg, Lennart Hardell	2017-(18)
<p>" Biological gradient: cumulative use of wireless phones increased the risk. Plausibility: animal studies showed an increased incidence of glioma and malignant schwannoma in rats exposed to radiofrequency (RF) radiation. There is increased production of reactive oxygen species (ROS) from RF radiation. Coherence: there is a change in the natural history of glioma and increasing incidence. Experiment: antioxidants reduced ROS production from RF radiation. Analogy: there is an increased risk in subjects exposed to extremely low-frequency electromagnetic fields. Conclusion. RF radiation should be regarded as a human carcinogen causing glioma." {From the publication}</p>				
Mobile phone use and risk of brain tumours: a systematic review of association between study quality, source of funding, and research outcomes	-	-	Manya Prasad, Prachi Kathuria, Pallavi Nair, Amit Kumar, Kameshwar Prasad	2017-(14)
Tumores cerebrales por exposición a campos electromagnéticos asociados al uso de teléfonos celulares: Un metanálisis de estudios observacionales	-	-	Luis Alejandro Quiroga Olaya, Jose Daniel Rojas Patiño	2016-(66)
<p>" Al realizar el estudio logramos contar con un total de 8513 casos y 16446 controles de los 7 estudios seleccionados y evaluados permitiendo de esta manera obtener como resultados una evidencia levemente significativa en cuanto a USO (OR de 1.107 con intervalo de confianza entre 0.783 – 1.566) y FRECUENCIA (OR de 1.08 con intervalo de confianza entre 0.938 – 1.262). Pero al evaluar la variable INTENSIDAD se logra evidenciar un OR significativo en los 2 casos, el cual nos permite sospechar en una asociación ya que la homogeneidad que se presenta en la intensidad con valor máximo en horas menor a 1000 de exposición lo confirman (OR de 1.242 con intervalo de confianza entre 1.065 – 1.449)."</p>				
Inferring the 1985–2014 impact of mobile phone use on selected brain cancer subtypes using Bayesian structural time series and synthetic controls	-	-	Frank de Vocht	2016-(8)
<p>" There is no evidence of an increase in malignant glioma, glioblastoma multiforme, or malignant neoplasms of the parietal lobe not predicted in the 'synthetic England' time series. Malignant neoplasms of the temporal lobe however, have increased faster than expected. A latency period of 10 years reflected the earliest latency period when this was measurable and related to mobile phone penetration rates, and indicated an additional increase of 35% (95% Credible Interval 9%:59%) during 2005–2014; corresponding to an additional 188 (95%CI 48–324) cases annually." {From the publication}</p>				
The Intracranial Distribution of Gliomas in Relation to Exposure From Mobile Phones: Analyses From the INTERPHONE Study	-	-	Kathrine Grell, Kirsten Frederiksen, Joachim Schüz, Elisabeth Cardis, Bruce Armstrong, Jack Siemiatycki, Daniel R. Krewski, Mary L. McBride, Christoffer Johansen, Anssi Auvinen, Martine Hours, Maria Blettner, Siegal Sadetzki, Susanna Lagorio, Naohito Yamaguchi, Alistair Woodward, Tore Tynes, Maria Feychting, Sarah J. Fleming, Anthony J. Swerdlow,	2016-(11)

			Per K. Andersen	
Mobile phone use and brain tumours in the CERENAT case-control study	-	-	Gaëlle Coureau, Ghislaine Bouvier, Pierre Lebailly, Pascale Fabbro-Peray, Anne Gruber, Karen Leffondre, Jean-Sebastien Guillamo, Hugues Loiseau, Simone Mathoulin-Pélissier, Roger Salamon, Isabelle Baldi	2014-(10)
Connection between Cell Phone use, p53 Gene Expression in Different Zones of Glioblastoma Multiforme and Survival Prognoses	-	-	Reza Akhavan-Sigari, Morteza Mazloum Farsi Baf, Vahid Ariabod, Veit Rohde, Saeed Rahighi	2014-(5)
" Results from the present study on the use of mobile phones for ≥3 hours a day show a consistent pattern of increased risk for the mutant type of p53 gene expression in the peripheral zone of the glioblastoma, and that this increase was significantly correlated with shorter overall survival time. The risk was not higher for ipsilateral exposure. We found that the mutant type of p53 gene expression in the peripheral zone of the glioblastoma was increased in 65% of patients using cell phones ≥3 hours a day." {From the publication}				
Association between vestibular schwannomas and mobile phone use	-	-	In Seok Moon, Bo Gyung Kim, Jinna Kim, Jong Dae Lee, Won-Sang Lee	2014-(7)
" In a case–control study, the odds ratio (OR) of tumor incidence according to mobile phone use was 0.956. In the case–case study, tumor volume and estimated cumulative hours showed a strong correlation ($r^2 = 0.144$, $p = 0.002$), and regular mobile phone users showed tumors of a markedly larger volume than those of non-regular users ($p < 0.001$). When the analysis was limited to regular users who had serviceable hearing, laterality showed a strong correlation with tumor side (OR = 4.5). We found that tumors may coincide with the more frequently used ear of mobile phones and tumor volume that showed strong correlation with amount of mobile phone use, thus there is a possibility that mobile phone use may affect tumor growth." {From the publication}				
Mobile phone and cordless phone use and the risk for glioma – Analysis of pooled case-control studies in Sweden, 1997–2003 and 2007–2009	900-1800-1900 MHz	-	Lennart Hardell, Michael Carlberg	2014-(13)
Decreased Survival of Glioma Patients with Astrocytoma Grade IV (Glioblastoma Multiforme) Associated with Long-Term Use of Mobile and Cordless Phones	900-1800-1900 MHz	-	Lennart Hardell, Michael Carlberg	2014-(16)
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	900-1800-1900 MHz	-	Lennart Hardell, Michael Carlberg	2013-(10)
Multifocal Breast Cancer in Young Women with Prolonged Contact between Their Breasts and Their Cellular Phones	-	-	John G. West, Nimmi S. Kapoor, Shu-Yuan Liao, June W. Chen, Lisa Bailey, Robert A. Nagourney	2013-(5)

DNA Damage provoked by 3G & 2G Phone radiation

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Micronucleus Assay in Cell Phone Users: Importance of Oral Mucosa Screening	-	-	Melika Ghandehari, Donia Sadri, Sareh Farhadi	2021-(4)
" The present study showed that the increased amount of cell phone usage had a strong and significant correlation with the higher frequency of the micronucleus containing cells and the higher frequency of micronucleus in each cell in the buccal mucosa."				
An Evaluation of the Genotoxic Effects of Electromagnetic Radiation at 900 MHz, 1800 MHz, and 2100 MHz Frequencies with a SMART Assay in <i>Drosophila melanogaster</i>	900 MHz, 1800 MHz, 2100 MHz	2-6h/ 2d	Merve Gunes, Kayhan Ates, Burcin Yalcin, Sibel Akkurt, Sukru Ozen, Bulent Kaya	2021-(1)
Exposed flies: The number of mutant clones was statistically increased according to the negative control group in all applications except for the six-hour application at 1800 MHz. This detection is based on the observation of genetic changes occurring in the trichomes of the <i>Drosophila</i> wings that appear as mutant clones under the microscope.				
Comparing chromosome damage induced by mobile telephony radiation and a high caffeine dose: Effect of combination and exposure duration	1920-1960 MHz (3G UMTS) - 0.029 mW/	15m/ 1d	Dimitris J. Panagopoulos	2020-(14)

	cm2			
<p>" I recently reported induction of chromatid-type aberrations in human peripheral blood lymphocytes after a single 15 min exposure to Universal Mobile Telecommunications System (UMTS) Mobile Telephony (MT) Electromagnetic Field (EMF) from a mobile phone. Lymphocytes from six healthy subjects were stimulated for mitosis, and exposed during the G2/M phase at 1 cm distance from the handset during an active phone call in "talk" mode. The same type of cells from the same subjects treated with a high caffeine dose (~ 290 times above the permissible single dose for an adult human) exhibited the same type of aberrations in a little smaller but comparable degree. The combination of this caffeine dose and the 15 min MT EMF exposure increased dramatically the number of aberrations in all subjects. The combined effect increased almost linearly with increasing duration of exposure to the MT EMF. Thus, MT EMF exposure ~ 136 times below the official limit (ICNIRP 2020) exerts a genotoxic action even greater than that of a caffeine dose ~ 290 times above the corresponding limit. Therefore, with a reasonable approximation, the limit for MT EMFs should be lowered by at least ~ 4×10⁴ times (136×290) for short-term exposures, and ~ 4×10⁶ times for long-term exposures."</p>				
Effects of different mobile phone UMTS signals on DNA, apoptosis and oxidative stress in human lymphocytes	1923-1977 MHz (3G UMTS)	1-3h/1d	Sachin Gulati, Pavol Kosik, Matus Durdik, Milan Skorvaga, Lukas Jakl, Eva Markova, Igor Belyaev	2020-(1)
<p>Exposed human lymphocytes: Relatively small but statistically significant induction of DNA damage in dependence on UMTS frequency (max. at 1977 MHz). The other measures do not reveal other changes.</p>				
Single-strand DNA breaks and oxidative changes in rat testes exposed to radiofrequency radiation emitted from cellular phones	900 MHz (GSM), 1800 (GSM) MHz, 2100 MHz (GSM) - (SAR 0.003 W/kg (1g))	2h/18 2d	Mehmet Esref Alkis, Mehmet Zulkuf Akdag, Suleyman Dasdag, Korkut Yegin, Veysi Akpolat	2019-(8)
<p>" The results of this study indicated that RFR increased TOS, OSI, MDA and 8-OHdG (p < 0.05). TAS levels in the exposed group were lower than in the sham group (p < 0.05). In terms of DNA damage, the tail intensities in the comet assay were higher in the exposure groups (p < 0.05). This study demonstrated that long-term exposure to RFR emitted by cellular phones may cause oxidative stress and oxidative DNA damage in rat testicular tissue and may generate DNA single-strand breaks at high frequencies (1800 and 2100 MHz)." {From the publication}</p>				
Comparative cyto- and genotoxicity of 900 MHz and 1800 MHz electromagnetic field radiations in root meristems of Allium cepa	900 MHz, 1800 MHz - 0.026-0.033 mW/cm2	30min -5h/1d	Arvind Kumar, Shalinder Kaur, Shikha Chandel, Harminder Pal Singh, Daizy Rani Batish, Ravinder Kumar Kohli	2019-(1)
<p>They conclude that radiofrequency exposure affects root meristems in plants and induce cytotoxic and DNA damage, they found that the effect is larger in the 1800 MHz exposure than in the 900 MHz.</p>				
Chromosome damage in human cells induced by UMTS mobile telephony radiation	1900-2200 MHz (3G UMTS) - 0.092 mW/cm2	15min /1d	D. J. Panagopoulos	2019-(1)
<p>Exposed Lymphocytes (during the G2 phase of the cell division cycle): Increased chromatid-type aberrations. Subject specific sensitivity to radiation is observed (that is, it exists some genetic specificity).</p>				
DNA-Related Modifications in a Mixture of Human Lympho-Monocyte Exposed to Radiofrequency Fields and Detected by Raman Microspectroscopy Analysis	1800 MHz (CW) - (SAR 0.21 W/kg)	5-20h /1d	Maria Lasalvia, Giuseppe Perna, Vito Capozzi	2019-(11)
<p>" The spectral analysis was able to detect variations of the biochemical composition of the nucleus of exposed cells. Such modifications are mainly detectable as an intensity decrease of some DNA and nucleic acid Raman peaks with respect to the intensity of some protein peaks and they were most evident in the case of 20 h exposed samples. These results were in agreement with the increase of reactive oxygen species (ROS) production, observed in the exposed cells. Overall, the obtained results point out that EMFs exposure may induce modifications of the DNA in some blood cells of long-term exposed people." {From the publication}</p>				
Appraisal of immediate and late effects of mobile phone radiations at 2100 MHz on mitotic activity and DNA integrity in root meristems of Allium cepa	2100 MHz (CW) - 0.049 mW/cm2 (SAR 0.28 W/kg)	1-4h/1d	Shikha Chandel, Shalinder Kaur, Mohd Issa, Harminder Pal Singh, Daizy Rani Batish, Ravinder Kumar Kohli	2019-(9)
Effect of 900-, 1800-, and 2100-MHz radiofrequency radiation on DNA and oxidative stress in brain	900-2100 MHz (GSM) - (SAR 0.039-0.084 W/kg (1g))	2h/18 0d	Mehmet Esref Alkis, Hakki Murat Bilgin, Veysi Akpolat, Suleyman Dasdag, Korkut Yegin, Mehmet Cihan Yavas, Mehmet Zulkuf Akdag	2019-(17)
<p>Exposed rats: Increased DNA damage and oxidative stress indicators.</p>				
Oxidative and mutagenic effects of low intensity GSM 1800 MHz microwave radiation	1800 MHz (GSM) - 0.00032 mW/cm2 (SAR	24h/1 9d	I. Yakymenko, A. Burlaka, O. Tsybulin, O. Brievieva, L. Buchynska, S. Tsehmistrenko, V. Chekhun	2018-(6)

	0.000038 W/kg)			
" The exposure of quail embryos before and during the incubation period to low intensity GSM 1800 MHz has resulted in expressive statistically significant oxidative effects in embryonic cells, including a 2-fold increase in superoxide generation rate and 85% increase in nitrogen oxide generation rate, damages of DNA integrity and oxidative damages of DNA (up to twice increased levels of 8-oxo-dG in cells of 1-day old chicks from the exposed embryos). Finally, the exposure resulted in a significant, almost twice, increase of embryo mortality."				
The Cytogenetic Effects Evaluation of Non-thermal Radiofrequency Radiation from Cellular Phones on Rat Peripheral Blood Lymphocytes	900 MHz (GSM) - (SAR, specs, 0.35 & 0.87 W/kg (body & head)	1-3h/105d	El Idrissi Sidi Brahim Salem, El Arbi Boussaber, El Goumi Younes, Hayat Talbi, Choukri Abdelmajid, Hillali Abderraouf	2017-(9)
Exposed rats: Increased micronucleated cells in the lymphocytes. Decreased proliferation index.				
Electromagnetic fields at a mobile phone frequency (900 MHz) trigger the onset of general stress response along with DNA modifications in Eisenia fetida earthworms	900 MHz (CW, 1 kHz) - 0.026-3.8 mW/cm2 (SAR 0.00013-0.00933 W/kg)	2h/1d	Jean-Paul Bourdineaud, Maja Šrut, Anamaria Štambuk, Mirta Tkalec, Daniel Brêthes, Krešimir Malarčić, Göran I. V. Klobučar	2017-(11)
" Eisenia fetida earthworms were exposed to electromagnetic field (EMF) at a mobile phone frequency (900 MHz) and at field levels ranging from 10 to 120 V m ⁻¹ for a period of two hours (corresponding to specific absorption rates ranging from 0.13 to 9.33 mW kg ⁻¹). Potential effects of longer exposure (four hours), field modulation, and a recovery period of 24 h after two hours of exposure were addressed at the field level of 23 V m ⁻¹ . All exposure treatments induced significant DNA modifications as assessed by a quantitative random amplified polymorphic DNA-PCR. Even after 24 h of recovery following a two hour-exposure, the number of probe hybridisation sites displayed a significant two-fold decrease as compared to untreated control earthworms, implying a loss of hybridisation sites and a persistent genotoxic effect of EMF. Expression of genes involved in the response to general stress (HSP70 encoding the 70 kDa heat shock protein, and MEK1 involved in signal transduction), oxidative stress (CAT, encoding catalase), and chemical and immune defence (LYS, encoding lysozyme, and MYD, encoding a myeloid differentiation factor) were up-regulated after exposure to 10 and modulated 23 V m ⁻¹ field levels. Western blots showing an increased quantity of HSP70 and MTCO1 proteins confirmed this stress response. HSP70 and LYS genes were up-regulated after 24 h of recovery following a two hour-exposure, meaning that the effect of EMF exposure lasted for hours." {From the publication}				
Mitochondrial DNA damage and oxidative damage in HL-60 cells exposed to 900 MHz radiofrequency fields	900 MHz (CW) - 0.12 mW/cm2	4h/5d	Yulong Sun, Lin Zong, Zhen Gao, Shunxing Zhu, Jian Tong, Yi Cao	2017-(1)
Exposed leukemia cells: Increased ROS and 8-OHdG. Decreased mitochondrial transcription factor A, mtDNA polymerase gamma, mtDNA transcripts, mtDNA copy number, and ATP.				
The 2100 MHz radiofrequency radiation of a 3G-mobile phone and the DNA oxidative damage in brain	2100 MHz (UMTS) - 0.068 mW/cm2 (SAR 0.4 W/kg (body))	6h/10d, 40d	Duygu Sahin , Elcin Ozgur, Goknur Guler, Arin Tomruk, Ilhan Unlu, Aylin Sepici-Dinçel, Nesrin Seyhan	2016-(1)
Exposed rats: Increased oxidative DNA damage in the brain after 10 days of exposure but decreased to levels below controls after 40 days of exposure. For the authors this can be the result of adapted and increased DNA repair mechanisms. But, would these increased or stimulated DNA repair mechanisms have no side effects on the cells?				
Analysis of the Genotoxic Effects of Mobile Phone Radiation using Buccal Micronucleus Assay: A Comparative Evaluation	(2G GSM & 3G CDMA)	-	Sumita Banerjee, Narendra Nath Singh, Gadiputi Sreedhar, Saikat Mukherjee	2016-(4)
The group of long-term use of mobile phones shows definite signs of DNA damage.				
Perspectives Revisited - The Buccal Cytome Assay in Mobile Phone Users	-	-	Gursatej Gandhi, Prabhjot Singh, Gurpreet Kaur	2015-(10)
They found increased frequency of micronuclei, nuclear buds, basal, karyorrhectic, karyolytic, pyknotic and condensed chromatin cells. Decreased binucleated cells and repair index. Results are indicative of genetic damage that has not been repaired.				
Micronucleus induction by 915 MHz Radiofrequency Radiation in Vicia faba root tips by 915 MHz Radiofrequency Radiation in Vicia faba root tips	915 MHz (CW) - 2.5-5.0 mW/cm2 (SAR 0.3-1.8 W/kg)	72h	Bianca Gustavino, Giovanni Carboni, Roberto Petrillo, Marco Rizzoni, Emanuele Santovetti	2014-(20)
Exposed root tips: Up to ten fold increased micronuclei frequency in direct relation with the increasing power densities values.				
Adverse Effect of Mobile Phone on TP53, BRCA1 Genes and DNA Fragmentation in Albino Rat Liver	1800 MHz (GSM) - (SAR 0.33 W/kg)	2h/14d, 28d, 42d	E.M. Gouda, M.K. Galal, S.A. Abdalaziz	2013-(5)
" The obtained results revealed that longer period (six weeks) of continuous EMR exposure induced mutation in both studied genes with relative increase in DNA fragmentation when compared with intermittent exposure. The study warrants the public against excessive exposure to mobile phone-induced EMR. Minimization of such exposure has to safeguard against genetic DNA				

fragmentation with possible consequent mutation and cancer formation." {From the publication}				
Mobile phone radiation induces mode-dependent DNA damage in a mouse spermatocyte-derived cell line: A protective role of melatonin ("Chemical remedy")	-	-/1d	Chuan Liu, Peng Gao, Shang-Cheng Xu, Yuan Wang, Chun-Hai Chen, Min-Di He, Zheng-Ping Yu, Lei Zhang, Zhou Zhou	2013-(1)
Exposed mouse cells: Increased DNA damage following exposure in the listen, dialed and dialing modes (more pronounced on the two last, that also have major radiation intensity).				
Single-strand DNA breaks in human hair root cells exposed to mobile phone radiation	900 MHz (GSM) - (SAR, specs, 0.97 W/kg (head))	15min, 30min /1d	Semra Tepe Çam, Nesrin Seyhan	2012-(5)
Exposed human hair: Increased single-strand DNA breaks in cells of hair roots close to the phone.				
The toxic effects of mobile phone radiofrequency (940 MHz) on the structure of calf thymus DNA	940 MHz - 0.059 mW/cm ² (SAR 0.04 W/kg)	45min /1d	Azadeh Hekmat, Ali Akbar Saboury, Ali Akbar Moosavi-Movahedi	2012-(7)
Exposed calf thymus: Disturbances on DNA structure, thermal instability of DNA. More fluorescence emissions that for the authors can be caused by the expansion of the exposed DNA structure. Increased surface charge and size of DNA. The authors think that radiation induced displacement of electrons in DNA may lead to conformational changes of DNA.				
Exposure to 1800 MHz radiofrequency radiation induces oxidative damage to mitochondrial DNA in primary cultured neurons	1800 MHz (GSM) - (SAR, specs, 2 W/kg)	24h/1d	Shang cheng Xu, Zhou Zhou, Lei Zhang, Zhengping Yu, Wei Zhang, Yuan Wang, Xubu Wang, Maoquan Li, Yang Chen, Chunhai Chen, Mindi He, Guangbin Zhang, Min Zhong	2009-(8)
Exposed neurons: Increased level of, the common biomarker of DNA oxidative damage, 8-hydroxyguanine in the mitochondria. Decreased copy number of mtDNA and mitochondrial RNA transcripts levels.				

Various / Other changes provoked by 3G & 2G Mobile Phone radiation

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
900 MHz Electromagnetic Fields Induce Microbiota Dysbiosis and Adaptive Immune System Disorders in Juvenile Rats	900 MHz (CW) - 0.00085 mW/cm ² (SAR 0.03 W/kg)	23h/3 5d	Louison Collet, Aymar Bosquillon Jenlis, Hafida Khorsi-Cauet, Marie Naudot, Nariman Djekkoun, Hussein Ghamlouch, Aurélie Corona, Hakim Ouled-Haddou, Stéphane Delanaud, Loïc Garçon, Véronique Bach, Amandine Pelletier, Jean-Pierre Marolleau	2022-(18)
" Exposure of rats to 900 MHz RF-EMF was associated with differences in the innate immune system and even more marked in the adaptive immune system. An analysis of the intestinal microbiota revealed dysbiosis, with an over-representation of Enterococcus, Clostridium and Bacteroides pp. Enterococcus was found to have translocated into the spleen in 67% exposed rats. Exposure to a 900 MHz RF-EMF appeared to alter the immune system (and particularly the adaptive immune system) directly or via intestinal dysbiosis." {From the publication}				
Corneal opacity in Northern Bald Ibises (Geronticus eremita) equipped with radio transmitters	(GSM)	-	Alfonso Balmori	2022-(1)
Does mobile phone impair blood cells?	1800 MHz (3G)	1h/1d	Mohammed Nazim Bennaoum, Amira Benabbou, Djouher Belbachir, Noujoum Zmouli, Mohamed Chekkal	2021-(5)
" Acute exposure to EW was responsible for a decrease of neutrophil count with a rise of myeloperoxidase activity explicated by an activation and destruction of neutrophils followed by the release of immature granulocytes. For red cells, an isolated decrease of mean cell volume (MCV) was observed without modification of hemoglobin rate. Theses modifications were more important in blood samples than in human volunteers."				
	-	-	Hava Bektas, Suleyman	2021-(9)

Evaluation of 900 and 1800 Mhz Radiofrequency Radiation Emitted from Mobile Phones on Pregnant Women			Dasdag, Mehmet Selcuk Bektas	
Exposed pregnant womans: Increased cord blood 8-OHdG (a marker of oxidative DNA damage). Increased tail intensity and tail moment values in cord blood lymphocytes DNA (so radiofrequency may have the potential to cause fetal DNA damage). Increased oxidative stress in placenta. Increased 8-OHdC, MDA and PCO levels in placenta as daily usage of mobile phone increased.				
Alteration of intrapancreatic serotonin, homocysteine, TNF- α , and NGF levels as predisposing factors for diabetes following exposure to 900-MHz waves	900 MHz	2-4h/30d	Gholamali Jelodar, Mansour Azimzadeh, Fatemeh Radmard, Narges Darvishhoo	2021-(1)
Exposed rats: Decreased pancreatic nerve growth factor (NGF) and serotonin levels and increased the proinflammatory markers intrapancreatic homocysteine (Hcy) and tumor necrosis factor- α (TNF- α), which can be a predisposing factor for type 2 diabetes.				
Low-Level Radiofrequency Exposure Induces Vasoconstriction in Rats	900 MHz (CW) - (SAR 0.35 W/kg)	23h/6d	Thi Cuc Mai, Anne Braun, Veronique Bach, Amandine Pelletier, Rene de Seze	2021-(9)
Effects of mobile phone emissions on human red blood cells	900-1800 MHz (GSM) - (SAR, specs, 1.5 W/kg (10g))	30-60 m/1d	Aniket Chowdhury, Yashveer Singh, Uttam Das, Deepak Waghmare, Raktim Dasgupta, Shovan Kumar Majumder	2021-(13)
Exposed red blood cells: Observed changes in shape and mechanical properties.				
Evaluation of Non-Thermal Microwave Effects on Bovine Lens by Measuring S-Parameters Induced by Variations in Dielectric Coefficient	900 MHz (CW) - (SAR 0.179 W/kg (local))	24h/4d	Junqing Lan, Xiaofeng Sun, Huacheng Zhu, Xiaoren Cao, Lan Yang, Guohong Du	2021-(7)
" The results showed that the bovine lens became gradually cloudy and its refractive index changed significantly with increasing doses of microwave radiation. A comparison of experimental and control bovine lenses stained with hematoxylin and eosin revealed that the change in bovine lens might be a result of the nuclear fragmentation of lens epithelial cells and disorderly arrangement of lens fiber cells, which were induced by the vibration and friction of fiber tissues upset by microwave radiation." {From the publication}				
Impact of Electromagnetic Radiation on Honey Stomach Ultrastructure and the Body Chemical Element Composition of Apis mellifera (honey bees)	900-1800 MHz (GSM) - (SAR, specs, 0.5 W/kg (head))	10-20 m/1d	E. A. Mahmoud, A. Gabarty	2021-(1)
Exposed bees 20min: Stomach cells were completely decayed. Exposed bees 10min: Some parts of the cells were completely lysed, appeared as a thin tubular-like layer, or as compact mass, and the internal plasma membranes were not clear. Increased Mg, Ca, Zn and Fe. Decreased sulphate elements.				
Ameliorative effects of high-protein diet on hepatotoxic alterations in Swiss albino mice exposed to mobile phone radiation ("Chemical remedy")	1800 MHz (GSM or 4G) - (SAR, specs, 1.5 W/kg (body))	3h/90d	Debajyoti Bhattacharya, Prerona Biswas, Somnath Gangopadhyay, Mausumi Sikdar	2020-(7)
" A significantly elevated level (P < 0.05) of aspartate aminotransferase, alanine transaminase, bilirubin and serum caspase-3 levels was observed in the group of animals exposed to electromagnetic radiation emitted from mobile phone. Histological changes were also observed in the experimental groups. Moreover, in genomic DNA ladder assay, fragmented DNA was observed in exposed group, which is a probable sign of cell apoptosis." {From the publication}				
Long-term exposure to electromagnetic radiation from mobile phones can cause considerable changes in the balance of Bax/Bcl2 mRNA expression in the hippocampus of mice	-	1-8h/30d	Fatemeh-Zakieh Tohidi, Arianeh Sadr-Nabavi, Hossein Haghiri, Reza Fardid, Houshang Rafatpanah, Hosein Azimian, Mohammad-Hossein Bahreyni-Toossi	2020-(1)
" The expression of both Bax and Bcl2 mRNAs was upregulated in the mice exposed for one and two hours. Whilst the highest expressions were observed in the two-hours radiation in the exposed group, the expression of both studied genes was downregulated in animals with longer exposure to radiation in a duration-dependent manner. The highest ratio of Bax/Bcl2 expression was observed in the mice that received radiation for four hours twice a day. These results revealed that mobile phone radiation can cause considerable changes in the balance of Bax/Bcl2 mRNA expression in laboratory mice hippocampus."				
Microtubular structure impairment after GSM-modulated RF radiation exposure	915 MHz (GSM) - (SAR 0.23 W/kg - 1.65 W/kg (cell))	1-3h/1d	Ana Marija Marjanović Čermak, Krunoslav Ilić, Ivan Pavičić	2020-(6)
" Three-hour radiation exposure significantly altered microtubule structure regardless of the electric field strength. Moreover, on the third post-exposure day, three-hour radiation significantly reduced cell growth, regardless of field strength. The same was observed with two-hour exposure at 20 and 30 V/m. In conclusion, 915 MHz GSM-modulated RF radiation affects microtubular proteins in a time-dependent manner, which, in turn, affects cell proliferation." {From the publication} " RF signal was modulated to the 900-MHz GSM band in line with mobile network systems common in Europe, Asia, Africa, and				

<p>mainly South America. This signal is designed for wide-area cellular operations with maximum output powers permissible for mobile operations. Although 2G is being decommissioned around the world, the selected frequency is also used in the 3G and 4G networks." {From the publication}</p>				
Effect of handphone EMF radiation on survival rate and morphological reproductive organ changes of fruit fly (<i>Drosophila melanogaster</i> Meigen, 1830)	2100 MHz (3.5G HSDPA)	6h/3d	Ignatius Sudaryadi, Azizah Nur Rahmawati, Meliana Rizqiyah	2020-(8)
Pulsed Telecommunication Signals of Non-ionizing Radiation Affect Amyloid Precursor Protein and α -Synuclein Metabolism in Non-neural Human Cells	1800 MHz (GSM) 0.003-0.029 mW/cm ²	30m/2d	Aikaterina L. Stefi, Aikaterini S. Skouroliaiko, Lukas H. Margaritis, Dido Vassilacopoulou	2020-(17)
<p>" Data presented here, indicate changes in APP metabolism, acquisition of different cellular topologies of the newly generated APP fragments, changes in monomeric α-syn accumulation and multimerization, indicating that APP and α-syn processing is possibly altered in the periphery by EMR. These effects are accompanied by a substantial increase in the levels of Reactive Oxygen Species (ROS). " {From the publication}</p> <p>" We have to point out that the pulses refer to the actual DCS protocol information pulses as shown in our previous work [16] and not to the 217 Hz ELF power saving pulses described in a similar recent study by Zielinski [85]. Our work shows a connection between altered APP and α-syn metabolism of non-neural (kidney) human cells exposed to a Pulsed Telecommunication Signal from an ordinary cell-phone during a normal 10min long." {From the publication}</p>				
Cell Phone Habits and the Related Health Issues – A Study Conducted in Kerala	-	-	P. D. Premlal, N. V. Eldhose	2020-(3)
Effects of Radiofrequency Radiation Emitted from Mobile Phone on Hematological Parameters in Albino Mice (blood)	900 MHz - 0.000013 mW/cm ²	1-2h/21d	Mona H. Ibraheim, Magda S. Hanafy, Amir shahwan, Samir A. Nassar	2020-(8)
<p>Exposed mice: Reduced number of red blood cells and hematocrit percentage. Increased white blood cells number and lymphocyte percentage. Faster erythrocyte sedimentation rate. Irregularities and deformations in red blood cells membranes. There is a shift towards the low concentration of water which indicates changes in the membrane permeability. So there are harmful effects on the blood parameters.</p>				
Decreased level of plasma nesfatin-1 in rats exposed to cell phone radiation is correlated with thyroid dysfunction, oxidative stress, and apoptosis (thyroid gland)	-	-/30d	Noha I. Hussien, Ayman M. Mousa, Abeer A. Shoman	2020-(1)
In Vitro Effects of Cellular Phone Electromagnetic Fields at 940 MHz on the Structure and Half-Life of Recombinant Human Growth Hormone	940 MHz (CW) - 0.059 mW/cm ² (SAR 0.04 W/kg)	45m/1d	Mehdi Mohammadpour-Aghdam, Ahmad Molaeirad, Reza Faraji-Dana, Azadeh Azizi	2020-(9)
Effect of mobile phone radiation on oxidative stress, inflammatory response, and contextual fear memory in Wistar rat	1966 MHz (3G UMTS) - 4 mW/cm ² (SAR 0.36 W/kg (body))	2h/112d	Kumari Vandana Singh, Rohit Gautam, Ramovtar Meena, Jay Prakash Nirala, Sushil Kumar Jha, Paulraj Rajamani	2020-(12)
<p>Exposed rats: Increased hippocampal oxidative stress. Increased adrenal gland weight. Increased level of circulatory PICs viz. IL-1β, IL-6 and TNF-α. Increased level of stress hormones viz. adrenocorticotrophic hormone and corticosterone. No significant alterations in contextual fear memory.</p>				
Dynamic changes in cytoskeleton proteins of olfactory ensheathing cells induced by radiofrequency electromagnetic fields (CW vs. modulated)	900 MHz (CW or 50 Hz modulated) - 0.013 mW/cm ²	10-20 m/1d	Rosaria Grasso, Rosalia Pellitteri, Santi A. Caravella, Francesco Musumeci, Giuseppina Raciti, Agata Scordino, Giovanni Sposito, Antonio Triglia, Agata Campisi	2020-(10)
<p>Cells exposed to continuous wave: Enhanced nestin expression levels (neural stem cell marker), that stimulate self-renewal of the cells. Induced dynamic interactions among the expressed cytoskeleton proteins and the extrinsic signals induced from the microenvironment modification due to the exposure.</p> <p>Cells exposed to modulated wave: Significant reduction of cellular viability, as a result of activation of the apoptotic pathway, accompanied by a significant decrease in the tested cytoskeletal proteins.</p>				
Apoptotic Effect of 1800 MHz Electromagnetic Radiation on NIH/3T3 Cells	1800 MHz (CW) - (SAR 2 W/kg)	12h-2d	Dan-Yang Li, Jing-Dong Song, Zhao-Yuan Liang, Kiana Oskouei, Xiang-Qian Xiao, Wen-Zhe Hou, Jin-Tao Li, Yi-Shu Yang, Ming-Lian Wang, Manuel Murbach	2020-(11)
<p>" The results showed that the viability of cells in the 12, 36, and 48 h exposure groups significantly decreased compared with the sham groups; after 48 h of exposure, the percentage of late apoptotic cells in the exposure group was significantly higher. Real-time qPCR results showed that p53 mRNA in the 48 h exposure group was 1.4-fold of that in the sham group; significant differences of p53 protein fluorescence expression were observed between the exposure groups and the sham groups after 24 h and 48 h. The</p>				

mitochondrial swelling and vesicular morphology were found in the electron microscopy images after 48 h exposure." {From the publication}				
Immunotropic effects in cultured human blood mononuclear cells exposed to a 900 MHz pulse-modulated microwave field	900 MHz (877 Hz pulse modulated) - 0.1 mW/cm ² (SAR 0.024 W/kg)	15min /2d	Łukasz Szymański, Elżbieta Sobiczewska, Aleksandra Cios, Paweł Szymanski, Martyna Ciepielak, Wanda Stankiewicz	2019-(7)
" Although the microcultures of PBMC exposed to radiofrequency radiation demonstrated higher immunogenic activity of monocytes (LM index) and T-cell response to concanavalin A than control cultures after first exposure, this parameter decreased after a second stimulation. Saturation of the interleukin-2 (IL-2) receptor rose significantly after the second day of exposure. On the other hand, response to mitogen dropped after EMF stimulation. The results suggest that PBMC are able to overcome stress caused by mitogens after stimulation with 900 MHz radiation." {From the publication}				
Effect of electromagnetic field exposure on the transcription of repetitive DNA elements in human cells	900 MHz (GSM) - (SAR 1 W/kg)	-	Brunella Del Re, Ferdinando Bersani, Gianfranco Giorgi	2019-(1)
Exposed human cells: Strongly dependent on the cellular context and the tissue type (3 type of cells tested) results show that RF-EMF exposure can significantly affects repetitive DNA transcription.				
Antibacterial Susceptibility Pattern of the Pseudomonas aeruginosa and Staphylococcus aureus after Exposure to Electromagnetic Waves Emitted from Mobile Phone Simulator	900 MHz	2-24h /1d	M. M. Movahedi, F. Nouri, A. Tavakoli Golpaygani, A. Ataee, S. Amani, M. Taheri	2019-(10)
Variation in epigenetic DNA modifications following the exposure of cells to radiofrequency fields (Conference Presentation)	900 MHz - 0.23, 1.12, 40.3 mW/cm ²	-	Jody Cantu, Xomalin G. Peralta, Cesario Z. Cerna, Ibtissam Echchgadda	2019-(1)
" Results show significant changes in global DNA methylation in the RF exposed cells compared to the sham (unexposed) counterparts. Importantly, these changes occur in the absence of cell death and without a concomitant increase in temperature during exposures, suggesting that alterations in DNA methylation are not associated with toxic or thermal effects of the RF fields."				
Effect of cell phone radiation on neutrophil of mice	(3G TD-CDMA or LTE)	-	Yinhui Pei, Hui Gao, Lin Li, Xin An, Qinyou Tian	2019-(1)
Direct and indirect effects of exposure to 900 MHz GSM radiofrequency electromagnetic fields on CHO cell line: Evidence of bystander effect by non-ionizing radiation	900 MHz (GSM) - (SAR 0.3 W/kg)	2-24h /1d	Najmeh Jooyan, Bahram Goliaei, Bahareh Bigdeli, Reza Faraji-Dana, Ali Zamani, Milad Entezami, Seyed Mohammad Javad Mortazavi	2019-(1)
" No statistically significant alteration was found in cell membrane permeability, cell redox activity, metabolic cell activity and micronuclei (MN) frequency in the cells directly exposed to RFR for 4, 12, or 24 h. However, RFR exposure for 24 h caused a statistically significant decrease in clonogenic ability as well as a statistically significant increase in olive moment in both directly exposed and bystander cells which received media from RFR-exposed cells (conditioned culture medium; CCM). Exposure to RFR also statistically significant elevated both intra and extra cellular levels of ROS."				
Mobile phone electromagnetic radiation affects Amyloid Precursor Protein and α -synuclein metabolism in SH-SY5Y cells	1800 MHz (GSM) - 0.001-0.029 mW/cm ² (SAR 0.008-0.23 W/kg (body))	30min /2d	Aikaterina L. Stefia, Lukas H. Margaritis, Aikaterini S. Skouroliakou, Dido Vassilacopoulou	2019-(1)
Effects of 2100 MHz radio frequency radiation on the viscosity of blood and oxidative stress parameters in hypertensive and normal rats	2100 MHz - 0.079 mW/cm ²	1h/40 d	D. Kuzay, C. Ozer, T. Goktas, B. Sirav, F. Senturk, G.T. Kaplanoglu, M. Seymen	2018-(12)
Exposed rats: Oxidative stress and antioxidants in the heart and plasma (more pronounced in hypertension cases). Increased left ventricular fibrosis and aortic degenerative effects in hypertensive rats.				
Effect of low-level 1800 MHz radiofrequency radiation on the rat sciatic nerve and the protective role of paricalcitol ("Chemical remedy")	1800 MHz (GSM) - 0.0097 mW/cm ² (SAR 0.0042 W/kg (10g))	1h/30 d	Ulku Comelekoglu, Savas Aktas, Burcu Demirbag, Meryem Ilkay Karagul, Serap Yalin, Metin Yildirim, Aysegul Akar, Begum Korunur Engiz, Fatma Sogut, Erkan Ozbay	2018-(13)
Exposed rats: Decreased amplitude, prolonged latency, increased MDA levels, increased catalase activity. Degeneration in the myelinated nerve fibers.				
An Experimental Investigation of the Impact of Electromagnetic Radiations Emitted from Mobile Phone on General Health, pH, Flow Rate and Electrolytes Concentrations of Saliva in Female Adults	-	-	Etimad Alattar, Khitam Elwasife, Eqbal Radwan, Hadeer Abu	2018-(12)

			Warda, Mohammed Abujami	
<p>" The results showed that the participants who use mobile phone had several problems in their health including dry mouth, bad odor from mouth, drooling of saliva, as well as ear and eye pain. The participants who use mobile phone complained of headache, anxiety and forgetfulness as compared to deaf participants. The study showed that there was no significant difference between pH and flow rate of saliva in all tested groups. This study has also shown that salivary level of Na⁺ and K⁺ were significantly lower in mobile phone users when compared to non-users of mobile phone." {From the publication}</p>				
Exposure to cell phone radiofrequency changes corticotrophin hormone levels and histology of the brain and adrenal glands in male Wistar rat	900 MHz (2G CDMA) - (SAR, specs, 1.01 W/kg)	6h/28 -56d	Sima Shahabi, Iman Hassanzadeh Taji, Maedeh Hoseinnehzaddarzi, Fateme Mousavi, Shermineh Shirchi, Atena Nazari, Hooman Zarei, Fereshteh Pourabdolhossein	2018-(6)
<p>" Enhanced plasma ACTH and cortisol levels were found after prolonged exposure to mobile RF. The fasciculata layer of adrenal cortex eventually thickened following mobile RF radiation. While the number of cells in zona fasciculata remained constant, the cell size and perimeter increased during RF exposure. Finally, we found that vacuolization in brain tissue and the number and size of vacuoles considerably increased during two months of RF exposure." {From the publication}</p>				
Effects of mobile phone prolonged radiation on kidney cells; an in-vitro study	900 MHz (GSM)	1-2h/ 8d	Golshan Mahmoudi, Safoora Nikzad, Mohammad Mehrpouyan, Masoud Moslehi, Milad Baradaran- Ghahfarokhi, Amirreza Dashty	2018-(5)
<p>" Results showed that radiation exposure from mobile phones simulator decreased the kidney cell survival in the exposed groups (up to 40%). ANOVA test revealed that a significant decrease in cell survival in the exposed group compared to the control group (P=0.014). No significant differences between the irradiated groups were found (P>0.05)." {From the publication}</p>				
Exposure to Global System for Mobile Communication 900 MHz Cellular Phone Radiofrequency Alters Growth, Proliferation and Morphology of Michigan Cancer Foundation-7 Cells and Mesenchymal Stem Cells	900 MHz (GSM) - 0.35 mW/cm ²	5-101 m/3-5 d	Daryoush Shahbazi-Gahrouei, Batool Hashemi-Beni , Alireza Moradi, Maryam Aliakbari, Saghar Shahbazi-Gahrouei	2018-(5)
<p>" The results showed that radiation of GSM 900 MHz cellular phone may be reduced cell viability and proliferation rates of both cells. It is recommended to reduce exposure time, increase distance from antenna, and reserve the use of cell phones for shorter conversations to prevent its biological and harmful effects." {From the publication}</p>				
Exposure to 1.8 GHz electromagnetic fields affects morphology, DNA-related Raman spectra and mitochondrial functions in human lymphomonocytes	1800 MHz (CW) - 0.046-10 mW/cm ² (SAR 0.21 W/kg)	1-20h /1d	M. Lasalvia, R. Scrima, G. Perna, C. Piccoli, N. Capitanio, P. F. Biagi, L. Schiavulli, T. Ligonzo, M. Centra, G. Casamassima, A. Ermini, V. Capozzi	2018-(26)
<p>" Morphological analysis of adherent cells unveiled, in some of these, appearance of an enlarged and deformed shape after EMFs exposure. Raman spectra of the nuclear compartment of cells exposed to EMFs revealed the onset of biochemical modifications, mainly consisting in the reduction of the DNA backbone-linked vibrational modes. Respirometric measurements of mitochondrial activity in intact lymphomonocytes resulted in increase of the resting oxygen consumption rate after 20 h of exposure, which was coupled to a significant increase of the FoF1-ATP synthase-related oxygen consumption. Notably, at lower time-intervals of EMFs exposure (i.e. 5 and 12 h) a large increase of the proton leak-related respiration was observed which, however, recovered at control levels after 20 h exposure. Confocal microscopy analysis of the mitochondrial membrane potential supported the respiratory activities whereas no significant variations in the mitochondrial mass/morphology was observed in EMFs-exposed lymphomonocytes. Finally, altered redox homeostasis was shown in EMFs-exposed lymphomonocytes, which progressed differently in nucleated cellular subsets." {From the publication}</p>				
Low power microwaves induce changes in gating function of Trpv4 ion channel proteins	1800 Mhz - 0.58 mW/ cm ²	4h/1d	Sohni Jain, Sara Baratchi, Elena Pirogova	2017-(1)
Effect of Chronic Exposure to GSM 900/1800 MHz Radiofrequency Radiation on General Blood Physiology and Reproductive Function in Male Rats	900 MHz (GSM), 1800 MHz (GSM)- 0.09 mW/ cm ²	2h/90 d	Chaithanya K., Kumari Preeti, Rema Razdan, Karan Devasani	2017-(8)
<p>" Total sperm count, their morphology, total platelet count were significantly affected at both RFR. BP, neutrophil, lymphocyte percentage were significantly affected at 900 MHz however no significant changes were observed in hemoglobin content, total RBC and WBC count, eosinophil percentage and serum testosterone level. Hence it can be concluded that a long term (12week) mobile phone RFR exposure significantly affected hematological parameter, and had perilous effect on male fertility in rats." {From the publication}</p>				
Effects of Mobile Phone Radiation on Surface Tension and Volume Flow Rate of Human Blood groups	900-1800 MHz (GSM) - (SAR, specs,	30-60 m/1d	Somayeh Arian Rad, Adeel Ahmad	2017-(6)

	0.91 W/kg)			
" It is interesting to note that surface tension of blood, irrespective of blood group, is increased significantly, when blood exposed to radiation produced by mobile phone. Volume flow rate decreases significantly in A, B and AB blood groups, and increases in blood group O, when blood exposed to radiation produced by mobile phone." {From the publication}				
The response of human bacteria to static magnetic field and radiofrequency electromagnetic field	900-1800 MHz (CW)	-	David P. E. Crabtree, Brandon J. Herrera, Sanghoon Kang	2017-(7)
" Of the total of 24 isolated colonies from the four subjects, a total of eight showed altered growth patterns due to exposure to RF-EMFs (Supplementary data Table S3). The growth of three was colonies altered at high power and low power, respectively. Only one (hand 3 sample from subject B) experienced a significant increase in growth at both high and low power. The growth of 5 isolated colonies was increased (Fig. 2A and B and Supplementary data Fig. S3) while growth of two of them was suppressed (Fig. 2C and D)."				
The effects of low power microwaves at 1800 MHz and 2100 MHz on yeast cells growth	1800-2100 MHz (CW) - 0.0012-0.6 mW/cm2	6h/1d	Sohni Jain, Vuk Vojisaveljevic, Elena Pirogova	2017-(5)
Exposed yeast cells: Decreased growth rate in all exposures. Both frequency and power contribute independently to modulate this growth rate.				
Low power microwaves at 1.8 GHz and 2.1 GHz induce changes in Catalase enzyme kinetics	1800-2100 MHz(CW) - 0.0012-0.6 mW/cm2	5m/1d	Sohni Jain, Vuk Vojisaveljevic, Elena Pirogova	2017-(4)
Exposed Catalase enzymes: The inhibitory and excitatory actions observed at the frequency of 2.1 GHz and respective powers indicate the power dependence of chemical reaction. At 1.8 GHz and different powers, no significant modulating effects were observed.				
Alterations of thymic morphology and antioxidant biomarkers in 60-day-old male rats following exposure to a continuous 900 MHz electromagnetic field during adolescence	900 MHz - 0.0208 mW/cm2 (SAR 0.0067 W/kg (body))	1h/38d	A. Kulaber, G. Kerimoğlu, Ş. Ersöz, S. Çolakoğlu, E. Odacı	2017-(7)
Exposed rats: Increased Malondialdehyde levels. Extravascular erythrocytes in the medullary/corticomedullary regions.				
Acute effects of mobile phone radiations on subtle energy levels of teenagers using electrophotonic imaging technique: A randomized controlled study	2100 MHz (3G UMTS) - 0.00013 mW/cm2	15min /1d	Hemant Bhargav, T.M. Srinivasan, Suman Bista, A. Mooventhan, Vandana Suresh, Alex Hankey, H.R. Nagendra	2017-(7)
" Subtle energy levels of various organs of the subjects were measured using gas discharge visualization Camera Pro device ..." {From the publication} " The subtle energy levels were significantly reduced after RF-EMF exposure in MPON group as compared to MPOF group for following areas: (a) Pancreas (P = 0.001), (b) thyroid gland (P = 0.002), (c) cerebral cortex (P < 0.01), (d) cerebral vessels (P < 0.05), (e) hypophysis (P = 0.013), (f) left ear and left eye (P < 0.01), (g) liver (P < 0.05), (h) right kidney (P < 0.05), (i) spleen (P < 0.04), and (j) immune system (P < 0.02)."				
Hair Loss due to Electromagnetic Radiation from Overuse of Cell Phone (case report)	-	-	Rajendrasingh J. Rajput	2016-(3)
Effect of Electromagnetic Waves Emitted from Mobile Phone on Nerve Conduction Velocity of Median Nerve in Adult Males	900-1800 MHz (GSM) - (SAR, specs, 0.702 W/Kg)	10min /1d	K. Dabla, K. Singh	2016-(5)
Exposed human males: Decreased sensory component and motor component in conduction velocity of median nerve in the upper limb that holds the phone.				
Effect of Exposure to 900 MHz GSM Mobile Phone Radiofrequency Radiation on Estrogen Receptor Methylation Status in Colon Cells of Male Sprague Dawley Rats	900 MHz (GSM) - (SAR, specs, 0.95 W/kg)	4h/1d	P. Mokarram, M. Sheikhi, S.M.J. Mortazavi, S. Saeb, N. Shokrpour	2016-(8)
" Results: Our finding showed that exposure to GSM cell phone RF radiation was capable of altering the pattern of ERα gene methylation compared to that of non-exposed controls. Furthermore, no adaptive response phenomenon was induced in the pattern of ERα gene methylation after exposure to the challenging dose of Co-60 γ-rays." {From the publication} " Conclusion: It can be concluded that exposure to RF radiation emitted by GSM mobile phones can lead to epigenetic detrimental changes in ERα promoter methylation pattern." {From the publication}				
Parallel β-sheet vibration band increases with proteins dipole moment under exposure to 1765 MHz microwaves	1765 MHz - 0.094 mW/cm2	4h/1d	Emanuele Calabrò, Salvatore Magazù	2016-(1)
Exposed protein solutions: A mechanism of unfolding occurred in the measured proteins: hemoglobin, myoglobin, and bovine serum albumin, as an increase of their intensity on the parallel β-sheet component around 1635 cm ⁻¹ is observed.				
Mobile phone exposure influences some erythrocytes parameters in vitro. A novel source of preanalytical variability? (red blood cells)	900 MHz (GSM)	30min /1d	Elisa Danese, Giuseppe Lippi, Giorgio Brocco, Martina Montagna, Gian Luca Salvagno	2016-(1)
Exposed human blood: Increased hematocrit, hemoglobin, mean corpuscular volume and mean corpuscular hemoglobin.				

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	900 MHz (CW)	1h/38 d	Gökçen Kerimoğlu, Ali Aslan, Orhan Baş, Serdar Çolakoğlu, Ersan Odacı	2016-(1)
Exposed rats: Increased vacuolization and infiltration of white matter into gray matter. Cytoplasm of some neurons in the gray matter was shrunken and stained dark. Appearance of vacuoles in the cytoplasm. Increased apoptotic index. Increased MDA values. Decreased SOD and GSH values.				
Morphological and antioxidant impairments in the spinal cord of male offspring rats following exposure to a continuous 900 MHz electromagnetic field during early and mid-adolescence	900 MHz (CW) - 0.021 mW/cm ² (SAR 0.01 W/kg (body))	1h/25 d	Ayşe İkinci, Tolga Mercantepe, Deniz Unal, Hüseyin Serkan Erol, Arzu Şahin, Ali Aslan, Orhan Baş, Havva Erdem, Osman Fikret Sönmez, Haydar Kaya, Ersan Odacı	2015-(1)
Exposed rats: Increased malondialdehyde and glutathione levels. Vacuolization, myelin thickening and irregularities in the perikarya. Etc.				
Oxidative changes and apoptosis induced by 1800-MHz electromagnetic radiation in NIH/3T3 cells	1800 MHz (GSM) - (SAR 2 W/kg)	(5 min on/10 min off) 0.5-8. 0h/1d	Qingxia Hou, Minglian Wang, Shuicai Wu, Xuemei Ma, Guangzhou An, Huan Liu, Fei Xi	2015-(8)
Exposed fibroblast cells: Increased intracellular ROS levels (max. at 1h). Increased late-apoptotic cells percentage.				
Effects of microwaves (900 MHz) on peroxidase systems: A comparison between lactoperoxidase and horseradish peroxidase	900 MHz (GSM) - 0.038 mW/cm ² (SAR 0.00004 W/kg)	30min /1d	Mario Barteri, Roberta De Carolis, Fiorenzo Marinelli, Goliardo, Linda Celeste Montemiglio	2015-(1)
Conformational changes of the active sites. Formation and stability of the intermediate free radicals is influenced.				
2.1 GHz electromagnetic field does not change contractility and intracellular Ca ²⁺ transients but decreases β-adrenergic responsiveness through nitric oxide signaling in rat ventricular myocytes	2100 MHz (GSM) - 0.138 mW/cm ² (SAR 0.83 W/kg)	2h/70 d	Yusuf Olgar , Enis Hidisoglu , Murat Cenk Celen , Bilge Eren Yamasan , Piraye Yargicoglu, Semir Ozdemir	2015-(8)
Exposed rats: Decreased isoproterenol-induced response. Increased nitric oxide level in heart.				
Effects of electromagnetic field (1.8/0.9 GHz) exposure on growth plate in growing rats	900-1800 MHz (GSM)	2h/90 d	H. Ozlem Nisbet, Aysegul Akar, Cevat Nisbet, M. Yavuz Gulbahar, Ahmet Ozak, Cenk Yardimci, Selcuk Comlekci	2015-(30)
Exposed rats: Faster increase in weight and length. Increased calcium, growth hormone, estradiol and testosterone hormone levels. Thinnest trabecular zone. Thickest proliferative zones.				
Effects of RF-EMF Exposure from GSM Mobile Phones on Proliferation Rate of Human Adipose-derived Stem Cells: An In-vitro Study	900 MHz (GSM) - 0.35 mW/cm ² (SAR 2.0 W/kg)	6-21min /5d	D. Shahbazi-Gahrouei, B. Hashmi-Beni, Z. Ahmadi	2015-(10)
" The proliferation rates of human ADSCs in all exposure groups were significantly lower than control groups (P<0.05) except in the group of 6 minutes/day which did not show any significant difference with control groups. Conclusion: The results show that 900 MHz RF signal radiation from antenna can reduce cell viability and proliferation rates of human ADSCs regarding the duration of exposure." {From the publication}				
Ameliorative Effect of Two Antioxidants on The Liver of Male Albino Rats Exposed to Electromagnetic Field ("chemical remedy")	900 MHz - 1.4 mW/cm ²	2h/3d x 8	A. Eid Fatma, M. El-Gendy Ahkam, A. Zahkook Samir, A. El-Tahway Nomaan, A. El-Shamy Sawsan	2015-(20)
Exposed rats: Decreased RBCs, Hb, Hct, MCV, MCH and MCHC levels. Increased WBCs count, platelets count, lymphocytes and neutrophil percentages. Increased liver enzyme activities. Decreased CAT and GSH antioxidants in serum and liver tissue. Hispatological changes like altered collagen fibres. Etc.				
Effects of cell phone radiation on the levels of T3, T4 and TSH, and histological changes in thyroid gland in rats treated with hydroalcoholic Allium sativum extract	900 MHz (GSM)	12 x 10min /30d	Behnaz Hajjoun, H. Jowhari, M. Mokhtari	2014-(8)
" The mean body weight in the sham group showed a statistically significant decrease compared to the control group, whereas, an increase was seen in the experimental group 3 compared with sham (P<0.05). In addition, the concentrations of T4 and T3 hormones were lowered while TSH increased significantly in all groups compared to the control. Furthermore, histological				

<p>examination of thyroid revealed a reduction in the number of cubic cells and disorder among them, as well as a reduction in the amount of follicular fluid and follicular diameter in groups exposed to radiation and received garlic extract. Although, microwaves can cause weight lost, presence of allicin and vitamins A and B in garlic can compensate some of this weight lost. In addition, both microwaves and garlic extract have a considerable effect on thyroid gland, reflected both in its secretion and in its morphology." {From the publication}</p>				
<p>Selenium Reduces Mobile Phone (900 MHz)-Induced Oxidative Stress, Mitochondrial Function, and Apoptosis in Breast Cancer Cells ("chemical remedy")</p>	<p>900 MHz (GSM) - 0.0012 mW/cm² (SAR 0.36 W/kg)</p>	<p>1h/1d</p>	<p>Mehmet Cemal Kahya, Mustafa Nazıroğlu, Bilal Çiğ</p>	<p>2014-(9)</p>
<p>Effects of microwave exposure and Gemcitabine treatment on apoptotic activity in Burkitt's lymphoma (Raji) cells</p>	<p>1800 MHz (GSM) - 0.42 mW/cm² (SAR 0.35 W/kg (10g))</p>	<p>24h/1d</p>	<p>Ayşe G. Canseven, Meric Arda Esmekaya, Handan Kayhan, Mehmet Zahid Tuysuz, Nesrin Seyhan</p>	<p>2014-(5)</p>
<p>Exposed cells: Increased apoptotic activity. Decreased cell viability.</p>				
<p>Differential Pro-Inflammatory Responses of Astrocytes and Microglia Involve STAT3 Activation in Response to 1800 MHz Radiofrequency Fields</p>	<p>1800 MHz (GSM) - (SAR, specs, 2 W/kg)</p>	<p>(5 min on/10 min off) 1-24h /1d</p>	<p>Yonghui Lu, Mindi He, Yang Zhang, Shangcheng Xu, Lei Zhang, Yue He, Chunhai Chen, Chuan Liu, Huifeng Pi, Zhengping Yu, Zhou Zhou</p>	<p>2014-(12)</p>
<p>" Microglia and astrocytes were activated by RF exposure indicated by up-regulated CD11b and glial fibrillary acidic protein (GFAP). However, RF exposure induced differential pro-inflammatory responses in astrocytes and microglia, characterized by different expression and release profiles of IL-1β, TNF-α, IL-6, PGE2, nitric oxide (NO), inducible nitric oxide synthase (iNOS) and cyclooxygenase 2 (COX2). Moreover, the RF exposure activated STAT3 in microglia but not in astrocytes. Furthermore, the STAT3 inhibitor Stattic ameliorated the RF-induced release of pro-inflammatory cytokines in microglia but not in astrocytes." {From the publication}</p>				
<p>17-B-Estradiol Counteracts the Effects of High Frequency Electromagnetic Fields on Trophoblastic Connexins and Integrins</p>	<p>1800 MHz (GSM) - (SAR, specs, 2 W/kg)</p>	<p>1h/1d</p>	<p>Franco Cervellati, Giuseppe Valacchi, Laura Lunghi, Elena Fabbri, Paola Valbonesi, Roberto Marci, Carla Biondi, Fortunato Vesce</p>	<p>2013-(11)</p>
<p>" We investigated the effect of high-frequency electromagnetic fields (HF-EMFs) and 17-β-estradiol on connexins (Cxs), integrins (Ints), and estrogen receptor (ER) expression, as well as on ultrastructure of trophoblast-derived HTR-8/SVneo cells. HF-EMF, 17-β-estradiol, and their combination induced an increase of Cx40 and Cx43 mRNA expression. HF-EMF decreased Int alpha1 and β1 mRNA levels but enhanced Int alpha5 mRNA expression. All the Ints mRNA expressions were increased by 17-β-estradiol and exposure to both stimuli. ER-β mRNA was reduced by HF-EMF but augmented by 17-β-estradiol alone or with HF-EMF. ER-β immunofluorescence showed a cytoplasmic localization in sham and HF-EMF exposed cells which became nuclear after treatment with hormone or both stimuli. Electron microscopy evidenced a loss of cellular contact in exposed cells which appeared counteracted by 17-β-estradiol. We demonstrate that 17-β-estradiol modulates Cxs and Ints as well as ER-β expression induced by HF-EMF, suggesting an influence of both stimuli on trophoblast differentiation and migration." {From the publication}</p>				
<p>Mobile Phone Radiation Induced Plasma Protein Alterations And Eye Pathology In Newly Born Mice</p>	<p>900-1800 MHz (GSM) - 0.5 mW/cm² (SAR 0.78 W/kg)</p>	<p>45min /30d</p>	<p>F. Eid, M. Abou Zeid, N Hanafi, A. El-Dahshan</p>	<p>2013-(21)</p>
<p>" The results showed deleterious changes in the plasma protein pattern by electrophoretic analysis. Also, the microscopic examination demonstrated numerous histopathological and histochemical changes in the eye mainly represented by degenerated, hemorrhagic areas and detachment in some layers of the eye with alteration in collagen, polysaccharides, total protein and marked increase in amyloid beta (β) protein contents of newly born mice exposed to RFEMF from mobile phone (45 min/day) for one month as well as after one month following the end of exposure. It was concluded that the exposure to mobile phone radiation causes plasma proteins alterations and eye pathology in newly born mice." {From the publication}</p>				
<p>In vitro Effect of Radiofrequency on hsp70 Gene Expression and Immune- effector Cells of Birds</p>	<p>850 MHz (GSM), 1200 MHz - (SAR 1.7 W/kg)</p>	<p>5-60min/1d</p>	<p>Pradip Kumar Das, Chandrakanta Jana, Thulasiraman Parkunan, Probal Ranjan Ghosh, Siddhartha Narayan Joardar, Guru Desika Vishaga Pandiyan, Joydip Mukherjee, Sagar Sanyal</p>	<p>2013-(6)</p>
<p>Exposed bird blood cells: Increased hsp70 gene expression.</p>				
<p>Unfolding and Aggregation of Myoglobin Can Be Induced by Three Hours' Exposure to Mobile Phone Microwaves: A FTIR Spectroscopy Study</p>	<p>1765 MHz (GSM) - 0.08 mW/cm² (SAR 0.85 W/kg)</p>	<p>3h/1d</p>	<p>Emanuele Calabrò, Salvatore Magazù</p>	<p>2013-(8)</p>
<p>Exposed myoglobin in D2O solution: Shift to lower frequencies of the amide I vibration. Increased β-sheet components with respect</p>				

to the α -helix content.				
Electromagnetic fields (UHF) increase voltage sensitivity of membrane ion channels; possible indication of cell phone effect on living cells	910-990 MHz (CW) - 0.005 mW/cm ²	1-2m/1d	N. Ketabi, H. Mobasheri, R. Faraji-Dana	2013-(14)
" ... effects of EMF on channel activities are frequency dependent, with a maximum effect at 930 MHz. The frequency of channel gating and the voltage sensitivity is increased when the channel is exposed to EMF."				
Is the effect of mobile phone radiofrequency waves on human skin perfusion non-thermal ?	900 MHz (GSM) - (SAR 0.49 W/kg (10g))	20min /1d	Nathalie Loos, Gyorgy Thuroczy, Rania Ghosn, Val'erie Brenet-Dufour, Sophie Liabeuf, Brahim Selmaoui, Jean-Pierre Libert, V'eronique Bach, Momar Diouf, Ren'e De Seze	2013-(26)
Exposed humans: Increased skin micro blood flow. Increased skin microvessels' vasodilatory ability. The specific vasodilatory effects are non-thermal effects.				
-A 1.8-GHz radiofrequency radiation induces EGF receptor clustering and phosphorylation in cultured human amniotic (FL) cells- Superposition of an incoherent magnetic field inhibited EGF receptor clustering and phosphorylation induced by a 1.8 GHz pulse-modulated radiofrequency radiation	1800 MHz (GSM) - (SAR 0.5-4 W/kg)	15min /1d	Wenjun Sun, Xiuying Shen, Dongbo Lu, Yiti Fu, Deqiang Lu, Huai Chiang	2012-(1)2013-(1)
" we investigated the effects of exposure to a 1.8-GHz RFR at different intensities on epidermal growth factor (EGF) receptor clustering and phosphorylation in human amniotic (FL) cells. ...The results showed ...induced EGF receptor clustering and enhanced phosphorylation on tyrosine-1173 residue, it is suggested that membrane receptors could be one of the main targets by which RFR interacts with cells. dose-rate threshold, in the case of EGF receptors, is between SAR of 0.1 and 0.5 W/kg." (SAR 0.1 W/kg radiation did not cause a significant effect). " When superimposed, the incoherent MF completely inhibited EGF receptor clustering and phosphorylation induced by RFR at SAR of 0.5, 1.0, and 2.0 W/kg, but did not inhibit the effects induced at SAR of 4.0 W/kg."				
Effect of 935-MHz phone-simulating electromagnetic radiation on endometrial glandular cells during mouse embryo implantation	935 MHz (CW) - 0.15-1.4 mW/cm ²	2h, 4h/3d	Wenhui Liu, Xinmin Zheng, Zaiqing Qu, Ming Zhang, Chun Zhou, Ling Ma, Yuanzhen Zhang	2012-(5)
" in high-intensity, 2- and 4-h groups, mitochondrial membrane potential of endometrial glandular cells was significantly lower, the calcium ion concentration was increased in low-intensity 2-h group but decreased in high-intensity 4-h group."				
Effects of cell phone radiofrequency exposure on the human cytochrome P450 reductase (protein structure change)	1900 MHz (3G UMTS) - (SAR 1 W/kg)	1h/1d	Shazia Tanvir, Gyorgy Thuroczy, Brahim Selmaoui, Viviane Silva Pires-Antoniotti, Pascal Sonnet, Philippe Léveque, René De Seze, Sylviane Pulvin	2012-(6)
Exposed solution with specific human protein: Altered electron transfer ability and structure of the cytochrome P450 reductase.				
Influence of Electromagnetic Radiation Produced by Mobile Phone on Some Biophysical Blood Properties in Rats	900 MHz (GSM)	1h/90d , 180d	Abu Bakr El-Bediwi, Mohamed Saad, Attalla F. El-kott, Eman Eid	2012-(4)
Exposed rats: Altered blood components as decreased values of RBCs, WBCs, Platelets, and Hemoglobin molecules. Decreased blood and plasma viscosity values. Altered hemoglobin structure.				
Biophysical Properties of Liquid Water Exposed to EM Radio Frequency Radiation	890-915 MHz (GSM), 1710-1785 MHz (GSM) - 0.055 mW/cm ² , 0.0017 mW/cm ²	1-1.5h /1d	Valery Shalatonin	2012-(21)
Electromagnetic Fields Effects on the Secondary Structure of Lysozyme and Bioprotective Effectiveness of Trehalose ("chemical remedy")	900 MHz (GSM) - (SAR 0.96 W/kg)	4h/1d	Emanuele Calabro, Salvatore Magazù	2012-(6)
" Fourier self-deconvolution spectral analysis of lysozyme in D2O solution after exposure to microwaves revealed an increase in intensity of the conformational components of amide I mode, particularly of β -sheet and turn that can be attributed to disorder and unfolding processes of the protein." (From the publication)				
Electromagnetic Treatment to Old Alzheimer's Mice Reverses β -Amyloid Deposition, Modifies Cerebral Blood Flow, and Provides Selected Cognitive Benefit	918 MHz (GSM) - 0.076-0.32 mW/cm ² (SAR 0.25-1.05 W/kg)	2h/12d , 60d	Gary W. Arendash, Takashi Mori, Maggie Dorsey, Rich Gonzalez, Naoki Tajiri, Cesar Borlongan	2012-(14)

Effects of 900 and 1800 MHz Electromagnetic Field Application on Electrocardiogram, Nitric Oxide, Total Antioxidant Capacity, Total Oxidant Capacity, Total Protein, Albumin and Globulin Levels in Guinea Pigs	900-1800 MHz (GSM) - 0.000135-0.000355 mW/cm ² (SAR 0.0015-0.15 W/kg)	4h/20d	Metin Çenesız, Onur Atakışı, Ayşegül Akar, Güven Önbiğın, Neslihan Ormancı	2011-(6)
Exposed guinea pigs: Differences in albumin, globulin, plasma oxidant status, and nitric oxide levels. Some irregularities in the autonomic control of the heart in addition to oxidative damage.				
Morphological changes induced by mobile phone radiation in liver and pancreas in Wistar albino rats	(GSM)	30min, 60min/91d	Sultan Ayoub Meo, Muhammad Arif, Shahzad Rashied, Sufia Husain, Muhammad M. Khan, Abeer A. Al Masri, Muhammad S. Vohra, Adnan M. Usmani, Ashraf Husain, Abdul M. Al-Drees	2010-(5)
" ... exposure to mobile phone radiation for 30 min/day caused inflammation of the liver in 18.75% of the animals (Group B). However, when the duration of exposure was increased to 60 min/day, we found inflammation in the liver in 43.75% and in pancreas in 31.25% of albino rats compared to their matched controls."				
Comparison of biological effects between continuous and intermittent exposure to GSM-900-MHz mobile phone radiation: Detection of apoptotic cell-death features	900 MHz (GSM)	1h/91d, 182d	Evangelia D. Chavdoula, Dimitris J. Panagopoulos, Lukas H. Margaritis	2010-(1)
Bioeffects of mobile telephony radiation in relation to its intensity or distance from the antenna	900-1800 MHz (GSM) - 0.0002-0.378 mW/cm ²	6min/6d	Dimitris J. Panagopoulos, Evangelia D. Chavdoula, Lukas H. Margaritis	2010-(13)
" ... an increased bioactivity 'window' was revealed at distances of 20–30 cm from the mobile phone antenna, (radiation intensity around 10 µW/cm ²) where the effect became highest, in relation to smaller or longer distances. the effect diminished considerably for distances longer than 40–50 cm and became not evident for distances longer than 1 m or radiation intensities smaller than 1 µW/cm ² ."				

Wi-Fi MW Hazards Experiments

/ Papers listed: 106

Wi-Fi MW Hazards Experiments

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Simultaneous effect of gamma and Wi-Fi radiation on gamma-H2Ax expression in peripheral blood of rat: A radio-protection note	gamma-ray + 2.45 GHz (Wi-Fi) - 0.000000000 42 mW/cm2	2-72h	Ehsan Khodamoradi, Shima Afrashi, Karim Khoshgard, Farshid Fathi, Soodeh Shahasavari, Rasool Azmoonfar, Masoud Najafi	2022-(6)
The interesting fact about this study is that it checks the effect of wi-fi in a completely different way, seeking if radiotherapy patients are more affected if they are also exposed to wi-fi. They found an increased double strand-breaks DNA in peripheral blood lymphocytes of rats in gamma radiation + wi-fi group than in the gamma radiation only group.				
Artificial EMG by WLAN-Exposure	(Wi-Fi) - 0.000003 mW/cm2	-	L. Yon Klitzing	2021-(3)
<p>The experiment detects the pulses of 10 Hz that the Wi-Fi router generates [1] ("In the absence of data traffic, only the access point transmits a short beacon signal, every 100 ms, which corresponds to a pulse rate of 10 Hz.") in the nerves of exposed humans: " Background: By a diagnostic routine of a "burn-out"-patient, additionally claiming an electrosensitivity, there was tested the nervous system electromyogram (EMG), recording from the lower arm skin surface, As well in the time series as by analyzing the frequency we found an artificial 10 Hz-component as a dominant signal. By the following anamnestic discussion, the patient told about a longtime exposure to active WLAN equipment in office. Testing other patients using this communication technique, there was a great number with the same 10 Hz-artifact in EMG. WLAN itself is characterized by a 10 Hz-modulated high-frequency signal. The measured EMG-data demonstrate the conflicts with the ICNIRP safety guidelines for this type of electromagnetic exposures. Because of these data with artifacts in EMG we tested patients with different healthy disorders by WLAN-exposure." {From the publication}</p> <p>So in the current experiments they expose patients to wi-fi to confirm the phenomenon, having the test person no information of Wi-Fi 'on/off'.</p> <p>In patient A: " These data demonstrate the 10 Hz-artifacts of EMG-trace during and after exposure. The patient claimed a reaction during exposure like heart troubles. This healthy effect disappears about 20 min alter exposure." {From the publication}</p> <p>In patient B: " As well in the first control as during and after WLAN-exposure there was monitored an EMG-trace superimposed by a 10 Hz signal. This patient reported about increasing headaches during "home-office" activity." {From the publication}</p> <p>In patient C: " This patient reported about many healthy disorders during working hours in open-plan office. In the control before exposure, there was detected the 10 Hz-artifact. In this case, this artificial signal disappears during exposure." {From the publication}</p> <p>Conclusions: " The influences in EMG during and after WLAN-exposure are obviously depending of the individual biosystem as demonstrated by the different data. That means: there is no uniform effect on EMG by WLAN-exposure. But this effect must be discussed about the consequence of artificial signals in the nervous system and influences on following biofunctions. The demonstrated data point to the necessary for a new discussion about healthy effects by low-energetic electromagnetic exposures. This especially under the background of WLAN-exposure in "home-office" or in schools by 'digital-learning.'" {From the publication}</p> <p>[1] Dongus, S., Jalilian, H., Schürmann, D., & Rössli, M. (2021). Health effects of WiFi radiation: a review based on systematic quality evaluation. Critical Reviews in Environmental Science and Technology, 1-20.</p>				
The influence of Wi-Fi range electromagnetic radiation on the parameters of the human's heart variability	2.4 GHz (Wi-Fi) - 0.00085 mW/cm2	-	S. Yu Rybalko, Yu V. Bobrik, A. L. Korepanov	2021-(7)
" As it is seen from the data above, a trustworthy increase of the stress index SI (characterizing the degree of the nervous system influence on the heart work) was observed in the experimental Groups 2 and 4 in comparison with the control group. The stress index (SI) of the body's regulatory systems is an integral parameter, characterizing obviously the level of the central regulation contour of the heart's work, and the most sensitive to the fluctuations of the sympathetic ANS influences. ... Under the complex influence of EMR factors and psychic load SI increased reliably in comparison with the control. However, in comparison with Group 2 SI in Group 4 decreased slightly, this may evidence about the disorder of heart rate regulation mechanisms under the influence of psycho-emotional load in complex with Wi-Fi EMR." {From the publication}				
Impact of Wi-Fi Energy on EZ Water	2.4 GHz (Wi-Fi)	20m/ 1d	Ji Won Lee, Gerald Pollack	2021-(15)
<p>" It is well-known that water has three phases: solid, liquid and gas. Yet, a gel-like phase of water, called Exclusion-Zone (EZ) or "fourth-phase" water has recently been identified [1-5]. In this phase, molecules are ordered, commonly forming a liquid crystal around hydrophilic surfaces, including those inside the cell. Thus, the body's cells are largely filled with EZ water, a feature critical for cell function [3]. Agents that impair cell function may act by diminishing the quantity of EZ water, while health promoting agents generally build EZ water [6]." {From the publication}</p> <p>" Under the conditions of these experiments, exposure to Wi-fi energy diminished EZ size by 15-20%. The results were statically significant, indicating the negative effect of the Wi-Fi energy on EZ size. Hence, the presence of Wi-fi has a negative impact on EZ-water buildup." {From the publication}</p>				

Effects of Wi-Fi Radiofrequency Radiation on Carbapenem-Resistant <i>Klebsiella pneumoniae</i> (bacteria)	2.45 GHz (Wi-Fi) - 0.005 mW/cm ²	24h/1 d	Ilham Said-Salman, Wissam Yassine, Ali Rammal, Mohammad Hneino, Hoda Yusef, Mohamed Moustafa	2021-(1)
Exposed bacterias: Morphological changes in the bacterial cell membrane, greater ability to form biofilms, higher levels of <i>bcsA</i> , <i>mrkA</i> , and <i>luxS</i> messenger RNAs. Data suggest that Wi-Fi exposure can influence bacteria in a stressful way, leading to an alteration in their antibiotic susceptibility, morphological changes, and cumulative biofilm formation.				
Evaluation of Electromagnetic Waves Effects on Various Bacterial Strains	2.45 GHz (Wi-Fi)	5h to 10d	Ilham Hassan Said-Salman	2021-(1)
<p>A thesis were different bacterial strains are exposed to wi-fi signal near to a router.</p> <p>First experiment findings:</p> <p>Exposed <i>Escherichia coli</i>: Increased motility and antibiotic resistance, increased metabolic activity and biofilm formation ability.</p> <p>Exposed <i>Klebsiella pneumoniae</i>: Altered minimum inhibitory concentration, increased metabolic activity and biofilm formation ability.</p> <p>Exposed <i>Staphylococcus aureus</i> and <i>Staphylococcus epidermidis</i>: Increased metabolic activity and biofilm formation ability.</p> <p>Second experiment findings:</p> <p>Exposed <i>Escherichia coli</i>: Altered growth rate and gene expression; it has been revealed that 101 genes were differentially expressed at $P \leq 0.05$. The up regulated genes were 52 while the down-regulated ones were 49.</p>				
Exposure to 2.45 GHz Radiation Triggers Changes in HSP-70, Glucocorticoid Receptors and GFAP Biomarkers in Rat Brain	2.45 GHz (CW) - (SAR 0.04-0.07 W/kg)	30-300m/1-10d	Haifa Othman, Alberto López-Furelos, José Manuel Leiro-Vidal, Mohamed Ammari, Mohsen Sakly, Hafedh Abdelmelek, Aarón Ángel Salas-Sánchez, Francisco Ares-Pena, Elena López-Martín	2021-(23)
<p>" Brain tissue may be especially sensitive to electromagnetic phenomena provoking signs of neural stress in cerebral activity. Fifty-four adult female Sprague-Dawley rats underwent ELISA and immunohistochemistry testing of four relevant anatomical areas of the cerebrum to measure biomarkers indicating induction of heat shock protein 70 (HSP-70), glucocorticoid receptors (GCR) or glial fibrillary acidic protein (GFAP) after single or repeated exposure to 2.45 GHz radiation in the experimental set-up. Neither radiation regime caused tissue heating, so thermal effects can be ruled out. A progressive decrease in GCR and HSP-70 was observed after acute or repeated irradiation in the somatosensory cortex, hypothalamus and hippocampus. In the limbic cortex, however, values for both biomarkers were significantly higher after repeated exposure to irradiation when compared to control animals. GFAP values in brain tissue after irradiation were not significantly different or were even lower than those of nonirradiated animals in all brain regions studied. Our results suggest that repeated exposure to 2.45 GHz elicited GCR/HSP-70 dysregulation in the brain, triggering a state of stress that could decrease tissue anti-inflammatory action without favoring glial proliferation and make the nervous system more vulnerable." {From the publication}</p>				
Effect of Wi-Fi radiofrequencies on the content of acid fatty and ergosterol, a precursor of vitamin D, in in vitro cultures of the fungus <i>Serpula himantioides</i>	2.45 GHz (Wi-Fi) - 0.000042 mW/cm ²	24h/7 d	Solange Torres, Gabriela Oyarce, Gastón Bravo, Sergio Triviño, Flavio Nanco, Rodrigo Hasbún, Claudia Pérez, José Becerra	2021-(5)
<p>" In the microwave-radiofrequency spectrum, Wi-Fi is a short-range wireless broadband technology, which transmits at a frequency of 2.5 GHz. This type of technology has been positioned itself as one of the most widely used technological advances in recent years. It has been reported that direct exposition to radiofrequencies can induce physiological changes in different animals and plants species. One of the degenerative effects Wi-Fi can cause is the production of reactive oxygen species, inducing tissue damage and DNA alterations. ... The results showed an increment in the content of some the fatty acids and ergosterol, in total extracts from the fungus mycelium. Antioxidant analysis revealed that the total extracts of <i>S. himantioides</i> culture medium showed antioxidant capacity associated with an increment in the content of phenolic compounds. Our results suggest that direct exposition to Wi-Fi radiation produces oxidative damage by modifying cellular components in the fungus <i>S. himantioides</i>." {From the publication}</p>				
Impact of 2.45 GHz Microwave Irradiation on the Fruit Fly, <i>Drosophila melanogaster</i>	2.45 GHz (CW) - 0.01-100 mW/cm ²	3m/1 d	Aya Yanagawa, Masatoshi Tomaru, Atsushi Kajiwara, Hiroki Nakajima, Elie Desmond-Le Quemener, Jean-Philippe Steyer, Tomohiko Mitani	2020-(15)
<p>They are very optimistic when they say that in 1996, the National Academy of Sciences concluded that microwave usage does not affect animal health at the business level of EMF usage, it is on the contrary very clear that it affects if you look to other papers in this site, that on the other side are much more recent than those speculative, "industry interested", conclusions taken at those times.</p> <p>Anyways authors here have found that irradiation causes various effects on the model that they have used: the fruit fly (<i>Drosophila melanogaster</i>).</p> <p>" This study indicated that there was no concern regarding the thermal effects of microwave irradiation for levels of daily usage if it is traveling waves. However, it still gave non-thermal effects. We detected genotoxicity and behavioral alterations associated with travelling wave irradiation. Electron spin resonance (ESR) revealed that fruit flies possessed paramagnetic substances in the body such as Fe³⁺, Cu²⁺, Mn²⁺, and organic radicals, and the behavioral tests supported the microwave susceptibility of the insects." {From the publication}</p>				

" International Commission on Non-Ionizing Radiation Protection (ICNIRP) put legal ceilings on microwave usage at 1 mW/cm ² . {From the publication}				
Lactobacillus Acidophilus and Lactobacillus Casei Exposed to Wi-Fi Radiofrequency Electromagnetic Radiation Show Enhanced Growth and Lactic Acid Production	2.45 GHz (Wi-Fi)	15-45 m/1d	S. Amanat, S. M. Mazloomi, H. Asadimehr, F Sadi, F. Shekouhi, S. M. J. Mortazavi	2020-(6)
Hepatic injury induced by radio frequency waves emitted from conventional Wi-Fi devices in Wistar rats	2.45 GHz (Wi-Fi) - (SAR 0.01 W/kg (body))	24h/4 0d	H. M. Fahmy, F. F. Mohammed	2020-(1)
Exposed rats: Severe oxidative stress. Deleterious effects in the liver function and its molecular structure was altered. Severe histological and ultrastructural alterations in the hepatic tissues.				
Ameliorative effects of vitamin C against hepatic pathology related to Wi-Fi (2.45 GHz electromagnetic radiation) in rats ("chemical remedy")	2.45 GHz (217 Hz modulated) - (SAR 0.0048 W/kg)	1h/30 d	O. Ozmen, O. Kavrik	2020-(8)
Exposed rats: Severe hyperemia, slight degeneration, and lipidosis in the liver tissue. Increased serum aspartate aminotransferase and alanine aminotransferase levels. Increased Caspase-3 hypoxiainducible factor-1 and factor-2 immunexpression. Decreased Sirtuin-1 expression.				
Stimulatory effect of exposure to low-power-density 2.45 GHz microwaves on Arabidopsis thaliana seedlings in vitro (plant)	2.45 GHz (CW) - 0.01 mW/cm ²	24h/2 d	Mudalige Don Hiranya Jayasanka Senevirathna, Isura Sumeda Priyadarshana Nagahage, Guligena Muhetaer	2020-(9)
Exposed plant seedlings: There is an increase in the hydrogen peroxide content, photosynthetic pigments, nonphotochemical quenching and fluorescence of the seedlings, but not oxidative stress.				
Protective Role of Vitamin C in Wi-Fi Induced Oxidative Stress in MC3T3-E1 Cells in Vitro ("chemical remedy")	2.45 GHz (Wi-Fi) - (SAR 0.16-0.83 W/kg)	30min-3h /1-3d	Mengxi Wang, Guohui Yang, Yu Li, Qun Wu, Yingsong Li	2020-(8)
The effect of Wireless (Wi-Fi) electromagnetic fields on oxidative stress in rat kidney tissues: A biophysical analysis	2.4 GHz (Wi-Fi)	12h/3 0d	Recep Akkaya	2020-(5)
Wi-Fi (2.4 GHz) affects anti-oxidant capacity, DNA repair genes expression and apoptosis in pregnant mouse placenta	2.4 GHz (Wi-Fi) - (SAR 0.09 W/kg (head))	2-4h/ 1d	Homeira Vafaei, Ghazal Kavari, Hamid Reza Izadi, Zahra Zare Dorahi, Mehdi Dianatpour, Afrooz Daneshparvar, Iman Jamhiri	2020-(8)
"MDA and SOD levels had significantly increased in exposed Wi-Fi signal groups (P-value< 0.05). Also, quantitative PCR experiment showed that SOD mRNA expression significantly increased in Wi-Fi signal groups. The data showed that CDKN1A and GADD45a genes were increased in Wi-Fi groups (P-value<0.05). The quantitative PCR and the TUNEL assay showed that apoptosis increased in Wi-Fi groups (P-value<0.05). Conclusion: Our results provide evidence that Wi-Fi signals increase lipid peroxidation, SOD activity (oxidative stres), apoptosis and CDKN1A and GADD45a overexpression in mice placenta tissue. However, further experimental studies are warranted to investigate other genes and aspects of pregnancy to determine the role of Wi-Fi radiation on fertility and pregnancy." {From the publication}				
Some Aspects of Good Practice for Safe Use of Wi-Fi, Based on Experiments and Standards	2.45 GHz (Wi-Fi)	-	Imants Gorbāns, Aleksejs Jurenoks	2020-(5)
" The results demonstrate that the radiation of Wi-Fi routers significantly impairs the growth, development, yield and unexpected drought resistance of plants at short distances from the microwave source (up to 1 m to 2 m; -33 dBm to -43 dBm; >10 V/m). Slight effects are found up to about 4.5 m from a full-power home Wi-Fi router." {From the publication}				
Investigation of the Effects of Radio Frequency Water Treatment on Some Characteristics of Growth in Pepper (Capsicum annuum) Plant	2.4 GHz (Wi-Fi)	-	Etimad Alattar, Eqbal Radwan	2020-(27)
" Exposure of plants to electromagnetic radiation indirectly through water is of particular interest due to the importance of water to living systems, particularly plants which are sessile. Previous studies demonstrated that water has unique electromagnetic and biophysical properties [53] [54]. Water plays an important role in determining the response of biological objects to electromagnetic radiation. Indeed, water is considered the primary medium in which biochemical reactions occur [55]. So it is supposed that the exposure to electromagnetic radiation may alter cellular metabolism using body's water as a primary receptor of the electromagnetic radiation [56] [57]." {From the publication}				
" The overall results showed changes of growth characters of plant watered with electromagnetic water. The length of pepper plants is significantly affected by the treated water, where the length of shoot was lower in plants grown under the effect of treated water (22.43 ± 7.17 cm) than those grown without treated water (28.11 ± 8.57 cm). The results revealed that the stem diameter of control plants (1.74 ± 0.39 cm) was significantly higher than that of the treated plants (1.66 ± 0.35 cm). In addition, the root length was lower in plants grown under the effect of treated water than those grown without treated water. Pepper plants watered with electromagnetic treated water exhibited marked decreases in health index, fresh and dry weight, relative water content, number of				

flowers and fruits/plant as well as number of seeds/fruit. In addition, the current experiment showed a significant decrease in the number of leaves, branch and flower per plant when watered with electromagnetic treated water. The results revealed that the first flowering time for plants in treated group was remarkably decelerated when compared to other plants in control group." {From the publication}				
Effect Of Exposure To Wi-Fi Router Radiation On The Lung Of Adult Male Albino Rats: Histological And Immunohistochemical Study	2.4 GHz (Wi-Fi)	4-24h /30d	Randa Ahmed Ibrahim, Azza Hussein Ali, Noura Hassan Khamis, Hanaa Hassanein Mohammed	2020-(11)
Evaluation of Short-Term Exposure to 2.4 GHz Radiofrequency Radiation Emitted from Wi-Fi Routers on the Antimicrobial Susceptibility of Pseudomonas aeruginosa and Staphylococcus aureus (bacterias)	2.4 GHz (Wi-Fi)	2-24h /1d	Samad Amani, Mohammad Taheri, Mohammad Mehdi Movahedi, Mohammad Mohebi, Fatemeh Nouri, Alireza Mehdizadeh	2020-(7)
" The aim of the present study was to examine the short-term exposure effect to radiation emitted from a Wi-Fi router on the sensitivity of pathogenic microorganisms to various antibiotics. The results of this study showed that there are significant changes in the resistance of S. aureus and P. aeruginosa to different antibiotics due to exposure to 2.4 GHz radiation after 24 hours. P. aeruginosa was resistant to all antibiotics after 24 hours of exposure to radiofrequency waves. Moreover, S. aureus was resistant to some antibiotics, such as ampicillin, amikacin, ceftriaxone, vancomycin, and piperacillin." {From the publication}				
Study of Wi-Fi waves effects on Genetic variations of Providencia stuartii bacteria isolated from otitis media infections	2.4 GHz (Wi-Fi)	18h/1 d	Rafea Zaidan Al-Sugmiany, Reyam Faris Saleh, Wakas Saadi Mahmood, Shadman Tariq Sadiq	2019-(10)
The Effect of Prenatal Exposure to 2.4 GHz Radio Frequency on the Histology and Expression of the osteocalcin and RUNX2 Gene of the Forelimb in an NMRI Mouse	2.4 GHz (Wi-Fi)	4h/21 d	Shaghayegh Amandokht Saghezchi, Nahid Azad, Reihane Heidari, Vahid Jajarmi, Shabnam Abdi, Hojjat-Allah Abaszadeh, Seyedeh Susan Sadjadpour, Naheid Neikoei, Mohammad Hassan Heidari, Mohammad-Amin Abdollahifar	2019-(7)
" Although, at first glance, there was no macroscopic teratogen effect in forelimbs in all groups, via a stereological method, we showed that bone and cartilage volume decreased in the experimental group compared to the other groups. We also found that the experimental group had lower expression of the osteocalcin and RUNX2 gene than the control and sham groups did." {From the publication}				
Gene expression of certain heat shock proteins and antioxidant enzymes in microwave exposed rats	2.45 GHz - (SAR 0.14 W/kg)	2h/60 d	Ali Saeed H. Alchalabi	2019-(1)
Exposed rats: Both up and down regulations of the studied genes. It is found a strong linear relationship between antioxidant enzymes and heat shock protein expression.				
Wi-Fi decreases melatonin protective effect and increases hippocampal neuronal damage in pentylenetetrazole induced model seizures in rats	2.4 GHz (Wi-Fi)	12h/1 4d	Recep Akkaya, Erkan Gümüs, Birnur Akkaya, Sebahattin Karabulut, Kader Gülmez, Mustafa Karademir, Yasar Tastemur, Ahmet Sevki Taskiran	2019-(1)
The effect of Wi-Fi electromagnetic waves on neuronal response properties in rat barrel cortex	2.4 GHz (Wi-Fi)	1h/1d	Sahar Sistani, Iman Fatemi, Seyed Ali Shafeie, Ayat Kaeidi, Mahdieh Azin, Ali Shamsizadeh	2019-(1)
Global gene expression analysis of Escherichia coli K-12 DH5a after exposure to 2.4 GHz wireless fidelity radiation	2.4 GHz (Wi-Fi)	5h/1d	Ilham H. Said-Salman, Fatima A. Jebaai, Hoda H. Yusef, Mohamed E. Moustafa	2019-(10)
" High-throughput RNA-sequencing of 2.4 GHz exposed and non-exposed bacteria revealed that 101 genes were differentially expressed (DEGs) at P ≤ 0.05. The up-regulated genes were 52 while the down-regulated ones were 49. QRT-PCR analysis of pgaD, fliC, cheY, malP, malZ, motB, alsC, alsK, appB and appX confirmed the RNA-seq results. About 7% of DEGs are involved in cellular component organization, 6% in response to stress stimulus, 6% in biological regulation, 6% in localization, 5% in locomotion and 3% in cell adhesion." {From the publication}				
Investigating The Effects of Modem Electromagnetic Waves (2.4 GHz) on Electroencephalogram	2.47 GHz (Wi-Fi) - 0.0002 mW/cm2	15min /1d	R. Javanrouh Givi, A. Aminian Modarres, M. Kafaee Razavi	2019-(8)
" In this paper, the effects of high-frequency wireless modem waves on the brain signal are investigated. To this end, the				

Electroencephalograph (EEG) recording of 15 volunteers is examined in four different bands. The experiments are designed to cover in four steps. Average power statistical analysis in different frequency bands and magnitude-squared coherence function shows significant changes in some bands." {From the publication}				
Role of Designed Bio-Geometrical Forms in Antagonizing Neurobehavioral Burden of Wi-Fi Radiation: Evidence-Based Experimental Study	2.4 GHz (Wi-Fi) - (SAR max. 0.091 W/kg)	24h/183d	Nevin E. Sharaf , Asmaa F. Galal, Mohamed S. El-Sawy, Aziza B. Shalby, Alaa H. Sayed, Hanaa H. Ahmed	2019-(18)
Rats were assigned into 3 groups... " Wi-Fi radiation exposed group showed elevated anxiety level and impaired spatial memory. Moreover, significant decline in dopamine, serotonin and acetylcholine levels in the investigated brain areas has been recorded. Melatonin levels were decreased in the cortex, striatum and hippocampus while HSP-70 was depleted in the cortex only. Using Bio-Geometrical forms along with Wi-Fi exposure could combat the burden of Wi-Fi radiation. This was evidenced by the recovery of the anxiety level and the improvement of memory task. In addition, the presence of Bio-Geometrical shapes could retrieve dopamine, serotonin and acetylcholine as well as melatonin and HSP-70 levels." {From the publication}				
Long-term exposure of 2450 MHz electromagnetic radiation induces stress and anxiety like behavior in rats	2.45 GHz	1h/28d	Sukesh Kumar Gupta, Shishir Kumar Patel, Munendra Singh Tomar, Shio Kumar Singh, Manoj Kumar Mesharam, Sairam Krishnamurthy	2019-(1)
Exposed rats: Various measured parameters shows that exists a deregulation of the hypothalamic pituitary adrenal axis. Impaired mitochondrial function and integrity. Decreased Bcl2 expression. Altered apoptosis regulation. Decreased neuronal cells in amygdala. Those are concomitant pathophysiological changes of anxiety like behavior.				
Exposure to a 2.5 GHz Non-ionizing Electromagnetic Field Alters Hematological Profiles, Biochemical Parameters, and Induces Oxidative Stress in Male Albino Rats Oxidative Stress	2.5 GHz (Wi-Fi)	28-56d	Afolabi Olakunle Bamikole, Obajuluwa Adejoke Olukayode, Tiwa Obajuluwa, Okiki Pius, Oloyede Omotade Ibidun, Fadaka Oluwaseun Adewale, Ojo Oluwafemi Adeleke	2019-(4)
Evaluation of Wi-Fi Radiation Effects on Antibiotic Susceptibility, Metabolic Activity and Biofilm Formation by Escherichia Coli O157H7, Staphylococcus Aureus and Staphylococcus Epidermis Staphylococcus Epidermis	2.4 GHz (Wi-Fi)	24h/1-2d	Ilham H. Said-Salman, Fatima A. Jebaai, Hoda H. Yusef, Mohamed E. Moustafa	2019-(8)
" The exposure to Wi-Fi radiation altered motility and antibiotic susceptibility of Escherichia coli O157H7. However, there was no effect Wi-Fi radiation on antibiotic susceptibility of Staphylococcus aureus and Staphylococcus epidermis. On the other hand, the exposed cells, as compared to the unexposed control, showed an increased metabolic activity and biofilm formation ability in Escherichia coli O157H7, Staphylococcus aureus and Staphylococcus epidermis." {From the publication}				
Effect of Non-Ionizing Electromagnetic Radiation on Behavior of the Honeybee, Apis mellifera L. (Hymenoptera, Apidae) Apis mellifera	2.4 GHz (Wi-Fi)	x-24h /1d	N. G. Lopatina, T. G. Zachepilo, N. G. Kamyshev, N. A. Dyuzhikova, I. N. Serov	2019-(1)
Complications of nonionizing radiofrequency on divided attention	2.4 GHz (Wi-Fi)	-	Kourosh Bamdad, Zahra Adel, Masoomeh Esmaeili	2019-(1)
Effects of Wi-Fi Wave Exposure on Human Working Memory (in Farsi)	2.45 GHz (Wi-Fi) - (SAR 0.15 W/kg)	20min /1d	Shahram Behbahanian, Alireza Moradi, Reza Khosroabadi, Vahid Negati	2018-(13)
" A significant decrease in reaction time was observed in the experimental group after exposure as compared to the sham group, but the accuracy rate was not changed significantly. Conclusion: According to the findings of present study, it can be concluded that electromagnetic wave exposure in 2450 MHz frequency may induce transient effect on working memory in healthy humans by curbing the reaction time." {From the publication}				
Radiofrequency radiation emitted from Wi-Fi (2.4 GHz) causes impaired insulin secretion and increased oxidative stress in rat pancreatic islets	2.45 GHz (Wi-Fi)	4h/45d	Ali Masoumi, Narges Karbalaee, S. M. J. Mortazavi, Mohammad Shabani	2018-(1)
Evaluation of the Effectiveness of Protective Patches on Acupoints to Preserve the Bioenergetic Status against Magnetic Fields ("physical remedy")	(SMF & Wi-Fi)	-	Claudio Molinari, Ian Stoppa, Nicola Limardo, Francesca Uberti	2018-(10)
" In this study, 10 male Italian volunteers aged between 50 and 60 were enrolled in the hospital. All participants were subjected to measurements at 4 specific time points to evaluate the effectiveness of Skudo® to counteract both EMF and SMF magnetic fields by evaluating the level of bioenergetic reactivity." {From the publication} " Analyzing the bioenergetic status of each measurements of participants, an evident unbalance was observed on meridians that regulate water. As reported in Figure 6, two water meridians related to kidney and bladder during the irradiation (phase 2) were unbalanced compared to the basal level (phase 1); the layouts of the left in red and of the right in blue were crossed. This phenomenon could be interpreted as an unbalance of the energy linked to water determined by the electromagnetic field of the Wi-				

Fi radiation source." {From the publication}				
Electromagnetic radiation 2450 MHz exposure causes cognition deficit with mitochondrial dysfunction and activation of intrinsic pathway of apoptosis in rats	2.45 GHz (CW) - 0.012 mW/cm ² (SAR 0.0616 W/kg (body))	1h/28 d	Sukesh Kumar Gupta, Manoj Kumar Mesharam, Sairam Krishnamurthy	2018-(35)
2.45 GHz microwave radiation impairs learning, memory, and hippocampal synaptic plasticity in the rat	2.45 GHz (CW) - 0.016 mW/cm ² (SAR 0.017 W/kg (body))	2h/40 d	Narges Karimi, Mahnaz Bayat, Masoud Haghani, Hamed Fahandezh Saadi, Gholam Reza Ghazipour	2018-(1)
Evidence of oxidative stress after continuous exposure to Wi-Fi radiation in rat model	2.45 GHz (Wi-Fi)	24h/70d	Kasra Kamali, Ali Taravati, Shayan Sayyadi, Fatemeh zahra Gharib, Houman Maftoon	2018-(8)
Exposed rats: Decreased total antioxidant capacity of plasma. Decreased catalase, glutathione peroxidase, and superoxide dismutase antioxidant enzymes activities. Increased glutathione S-transferase activities.				
Microwave radiation alters burn injury-evoked electric potential in <i>Nicotiana benthamiana</i>	2.45 GHz (CW) - 0.5 mW/cm ²	1h/1d	M. D. H. J. Senavirathna, T. Asaeda	2018-(6)
Exposed plants: Decreased amplitude of leaf burning-induced variation potential along the plant stem (with a decrease of the depolarization rate).				
High-frequency electromagnetic radiation action and influence resonators-converters on frequency of chromosome aberrations in bone marrow cells of male Wistar rats ("physical remedy")	2.4 GHz (Wi-Fi)	2-6h/1-21d	N.A. Dyuzhikova, A.V. Kopyltsov, K.A. Korshunov, G.N. Lukyanov, V.A. Puchkova, I.N. Serov	2018-(7)
Exposed rats: Exposure is cytogenetically active and induce mitotic disorders. Functioning of immune system elements, related to bone marrow activity, is affected.				
Consequences of 2.4-2.48 Ghz non-ionizing radiation of Wi-Fi router devices on the information processing speed in adolescents	2.4 GHz (Wi-Fi)	-	Kourosh Bamdad, Abdolhasan Shakiba, Masoomeh Esmaeili	2018-(5)
" Background: In order to investigate possible consequences of radiofrequency electromagnetic radiations of Wi-Fi modem devices on the information processing speed of university students, six hundred teenagers (14-17 years old) selected by cluster random sampling. They further classified into two groups consisting one control group (without Wi-Fi modem at home; n=200) and experimental group (with Wi-Fi modem at home; n=400)... According to our analyses, a significant decrease in the reaction time could be detected in WiFi modem users. The results also revealed that a significant correlation between the uses of Wi-Fi modems with the speed of information processing exists." {From the publication}				
Histopathological Effects of 2.45 Gigahertz Electromagnetic Radiation on the Rat Kidney, and Protective Effects of Vitamin C ("chemical remedy")	2.45GHz (217 Hz modulated) - (SAR 0.002 W/kg (kidney))	1h/30 d	Ercan Bas, Murat Ucar, Funda Yıldırım Bas, Sükriye Yesilot, Ilkay Armagan, Arzu Yalcın	2018-(5)
Exposed rats: Pathological changes including tubular and glomerular damage (p<0.05).				
Moderate Dose of Trolox Preventing the Deleterious Effects of Wi-Fi Radiation on Spermatozoa In vitro through Reduction of Oxidative Stress Damage ("chemical remedy")	2.45 GHz (Wi-Fi) - (SAR 1-2.5 W/kg (body))	90min /1d	Shang-Shu Ding, Ping Sun, Zhou Zhang, Xiang Liu, Hong Tian, Yong-Wei Huo, Li-Rong Wang, Yan Han, Jun-Ping Xing	2018-(12)
" Compared with the sham group, the oxidative stress, induced by the increase in ROS and the decrease in GSH-PX and SOD, resulted in an increase in 8-OHdG and sperm DNA fragments, more damage to sperm mitochondrial DNA, and a decline in sperm mitochondrial potential in the Wi-Fi-exposed group. The parameters of semen quality showed the decreased vitality and progressive sperm percentages, accompanied by an increase in immotility sperm percentage under Wi-Fi exposure. The oxidative condition between ROS and antioxidants under Wi-Fi exposure was considered as the main biological effect on the organisms." {From the publication}				
Effects of microwave radations (2.45 ghz) on biochemical alterations in brain of swiss albino mice and its amelioration by melatonin ("chemical remedy")	2.45 GHz - max. 0.174 mW/cm ² (SAR 0.368 W/kg)	2h/30 d	Rajendra Jat, Najendra Singh, Sanjay Singh, Rashmi Sisodia, Deepak Bhatnagar, Virender Saxena	2018-(7)
The effects of wireless electromagnetic fields on the activities of carbonic anhydrase and acetylcholinesterase enzymes in various tissues of rats	2.4 GHz (Wi-Fi)	12h/14d	Umit Muhammet Kocyigit, Parham Taslimi, Fatih Gurses, Sinan Soylu, Sevgi Durna Dastan, İlhami Gulcin	2018-(6)
Exposed rats: Changes of enzyme activities in salivary gland, stomach, colon, liver, and striated muscle tissues.				

Exposure to radio-frequency electromagnetic waves alters acetylcholinesterase gene expression, exploratory and motor coordination- linked behaviour in male rats	2.5 GHz (Wi-Fi)	24h/28-56d	Adejoke Olukayode Obajuluwa, Ayodele Jacob Akinyemi, Olakunle Bamikole Afolabi, Khalid Adekoya, Joseph Olurotimi Sanya, Azeez Olakunle Ishola	2017-(5)
" The results revealed that WiFi exposure caused a significant increase in anxiety level and affect locomotor function. Furthermore, there was a significant decrease in AChE activity with a concomitant increase in AChE mRNA expression level in WiFi exposed rats when compared with control. In conclusions, these data showed that long term exposure to WiFi may lead to adverse effects such as neurodegenerative diseases as observed by a significant alteration on AChE gene expression and some neurobehavioral parameters associated with brain damage." {From the publication}				
Rats exposed to 2.45 GHz of non-ionizing radiation exhibit behavioral changes with increased brain expression of apoptotic caspase 3	2.45 GHz - 0.788 mW/cm ²	4h/45d	Rini Varghese, Anuradha Majumdar, Girish Kumar, Amit Shukla	2017-(12)
Exposed rats: Memory decline and anxiety behavior. Decreased super oxide dismutase and catalase activities. Decreased glutathione levels. Increased brain lipid peroxidation. Decreased number of dendritic branching and intersections which corresponds to alteration in dendritic structure of neurons, that in turn affects neuronal signaling.				
RAPD Profiling, DNA Fragmentation, and Histomorphometric Examination in Brains of Wistar Rats Exposed to Indoor 2.5 Ghz Wi-Fi Devices Radiation	2.5 GHz (Wi-Fi)	24h/30-60d	A. O. Ibitayo, O. B. Afolabi, A. J. Akinyemi, T. I. Ojjezeh, K. O. Adekoya, O. O. Ojewunmi	2017-(7)
" Alterations in harvested brain tissues were confirmed by histopathological analyses which showed vascular congestion and DNA damage in the brain was assayed using agarose gel electrophoresis. Histomorphometry analyses of their brain tissues showed perivascular congestion and tissue damage as well." {From the publication}				
Does all-day and long-term exposure to radiofrequency radiation emitted from Wi-Fi affect hearing?	2.45 GHz - 0.00036 mW/cm ²	24h/265d	Ediz Yorgancilar, Suleyman Dasdag, Mehmet Zülküf Akdag, Zeki Akkus, Mehmet Akdag, Ismail Topcu	2017-(6)
" Pre-exposure distortion product otoacoustic emissions (DPOAE) of all rats were measured at the beginning, 6th and 12th months of the study. The DPOAE values of the sham, baseline and exposure groups were compared statistically. For the 6000 Hz hearing frequency, the DPOAE values in the exposure group were lower than those in the sham group (p < 0.05). Similarly, the 6000 Hz hearing frequency values obtained at the end of the 12th month were also lower than the baseline and 6-month values in the exposure group (p < 0.05). In contrast, the DPOAE values at the 6th and 12th months of exposure for the 2000 Hz hearing frequency were higher than the baseline value (p < 0.05). These results indicated that 12 months of RFR (24 h/day) at 50 cm from a 2.4 GHz Wi-Fi source can affect hearing. However, further studies are necessary." {From the publication}				
2.45 GHz Microwave radiation impairs hippocampal learning and spatial memory: Involvement of local stress mechanism induced suppression of iGluR/ERK/CREB signaling	2.45 GHz (CW) - 0.0248 mW/cm ² (SAR 0.0146 W/Kg)	2h/15-60d	Saba Shahin, Somanshu Banerjee, Vivek Swarup, Surya Pal Singh, Chandra Mohini Chaturvedi	2017-(1)
Exposed mice: Slower learning. Increased number of working and reference memory errors in the radial arm maze task. Increases serum corticosterone level and the expression of CRH, CRH-R1 and i-NOS. Decreased expression of iGluRs, n-NOS, PSD-95, PKC ϵ , PKA, ERK-p-ERK, CREB and p-CREB.				
Effects of prenatal exposure to WIFI signal (2.45 GHz) on postnatal development and behavior in rat: Influence of maternal restraint	2.45 GHz (Wi-Fi)	2h/?d	Haifa Othman, Mohamed Ammari, Mohsen Sakly, Hafedh Abdelmelek	2017-(1)
Effects of repeated restraint stress and WiFi signal exposure on behavior and oxidative stress in rats	2.45 GHz (Wi-Fi)	2h/20d	Haifa Othman, Mohamed Ammari, Mohsen Sakly, Hafedh Abdelmelek	2017-(11)
Exposed rats: Anxiety-like behavior without impairing spatial learning and memory abilities. Oxidative stress. WiFi signal combined with restraint stress impact brain and cognitive processes especially in elevated plus maze task.				
The ameliorative effect of gallic acid on pancreas lesions induced by 2.45 GHz electromagnetic radiation (Wi-Fi) in young rats ("chemical remedy")	2.45 GHz (217 Hz modulated) - (SAR 0.05 W/kg (body))	3h/30d	Senay Topsakal, Ozlem Ozmen, Ekrem Cicek, Selcuk Comlekci	2017-(8)
" Serum amylase, lipase, glucose, and tissue malondialdehyde, total oxidant status and oxidative stress index were increased, whereas total antioxidant status decreased in the EMR group. The histopathological examination of the pancreases indicated slight degenerative changes in some pancreatic endocrine and exocrine cells and slight inflammatory cell infiltrations in the EMR group. At the immunohistochemical examination, marked increase was observed in calcitonin gene related protein and Prostaglandin E2 expressions in pancreatic cells in this group." {From the publication}				
Postnatal development and behavior effects of in-utero exposure of rats to radiofrequency waves emitted from conventional WiFi devices	2.45 GHz (Wi-Fi)	2h /17-43d	Haifa Othman, Mohamed Ammari, Kaïs Rtibi, Noura	2017-(1)

			Bensaid, Mohsen Sakly, Hafedh Abdelmelek	
Exposed rats (pre-natally): Impaired offspring neurodevelopment during the first seventeen postnatal day (but not altered emotional and motor behavior at adult age). Cerebral oxidative stress imbalance at 28 but not 43 days old rats. Altered acetylcholinesterase activity.				
The effect of Wi-Fi electromagnetic waves in unimodal and multimodal object recognition tasks in male rats	2.4 GHz (Wi-Fi)	12h/30d	Amin Hassanshahi, Seyed Ali Shafeie, Iman Fatemi, Elham Hassanshahi, Mohammad Allahtavakoli, Mohammad Shabani, Ali Roohbakhsh, Ali Shamsizadeh	2017-(8)
Exposed rats: Discriminatory errors between novel and familiar objects in the standard, tactile and visual spontaneous object recognition tasks and in the cross-modal visual-tactile object recognition task. Increased expression of M1 receptors.				
The effects of electromagnetic radiation (2450 MHz wireless devices) on the heart and blood tissue: role of melatonin	2.45 GHz (217 Hz modulated) - max. 0.026 mW/cm ² (SAR 0.019 W/kg (body))	1h/30d	N. Gumral, M. Saygin, H. Asci, A.C. Uguz, O. Celik O, D.K. Doguc, H.B. Savas, S. Comlekci	2016-(7)
Exposed rats: Increased malondialdehyde and nitric oxide levels. Decreased dismutase and catalase enzyme activities. If treated with melatonin the lipid peroxidation decreased and plasma vitamin C and vitamin E concentrations increased compared to exposed without melatonin supplements rats.				
Efectos atérmicos de la radiación wifi (RF-MI) sobre la germinación, desarrollo vegetativo y patrones de metilación de Arabidopsis thaliana en cultivo hidropónico	2.4 GHz (Wi-Fi) - 0.000000024 - 0.00000199 mW/cm ²	24h/14d	Victoria Valentina Montero Lopez	2016-(51)
Exposed seedlings: Differential response of biomass formation. Increased leaf growth at the expense of root. Altered Methylation patterns in leaves with decreased overall methylation.				
Microwave radiation (2.45 GHz)-induced oxidative stress: Whole-body exposure effect on histopathology of Wistar rats	2.45 GHz - 0.2 mW/cm ² (SAR 0.14 W/kg (body))	2h/35d	Parul Chauhan, H. N. Verma, Rashmi Sisodia, Kavindra Kumar Kesari	2016-(1)
Exposed rats: Higher levels of lipid peroxide in the liver, brain and spleen. Histological changes in the brain, liver, testis, kidney and spleen.				
Effects of long-term pre- and post-natal exposure to 2.45 GHz wireless devices on developing male rat kidney	2.45 GHz (217 Hz modulated) - (SAR 0.1 W/kg (body))	1h / pregnancy + 66d	Ayça Esra Kuybulu, Faruk Öktem, İbrahim Metin Çiriş, Recep Sutcu, Ahmet Rifat Örmeci, Selçuk Çömlekçi, Efkan Uz	2016-(10)
Exposed rats (pre-natally): Increased renal tissue malondialdehyde and total oxidant levels. Decreased total antioxidant and superoxide dismutase levels. Increased spot urine NAG/creatinine ratio. Immunohistochemical analysis showed low-intensity staining with Bax in cortex and high-intensity staining with Bcl-2 in cortical and medullar areas. Higher Bcl2/Bax staining intensity ratios of medullar and cortical areas. Exposed rats (post-natally): Increased spot urine NAG/creatinine ratio. Tubular injury.				
Does prolonged radiofrequency radiation emitted from Wi-Fi devices induce DNA damage in various tissues of rats?	2.4 GHz (Wi-Fi) - (SAR 0.00014 W/kg (body))	24h/365d	Mehmet Zulkuf Akdag, Suleyman Dasdag, Fazile Canturk, Derya Karabulut, Yusuf Caner, Nur Adalier	2016-(1)
" ...it was found that the % tail DNA values of the brain, kidney, liver, and skin tissues of the rats in the experimental group increased more than those in the control group. The increase of the DNA damage in all tissues was not significant (p > 0.05). However the increase of the DNA damage in rat testes tissue was significant (p < 0.01)."				
What is harmful for male fertility: Cell phone or the wireless internet?	-	-	Mehmet Erol Yildirim, Mehmet Kaynar, Huseyin Badem, Mucahit Cavis, Omer Faruk Karatas, Ersin Cimentepe	2015-(5)
Humans who use wireless internet: Decreased total motile sperm count and the progressive motile sperm count. Negative correlation between wireless internet usage duration and the total sperm count.				
Effects of 2.4 GHz radiofrequency radiation emitted from Wi-Fi equipment on microRNA expression in brain tissue	2.4 GHz (Wi-Fi) - (SAR 0.00014-0.0015 W/kg)	24h / 365d	Suleyman Dasdag, Mehmet Zulkuf Akdag, Mehmet Emin Erdal, Nurten Erdal, Ozlem	2015-(7)

	(body-1g))		Izci Ay, Mustafa Ertan Ay, Senay Gorucu Yilmaz, Bahar Tasdelen, Korkut Yegin	
Exposed rats: Some miRNAs expression where altered, for example miR-107 expression was 3.3 times lower and miR-106b-5p expression was 3.65 times lower.				
Effects of acute exposure to WIFI signals (2.45 GHz) on heart variability and blood pressure in Albinos rabbit	2.45 GHz (Wi-Fi)	1h/1d	Linda Saili, Amel Hanini, Chiraz Smirani, Ines Azzouz, Amina Azzouz, Mohsen Sakly, Hafedh Abdelmelek, Zihad Bouslama	2015-(6)
" acute exposure of rabbits to WIFI increased heart frequency (+22%) and arterial blood pressure (+14%). moreover, analysis of ECG revealed that WIFI induced a combined increase of PR and QT intervals."				
2.45 GHz Microwave Radiation Impairs Learning and Spatial Memory via Oxidative/Nitrosative Stress Induced p53 Dependent/Independent Hippocampal Apoptosis: Molecular Basis and Underlying Mechanism	2.45 GHz (CW) - 0.0248 mW/cm ² (SAR 0.0146 W/kg (body))	2h/15d ,30d, 60d	Saba Shahin, Somanshu Banerjee, Surya Pal Singh, Chandra Mohini Chaturvedi	2015-(1)
Exposed Rats: Increased oxidative/nitrosative stress. Increased apoptosis in hippocampal subfield neuronal and non-neuronal cells. Learning and spatial memory deficits are also suggested.				
Oxidative stress of brain and liver is increased by Wi-Fi (2.45GHz) exposure of rats during pregnancy and the development of newborns	2.45 GHz (Wi-Fi)	1h/ pregnancy + 15d	Ömer Çelika, Mehmet Cemal Kahyac, Mustafa Nazıroğlu	2015-(1)
Exposed rats: Increased lipid peroxidation levels in the brain and liver. Decreased glutathione peroxidase activity. Decreased concentrations of vitamin A, vitamin E and β-carotene in the brain and liver and decreased concentrations of glutathione and vitamin C also in the brain.				
Klebsiella pneumonia, a Microorganism that Approves the Non-linear Responses to Antibiotics and Window Theory after Exposure to Wi-Fi 2.4 GHz Electromagnetic Radiofrequency Radiation	2.45 GHz (Wi-Fi)	3-8h/ 1d	M. Taheri, S. M. J. Mortazavi, M. Moradi, Sh. Mansouri, F. Nouri, S. A. R. Mortazavi, F. Bahmanzadegan	2015-(6)
Exposure to non-ionizing radiation provokes changes in rat thyroid morphology and expression of HSP-90	2.45 GHz (CW) - (SAR 0.036-0.16 (body))	30min /1-10 d	Maria J. Misa-Agustiño, Teresa Jorge-Mora, Francisco J. Jorge-Barreiro, Juan Suarez-Quintanilla, Eduardo Moreno-Piquero, Francisco J. Ares-Pena, Elena López-Martín	2015-(13)
Exposed rats: Depending on exposure time and intensity peripheral follicles are bigger or smaller. Decreased peripheral septa.				
The effects of long-term exposure to a 2450 MHz electromagnetic field on growth and pubertal development in female Wistar rats	2.45 GHz - (SAR 0.1 W/kg (body))	1h/ pregnancy + 21d	Ozlem Sangun, Bumin Dundar, Hakan Darici, Selcuk Comlekci, Duygu Kumbul Doguc, Suheyla Celik	2015-(1)
Exposed rats (prenatally): Decreased mass gain per day. Later puberty. Increased brain and ovary total oxidant status and oxidative stress values. Increased serum LH levels.				
Effects of Prenatal and Postnatal Exposure of Wi-Fi on Development of Teeth and Changes in Teeth Element Concentration in Rats	2.45 GHz (217 Hz modulated) - (SAR 0.009 W/kg (head))	2h/42 d	Zülfikar Zahit Çiftçi, Zühal Kırzioğlu, Mustafa Nazıroğlu, Özlem Özmen	2015-(9)
Exposed rats: Increased iron and strontium concentrations. Decreased boron, copper, and zinc concentrations, that are related to oxidative stress.				
Effects of Electromagnetic Waves on Brainwaves under Logically Reasoning Status	2.45 GHz (Wi-Fi) - 0.005-0.025 mW/cm ²	-	Fu-Chien Kao, Shiping R. Wang, Chih-Chia Chen, Yun-Kai Lin, Chih-Hsun Huang	2015-(5)
" This research from the prospective of Cognitive Neuroscience investigates the effect of high frequency EMW to the energy distribution of human brainwave characteristic band. The experiment extracts energy of brainwave characteristic band of Wi-Fi users and analyze the changes according to different EWM intensity. The experimental results show that β brainwaves energy gradually increase and δ, θ brainwaves energy gradually decrease while the intensity of electromagnetic wave gradually increases. This means that the intensity of the electromagnetic wave would actually affect people's brainwaves under logically reasoning." {From the publication}				
Effects of Wi-Fi (2.45 GHz) Exposure on Apoptosis, Sperm Parameters and Testicular Histomorphometry in Rats: A Time Course Study	2.45 GHz (Wi-Fi)	1h, 7h/60 d	Saeed Shokri, Aiob Soltani, Mahsa Kazemi, Dariush Sardari, Farshid Babapoor Mofrad	2015-(10)

" Both 1-hour and 7-hour groups showed a decrease in sperm parameters in a time dependent pattern. In parallel, the number of apoptosis-positive cells and caspase-3 activity increased in the seminiferous tubules of exposed rats. The seminal vesicle weight reduced significantly in both 1-hour or 7-hour groups in comparison to the control group" {From the publication}				
Impact of 2.45 GHz microwave radiation on the testicular inflammatory pathway biomarkers in young rats: The role of gallic acid ("chemical remedy")	2.45 GHz (217 Hz modulated) - (SAR 3.21 W/kg (body))	3h/30 d	Mustafa Saygin, Halil Asci, Ozlem Ozmen, Fatma Nihan Cankara, Dilnur Dincoglu, Ilter Ilhan	2015-(14)
Exposed rats: Increased Malondialdehyde and total oxidant status levels. Decreased total antioxidant status activities. Increased Prostaglandin E2 and calcitonin gene related peptide staining in testes tubules. Decreased spermatozoa and spermatozoon counts.				
Impact of L-carnitine and Selenium Treatment on Testicular Apoptosis in Rats Exposed to 2.45 GHz Microwave Energy ("chemical remedy")	2.45 GHz (217 Hz modulated) - (SAR 3.25 W/kg (body))	1h/28 d	M. Saygin, S. Caliskan, M.F. Ozguner, N. Gumral, S. Comlekci, N. Karahan	2015-(7)
Exposed rats: Testicular apoptosis and down-regulated expression of caspase-8.				
EMF radiation at 2450 MHz triggers changes in the morphology and expression of heat shock proteins and glucocorticoid receptors in rat thymus	2.45 GHz (CW) - (SAR 0.017-0.161 W/kg (body))	30min /1d	M.J. Misa-Agustiño, J.M. Leiro-Vidal, J.L. Gomez-Amoza, M.T. Jorge-Mora, F.J. Jorge-Barreiro, A.A. Salas-Sánchez, F.J. Ares-Pena, E. López-Martín	2015-(1)
Exposed rats: Morphological changes (increased distribution of blood vessels, appearance of red blood cells and hemorrhagic reticuloepithelial cells) Decreased levels of Hsp90 (at max. power level).				
Estudio de marcadores biológicos de estrés en la glándula tiroides y en el timo de rata en un modelo experimental de radiación subtérmico a 2,45 GHz	2.45 GHz (CW) - (SAR 0.017-0.161 W/kg (body))	30min /1d, 10d	María José Misa Agustiño	2014-(196)
" Conclusiones:1.- En esta tesis hemos conseguido un modelo animal para el estudio de efectos subtérmicos, por exposición a microondas, mediante la puesta a punto de un sistema experimental de radiación en una cámara GTEM.2.- La exposición a la radiación con microondas de ratas Sprague-Dawley en una cámara GTEM con frecuencia de 2,45 GHz, ha demostrado que la glándula tiroides es sensible, tanto en exposición aguda como repetida, para niveles de SAR subtérmicos.3.- La radiación controlada durante 30 minutos, con niveles de SAR subtérmicos, de los animales expuestos en la cámara GTEM, expresan valores de Hsp90 y Hsp70 que determinan niveles de estrés celular en la glándula tiroides y en timo.4.- Las glándulas tiroides de ratas expuestas a radiación microondas de 2,45 GHz, mostraron un descenso en las proteínas de estrés celular térmico, Hsp90 y Hsp70, de forma transitoria por mecanismos no térmicos.5.- La glándula tiroides se mostró más sensible a radiación microondas con potencias de 3 W para los niveles de proteína Hsp90.6.- La exposición a radiación con microondas, en la glándula tiroides, bajo las condiciones experimentales descritas anteriormente, no mostró signos de lesión ni de apoptosis en la estructura glandular que indique un daño incipiente, causado por la radiación no ionizante.7.- La exposición aguda/ repetida de la glándula tiroides a 2,45 GHz en el modelo experimental de diatermia a niveles subtérmicos en ratas, provoca cambios morfológicos visibles: A) Una hipertrofia glandular en relación al SAR y/o el número de exposiciones. B) Una modificación de la distribución de la proteína Hsp90 asociada a las membranas y las células parafoliculares. Estos efectos pueden no ser exclusivos o directamente producidos por la radiación, añadiéndose efectos indirectos del hipotálamo.8.- La exposición a la radiación a 2,45 GHz de animales pequeños ha demostrado que el timo también es vulnerable, a niveles de SAR subtérmicos. La radiación causó un descenso transitorio de los valores de la proteína Hsp90, que determinó los niveles de estrés celular en el timo, por mecanismos no térmicos. No aparecieron modificaciones apreciables de los niveles de Hsp70 en el timo.9.- La recuperación de los niveles basales de la proteína Hsp90, en el timo, fue más tardía para potencias de 3 W. Al igual que en tiroides, a esta potencia la glándula se mostró más resistente a su recuperación a niveles basales, después de transcurridas 24 horas de la exposición a radiación no ionizante.10.- El estudio combinado de los niveles de proteínas de estrés térmico (Hsp90 y Hsp70) y los cambios morfológicos que han tenido lugar en el tejido tímico, por efecto de la radiofrecuencia a 2,45 GHz con niveles de SAR subtérmicos, nos han permitido determinar que: a) La radiación no ionizante, a niveles subtérmicos, constituye un agente modulador de la proteína Hsp90 pero no de la Hsp70, tanto de forma cuantitativa como cualitativa en el tejido tímico. b) Hay una relación directa entre la intensidad aplicada de SAR en la radiación y el estrés causado al animal, medido por temperatura rectal, así como los signos tisulares que están en relación con un incremento de la permeabilidad endotelial y de la vascularización en el timo.11.- En función de los cambios encontrados en la morfología y en la estructura celular de la glándula tiroides y del timo sería necesario realizar más estudios en ambos tejidos que determinen el umbral entre los efectos beneficiosos y tóxicos para poder establecer un balance terapéutico." {From the publication}				
Structural and Ultrastructural Study of Rat Testes Influenced by Electromagnetic Radiation	2.45 GHz - 2.8 mW/cm2	3h/21 d	Viera Almasiiová, Katarína Holovská, Viera Cigánková, Enikő Račeková, Kamila Fabianová, Marcela Martončíková	2014-(1)
Exposed rats: Shape irregularities in the seminiferous tubules. Appearance of empty spaces in seminiferous epithelium. Groups of sloughed epithelial cells found inside the lumina of tubules. Striveled Sertoli cells inside locations of basal compartment of seminiferous epithelium. Etc...				
Therapeutic approaches of melatonin in microwave radiations-induced oxidative stress-mediated toxicity on male fertility pattern of Wistar rats ("chemical remedy")	2.45 GHz - 0.21 mW/cm2 (SAR 0.14 W/kg (body))	2h/45 d	Ramovatar Meena, Kajal Kumari, Jitendra Kumar, Paulraj Rajamani, H. N. Verma, Kavindra Kumar Kesari	2014-(1)
Electromagnetic radiation (Wi-Fi) and epilepsy induce calcium entry	2.45 GHz (217 Hz)	1h/1d	Vahid Ghazizadeh, Mustafa Naziroglu	2014-(15)

and apoptosis through activation of TRPV1 channel in hippocampus and dorsal root ganglion of rats	modulated) - 0.012 mW/cm ²			
Exposed Rats (epileptic): Apart from Ca ²⁺ increase there are induced additional effects like apoptosis and oxidative damages. Induction of Ca ²⁺ influx via the TRPV1 channels can result on cell death in the hippocampal and dorsal root ganglion.				
2450 MHz electromagnetic field effect on the rat thyroid tissue; Protective role of selenium and L-Carnitine ("chemical remedy")(in Turkish)	2.45 GHz - (SAR 0.054 W/kg)	1h/28 d	Ahmet Koyu, Nurhan Gümral, Halil Aşçı, Alpaslan Gökçimen, Meltem Özgöçmen, Nilüfer Özdamar	2014-(9)
" T3 and T4 levels decreased significantly. thyroid follicle degeneration, fibrosis, vascular congestion and mononuclear cell infiltration increased significantly."				
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 ("chemical remedy")	2.45 GHz (217 Hz modulated) - 0.0036 mW/cm ² (SAR 0.02 W/kg (body))	1h/30 d	Hatice Ş. Gürler, Birşen Bilgici, Ayşegül K. Akar, Leman Tomak, Abdülkerim Bedir	2014-(5)
Exposed rats: Increased 8-OHdG level in both plasma and brain tissue (DNA damage). Increased protein oxidation only in plasma.				
Effects of melatonin on Wi-Fi-induced oxidative stress in lens of rats ("chemical remedy")	2.45 GHz (217 Hz modulated) - 0.0001 mW/cm ² (SAR 0.14 W/kg (body))	1h/30 d	Levent Tök, Mustafa Nazıroğlu, Salih Doğan, Mehmet Cemal Kahya, Özlem Tök	2014-(6)
" higher lipid peroxidation levels, lower glutathione peroxidase (GSH-Px) activity."				
Effect of long-term exposure of 2.4 GHz radiofrequency radiation emitted from Wi-Fi equipment on testes functions	2.45 GHz (Wi-Fi) - (SAR 0.0024 W/kg (1g))	24h/3 65d	Suleyman Dasdag , Muzaffer Tas , Mehmet Zulkuf Akdag, Korkut Yegin	2014-(1)
" head defects increased in the exposure group while weight of the epididymis and seminal vesicles, seminiferous tubules diameter and tunica albuginea thickness were decreased in the exposure group."				
2.45-GHz microwave irradiation adversely affects reproductive function in male mouse, Mus musculus by inducing oxidative and nitrosative stress	2.45 GHz (CW) - 0.0298 mW/cm ² (SAR 0.018 W/kg)	2h/30 d	S. Shahin, V. Mishra, S. P. Singh, C. M. Chaturvedi	2014-(1)
" significant decrease in sperm count and sperm viability along with the decrease in seminiferous tubule diameter and degeneration of seminiferous tubules. reduction in testicular 3β HSD activity and plasma testosterone levels, increased expression of testicular i-NOS."				
Short-duration exposure to 2.45 GHz microwave radiation induces DNA damage in Sprague Dawley rat's reproductive systems	2.45 GHz - (SAR 0.48-4.30 W/kg)	10min /1d	M. R. Usikalu, O. O. Obembe, M. L. Akinyemi, J. Zhu	2013-(8)
" significant differences in the Olive moment and % DNA in the blood, hyperchromasia in the ovary, reduction in the number of germ cells and cell disorganization in the testis."				
Genome toxicity upshot of low 2.45 GHz microwave radiation exposures on Sprague Dawley rats	2.45 GHz - (SAR 0.48-4.30 W/kg)	24h/8 d	B. N. Aweda, C. P. Osika, J. H. Xiu, N. Dong, J. Y. Park	2013-(9)
" Densitometric gel analysis demonstrated distinctly altered band patterns within the range of 40 and 120 bp in exposed samples and in the tail DNA of the same animals before exposure compared with control. Results were re-affirmed with SCGE (comet assay) for the same cells. Different tissues had different sensitivities to exposures with the brains having the highest. DNA damages were sex-independent. There was statistically significant difference in the Olive moment and % DNA in the tail of the exposed tissues compared with control (p < 0.05). Observed effects were attributed to magnetic field interactions and production of reactive oxygen species. We conclude that low SAR 2.45 GHz MW radiation exposures can induce DNA single strand breaks and the direct genome analysis of DNA of various tissues demonstrated potential for genotoxicity." (From the publication)				
Microwaves irradiation experiments on biological samples	2.45 GHz (Wi-Fi) - 0.005 mW/cm ²	24h/1 4-25d	Emanoil Surducun, Vasile Surducun, Anca Butiuc-Keul, Adela Halmagyi	2013-(16)
" reference and irradiated plants were phenotypically similar, but the growth was strongly correlated with microwave irradiation. the protein metabolism was activated under microwave irradiation, demonstrated by higher values of total soluble protein content in irradiated plants."				
Modulation of wireless (2.45 GHz)-induced oxidative toxicity in laryngotracheal mucosa of rat by melatonin ("chemical remedy")	2.45 GHz (217 Hz modulated) - 0.0001 mW/cm ²	1h/28 d	Giray Aynali, Mustafa Nazıroğlu, Ömer Çelik, Mustafa Doğan, Murat Yarıktaş, Hasan Yasan	2013-(6)

	cm2 (SAR 0.14 W/kg (body))			
" lipid peroxidation levels were significantly higher, activity of glutathione peroxidase was lower."				
Effects of olive leave extract on metabolic disorders and oxidative stress induced by 2.45 GHz WIFI signals ("chemical remedy")	2.45 GHz (Wi-Fi)	1h/21 d	Myriam Ben Salah, Hafedh Abdelmelek, Manef Abderraba	2013-(9)
2.45 GHz Microwave Irradiation-Induced Oxidative Stress Affects Implantation or Pregnancy in Mice, Mus musculus	2.45 GHz (CW) - 0.033 mW/cm2 (SAR 0.023 W/kg)	2h/45 d	Saba Shahin, Vineet Prakash Singh, Ritesh K. Shukla, Alok Dhawan, Ravi Kumar Gangwar, Surya Pal Singh, Chandra Mohini Chaturvedi	2013-(25)
" low level of MW irradiation-induced oxidative stress not only suppresses implantation, but it may also lead to deformity of the embryo in case pregnancy continues. MW radiation-induced oxidative stress by increasing ROS production in the body may lead to DNA strand breakage in the brain cells and implantation failure/resorption or abnormal pregnancy in mice."				
2.45-Gz wireless devices induce oxidative stress and proliferation through cytosolic Ca ²⁺ influx in human leukemia cancer cells	2.45 GHz (217 Hz modulated) - (1.3-2.5 W/kg)	1h, 2h, 12h, 2 4h/1d	Mustafa Nazıroğlu, Bilal Çiğ, Salih Doğan, Abdulhadi Cihangir Uğuz, Selin Dilek, Dahdouh Faouzi	2012-(8)
" higher extent of lipid peroxidation, cytosolic free Ca ²⁺ (radiation-time dependent) and cell numbers, reduced glutathione, glutathione peroxidase, vitamin C and cell viability values."				
Pathophysiology of Microwave Radiation: Effect on Rat Brain	2.45 GHz - 0.21 mW/cm2 (SAR 0.14 W/kg (body))	2h/45 d	Kavindra Kumar Kesari, Sanjay Kumar, Jitendra Behari	2012-(10)
" significant decrease in the level of pineal melatonin, significant increase in increateine kinase, caspase 3, and calcium ion concentration was observed in whole brain."				
Glucose administration attenuates spatial memory deficits induced by chronic low-power-density microwave exposure ("chemical remedy")	2.45 GHz - (SAR 0.2 W/kg (body))	3h/30 d	Yonghui Lu, Shangcheng Xu, Mindi He, Chunhai Chen, Lei Zhang, Chuan Liu, Fang Chu, Zhengping Yu, Zhou Zhou, Min Zhong	2012-(1)
" MW exposure induced spatial learning and memory impairments in rats. hippocampal glucose uptake was also reduced by MW exposure."				
Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices	2.437 GHz (Wi-Fi) - (SAR 0.091 W/kg)	24h / 140d	Halil I. Atasoy, Mehmet Y. Gunal, Pinar Atasoy, Serenay Elgun, Guler Bugdayci	2012-(7)
" significant increases in serum 8-hydroxy-2-deoxyguanosine levels and 8-hydroxyguanosine staining in the testes (DNA damage), decreased levels of catalase and glutathione peroxidase activity."				
Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation	2.4 GHz (Wi-Fi) - 0.0005-0.001 3 mW/cm2	4h/1d	Conrado Avendano, Ariela Mata, Cesar A. Sanchez Sarmiento, Gustavo F. Doncel	2012-(9)
" significant decrease in progressive sperm motility and an increase in sperm DNA fragmentation."				
Electromagnetic fields at 2.45 GHz trigger changes in heat shock proteins 90 and 70 without altering apoptotic activity in rat thyroid gland	2.45 GHz - (SAR 0.017-0.16 W/kg (body))	30min /1d	María José Misa Agustiño, José Manuel Leiro, María Teresa Jorge Mora, Juan Antonio Rodríguez González, Francisco Javier Jorge Barreiro, Francisco José Ares-Pena, Elena López Martín	2012-(8)
" ninety minutes after radiation, HSP- 90 and HSP-70 had decreased significantly. twenty-four hours after radiation, HSP-90 had partially recovered and HSP-70 had recovered completely. there were few indications of lesions in the glandular structure and signs of apoptosis were negative in all radiated animals."				
Effects of Green Tea Catechin on Microsomal Phospholipase A2 Activity and Arachidonic Acid Cascade in Rat Lung Exposed to Microwave ("chemical remedy")(in Korean)	2.45 GHz	15min /1d	Mi-Ji Kim	2012-(5)
" the lung microsomal PLA2 activity was 30% greater, the percentage of phosphatidylethanolamine (PE) hydrolyzed in the lung microsome increased by 47%, The formation of thromboxane A2 (TXA2) in the lung microsome was 50% greater, the formation of prostacyclin (PGI2) in the lung microsome was 31% lower, the lung microsomal thiobarbituric acid reactive substances (TBARS) concentration, which can be used as a index of lipid peroxide was 34% greater."				

Protective effects of β -glucan against oxidative injury induced by 2.45-GHz electromagnetic radiation in the skin tissue of rats ("chemical remedy")	2.45 GHz (217 Hz modulated) - 0.165 mW/cm ² (SAR 0.064 W/kg)	1h/28 d	Ali Murat Ceyhan, Vahide Baysal Akkaya, Şeyma Celik Güleçol, Betül Mermi Ceyhan, Fehmi Özgüner, WenChieh Chen	2012-(7)
" significant increase in MDA levels and CAT activity, while the activities of SOD and GSH-Px decreased in skin tissues."				
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 ("chemical remedy")	2.45 GHz (217 Hz modulated) - 0.0001 mW/cm ² (SAR 0.14 W/kg (body))	1h/1d	M. Nazıroğlu, Ö. Çelik, C. Özgül, B. Çiğ, S. Doğan, R. Bal, N. Gümral, A.B. Rodríguez, J.A. Pariente	2012-(10)
" Lipid peroxidation (LP), cell viability and cytosolic Ca(2+) values in root ganglion neurons were higher."				
Selenium and l Carnitine Reduce Oxidative Stress in the Heart of Rat Induced by 2.45GHz Radiation from Wireless Devices ("chemical remedy")	2.45 GHz (217 Hz modulated) - 0.032 mW/cm ² (SAR 0.14 W/kg (body))	1h/28 d	Yasin Türker, Mustafa Nazıroğlu, Nurhan Gümral, Ömer Çelik, Mustafa Saygın, Selçuk Çömlekçi, Manuel Flores-Arce	2011-(11)
" lipid peroxidation (LP) levels were higher in the radiation-exposed groups. concentrations of vitamins A, C, and E were lower in the irradiated-only group."				
The Investigation of the protective effects of hydro-alcoholic extract of sea buckthorn (Hippophaerhamnoides L.) in spermatogenesis of rat after exposure of Wi-Fi radiation ("chemical remedy")	2.45 GHz (Wi-Fi)	4h/48 d	Zohreh Hosseinzadeh, Manzarbanoo Shojaeefard, Mansooreh Hooshiyar, Leila Firozi Dalvand, Mehdi Pooladi	2011-(8)
" a significant difference was found in sperm motility."				
Effects of Wi-Fi signals on the p300 component of event-related potentials during an auditory hayling task	2.45 GHz (Wi-Fi) - 0.000063 mW/cm ²	-	Argiro E. Maganioti, Charalabos C. Papageorgiou, Chrissathi D. Hountala, Miltiades A. Kyprianou, Andrea D. Rabavilas, George N. Papadimitriou, Christos N. Capsalis	2011-(14)
" P300 amplitude values were found to be significantly lower in the response inhibition condition than in the response initiation and baseline conditions, decreased P300 amplitudes of males in comparison to female subjects only at the presence of EMF."				
Somatic and Genetic Effects of Low Sar 2.45GHz Microwave Radiation on Wistar Rats	2.45 GHz - (SAR 0.48-2.39 W/kg)	-	Mojisola Rachael Usikalu	2010-(147)
Exposed rats: Decreased cumulative time spent in the open arms. Exploratory behaviour affected. Decreased sperm concentration and gross motility. Increased percentage of abnormal sperm cells. Decreased reproductive organ weights. Increased frequency of chromosomal aberrations. Etc.				
Mutagenic response of 2.45 GHz radiation exposure on rat brain	2.45 GHz (50 Hz modulated) - 0.34 mW/cm ² (SAR 0.11 W/kg (body))	2h/35 d	Kavindra Kumar Kesari, J. Behari, Sanjay Kumar	2010-(10)
Exposed rats: Increased comet head, tail length and tail movement in brain cells. Decreased glutathione peroxidase and superoxide dismutase levels. Increased catalase levels. Decrease in histone kinase.				
Wi-Fi Electromagnetic fields exert gender related alterations on EEG	2.4 GHz (Wi-Fi) - 0.000063 mW/cm ²	-	Argiro E. Maganioti, Charalabos C. Papageorgiou, Chrissathi D. Hountala, Miltiades A. Kyprianou, Andrea D. Rabavilas, George N. Papadimitriou, Christos N. Capsalis	2010-(8)
Exposed humans: Reduced energies of alpha and beta band only in female subjects.				
Effects of Selenium and L-Carnitine on Oxidative Stress in Blood of Rat Induced by 2.45-GHz Radiation from Wireless Devices ("chemical remedy")	2.45 GHz (217 Hz modulated) -	1h/28 d	Nurhan Gumral, Mustafa Nazıroglu, Ahmet Koyu, Kurtulus	2009-(1)

	0.032 mW/cm ² (SAR 0.14 W/kg (body))		Ongel, Omer Celik, Mustafa Saygin, Mesud Kahriman, Sadettin Caliskan, Mustafa Kayan, Osman Gencel, Manuel F. Flores-Arce	
Exposed rats: Increased lipid peroxidation levels in plasma and erythrocytes. Decreased glutathione peroxidase values.				

Phone Base Station MW Hazards

/ Papers listed: 41

Phone Base Station MW Hazards

Title	Authors	Year (pages)
Effect of Base Transceiver Station (BTS) waves on some blood factors in domestic pigeons: an experimental study	Hesam Akbari, Sanaz Khoramipour, Seyed Kamal Eshagh Hossaini, Roya Mafigholami, Behnaz Moradighiasabadi	2021-(7)
Evaluation Study of Radio Frequency Radiation Effects from Cell Phone Towers on Human Health	Marwah T. Ali, Yousif R. Muhsen, Raad Farhood Chisab, Sameeha N. Abed	2021-(10)
" In this paper, two study groups were selected. The first one lived in the area with three installed towers at distance of 50–100 m between them. The second group resided in the area where towers were installed outside its borders at distances of more than 500 m. The results show that the first group suffers from a health problem much more than the second one." {From the publication}		
The effects of base station as an electromagnetic radiation source on flower and cone yield and germination percentage in Pinus brutia TenPinus brutia	Halil Baris Ozel, Mehmet Cetin, Hakan Sevik, Tugrul Varol, Berkant Isik, Barbaros Yaman	2021-(1)
The pines exposed to the radiation of a mobile phone station at 100m compared to those having it at 800m have 11 times less number of flowers and 7 times less number of cones. There is also a three-times difference in terms of the germination percentage of the seeds subject to the study.		
Effects of radiofrequency electromagnetic radiation emitted from a mobile phone base station on the redox homeostasis in different organs of Swiss albino mice	Mary Zosangzuali, Marina Lalremruati, C. Lalmuansangi, F. Nghakliana, Lalrinthara Pachuau, Priyanka Bandara, Zothan Siama	2021-(1)
Exposed mice: Decreased glutathione-s-transferase and superoxide dismutase activities in brain. Increased malondialdehyde (an index of lipid peroxidation) levels in brain. Decreased RBC count with increased WBC count in mice subjected to 12 hr/day and 24 hr/day exposures.		
What is the radiation before 5G? A correlation study between measurements in situ and in real time and epidemiological indicators in Vallecas, Madrid	Isabel López, Nazario Félix, Marco Rivera, Adrián Alonso, Ceferino Maestú	2021(1)
The Effect of Continuous Low Intensity Exposure to Electromagnetic Fields from Radio Base Stations to Cancer Mortality in Brazil	Nádia Cristina Pinheiro Rodrigues, Adilza Condessa Dode, Mônica Kramer de Noronha Andrade, Gisele O'Dwyer, Denise Leite Maia Monteiro, Inês Nascimento Carvalho Reis, Roberto Pinheiro Rodrigues, Vera Cecília Frossard, Valéria Teresa Saraiva Lino	2020-(9)
" In capitals where RBS radiofrequency exposure was higher than 2,000/antennas-year, the average mortality rate was 112/100,000 for all cancers. The adjusted analysis showed that the higher the exposure to RBS radiofrequency, the higher cancer mortality. The highest adjusted risk was observed for cervix cancer (Rate Ratio = 2.18). The spatial analysis showed that the highest RBS radiofrequency exposure was observed in a city in southern Brazil, which also showed the highest mortality rate for all types of cancer and specifically for lung and breast cancer. Conclusion. The balance of our results indicates that the exposure to radiofrequency electromagnetic fields from RBS increases the rate of death by all types of cancer." {From the publication} RBS: Radio Base Stations.		
Effect of cell tower radiations on development of zebrafish embryos	Gayathri N., Dubey Priti, Wasnik Nitin	2020-(1)
Physiological Study Comprising the Sequelae of Magnetic Radiation on Human	Wissam Sajid Hashim, Azal Hamoody Jumaa, Noor Thamer Alsaadi, Ayad Gaber Arean	2020-(5)
People living in the vicinity of mobile phone mast are more propense to a significant elevation in transaminases, blood calcium, blood potassium, total serum cholesterol, triacylglycerols, very low density lipoprotein, and low density lipoprotein.		
The Chromosomal DNA Damage in Buccal Mucosa Cells among Schools Children in The Vicinity Of Mobile Base Stations in Selangor	Raihanah Chokeli, Nur Azira Baharuddin, Vivien How, Nurul Syazani Yuswir, Shariza Afini Mohd Noor, Ho Yu Bin, Lim Poh Ying, Juliana Jalaludin, Zailina Hashim	2019-(6)
The Effect of mobile electromagnetic waves on large biomacromolecules such as hemoglobin is polarization dependent	N. Hamed, A. Banaei, M. Saviz, R. Faraji Dana, A. A. Moosavi-Movahedi	2019-(1)
They show that exposure causes conformational changes in proteins, in particular they experimented with Adult Hemoglobin, and that those changes are significantly greater in circularly polarized radiation (as those produced by the mobile phone bases stations in urban areas).		
The Effect of Radio Frequency (RF) on Proteomics Pattern of Brain Tissue in	Maryam Sadat Heidari Tekyeh,	2019-(8)

male Wister Rats	Mino Shahani, Hessam Sepasi Tehrani, Azadeh Hekmat	
<p>" Tissue exposed to nonstandard waves showed similar pattern of changes in the expression of some proteins, which have key roles in the induction of apoptosis. The expressions of key proteins including Bcl-2-A1, Bid, Neurofilament and Cytochrome Oxidase were decreased. Expression or suppression of apoptosis related proteins such as BCL-2 in rat brain proteome exposed to standard RF900 MHz (at 180m and beyond), can serve as a biomarker of brain activity, memory and sleep. RF radiated from transmission antenna in urban and standard spaces may not be carcinogenic, but, individuals exposed in nonstandard distances to those antennas (less than 180meter) may be at risk." {From the publication}</p>		
Effect of radio frequency electromagnetic field from mobile phones' base station antennas on maturation of rat erythrocytes	Sanjiv Singh, Amit Pawar	2019-(1)
<p>Exposed rats: Increased polychromatic erythrocytes and increased frequency of micronucleated polychromatic erythrocytes.</p>		
Mobile Tower Radiation and Its Impacts on Child Health: a Study Conducted in an Ecologically Sensitive Area of Western Ghats	P. D. Premal, N. V. Eldhose	2019-(6)
<p>" In this paper, we have attempted to discover whether any relation exists between the RF exposure and the health of children under 15 years old. At some point of path of this work, twenty common diseases were considered. From our analysis, it has been discovered that five of them are very much related to RF exposure. Furthermore, the age group between ten to fifteen years is more vulnerable to mobile tower radiation, and boys are observed to be more affected than girls." {From the publication}</p>		
Effect of Electromagnetic Field on Some Behaviour Modality of Honeybee Colonies (Apis mellifera) in Field Conditions	Ivana Tlak Gajger, Marinko Vilic, Perica Tucak, Kresimir Malaric	2019-(4)
<p>Exposed honeybees: At beginning of experiment honeybees were distress and within time they moderated described behavioural modality.</p>		
Bio-physical effects of radiofrequency electromagnetic radiation (RF-EMR) on blood parameters, spermatozoa, liver, kidney and heart of albino rats	E. A. Adebayo, A. O. Adeeyo, M. A. Ogundiran, O. Olabisi	2018-(9)
<p>" Impacts of radiation were noted in the exposed groups of rats. There was rise in white blood cells with variations in other blood parameters; the sperm motility and sperm count of the exposed rats is lower than the control; the liver of the exposed rats shows pronounced dilated sinusoids, distorted architecture, hyperchromatic nuclei, congested central vein, with change of hepatocytes structure; the heart shows gross distortion of cardiac muscular architecture with distorted irregular cardiac muscle fibres and wider interfibres spaces; kidney showing hyperchromatic nuclei, gradual loss and degeneration of flattened squamous epithelial cells lining and testis shows grossly distorted seminiferous tubules and epididymis with loss of cellular structure and an area of inflammatory changes with complete absence of spermatozoa, which may lead to low fertility. This study shows that radiofrequency electromagnetic radiation may induce morphological changes in various tissues of living systems in rat." {From the publication}</p>		
Yield and Nutrient Depletion of Tomatoes by Radio-Frequency Radiation Exposure from Base Transceiver Stations in Ogbomoso, Nigeria	Dauda Biodun Amuda, Funmilayo Grace Oni, Olatunde Michael Oni	2018-(7)
<p>" The variation noticed in the tomato yield of the exposed group at the nearest distance and the contents of magnesium and potassium of the exposed groups at all the distances were significantly different when compared with the control group. It is imperative from this study to state that significant effect of RFR from BTS was noticed in plant, thus suggesting that regulations be put in place to check the proliferation of BTS close to residential buildings." {From the publication}</p>		
Experimental and simulation study of electromagnetic radiation (EMR) effect on human thyroid tissue	Khitam Y. Elwasife, M. Abujami, I. Abdelaziz, M. Shabat	2018-(10)
<p>" A total of 120 volunteer children (aging 6–12 years) participated in the experiment. They were divided into three groups: the first group (30 children) served as control group who are live outside the area of radiation, and two experimental groups, who lived, more than 5 years, in an area nearby mobile phone base station (100–150 m)." {From the publication}</p> <p>" Electromagnetic field exposure caused a decrease in TSH. TSH level in children tissue decreased by 28.8%, compared to the control level." {From the publication}</p>		
Phenotypic and genotypic characterization of antioxidant enzyme system in human population exposed to radiation from mobile towers	Sachin Gulati, Anita Yadav, Neeraj Kumar, Kanu Priya, Neeraj K. Aggarwal, Ranjan Gupta	2017-(9)
<p>" ... people living within 100s of meters from the tower receive 10,000 to 10,000,000 times stronger signal than required for mobile communication ... we have found a significantly lower mean value of manganese superoxide dismutase (MnSOD) enzyme activity, catalase (CAT) enzyme activity, and a high value of lipid peroxidation assay in exposed as compared to control subjects. Polymorphisms in antioxidant MnSOD and CAT genes significantly contributed to its phenotype. In the current study, a significant association of genetic polymorphism of antioxidant genes with genetic damage has been observed in human population exposed to radiations emitted from mobile towers."</p>		
Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations	Zothansiam, Mary Zosangzuali, Miriam Lalramdinpui, Ganesh Chandra Jagetia	2017-(11)
Effect of Mobile Tower Radiation on Birds in Bijapur District, Chhattisgarh	Devendra Kumar Durgam, Shweta Sao, R. K. Singh	2017-(9)
Radiofrequency radiation injures trees around mobile phone base stations / (some extra documentation here)	Cornelia Waldmann-Selsam, Alfonso Balmori-de la Puente, Helmut Breunig, Alfonso Balmori	2016-(16)
Electromagnetic radiation of mobile telecommunication antennas affects the abundance and composition of wild pollinators	A. Lázaro, A. Chroni, T. Tscheulin, J. Devalez, C. Matsoukas, T. Petanidou	2016-(10)

Electromagnetic Radiations: A Possible Impact on Population of House Sparrow (<i>Passer Domesticus</i>)	Virendra Abaji Shende, Kishor G. Patil	2015-(9)
Association of Exposure to Radio-Frequency Electromagnetic Field Radiation (RF-EMFR) Generated by Mobile Phone Base Stations with Glycated Hemoglobin (HbA1c) and Risk of Type 2 Diabetes Mellitus	Sultan Ayoub Meo, Yazeed Alsubaie, Zaid Almubarak, Hisham Almutawa, Yazeed AlQasem, Rana Muhammed Hasanato	2015-(10)
Influence of non ionizing radiation of base stations on the activity of redox proteins in bovines	Michael Hässig, Marietta Wullschleger, Hanspeter Naegeli, Jaqueline Kupper, Bernhard Spiess, Niels Kuster, Myles Capstick, Manuel Murbach	2014-(11)
" The present results coincide with the information from the literature, according to which NIR leads to changes in redox proteins, and that there are individuals who are sensitive to radiation and others that are not. However, the latter could not be distinctly attributed – there are cows that react clearly with one enzyme while they do not react with another enzyme at all, or even the inverse. The study approach of testing ten cows each ten times during three phases has proven to be appropriate. Future studies should however set the post-exposure phase later on." {From the publication}		
A cross-sectional case control study on genetic damage in individuals residing in the vicinity of a mobile phone base station	Gursatej Gandhi, Gurpreet Kaur, Uzma Nisar	2014-(11)
Significant Decrease of Clinical Symptoms after Mobile Phone Base Station Removal – An Intervention Study	Tetsuharu Shinjyo, Akemi Shinjyo	2014-(17)
The Exposure Effects of the Signals of Cell Phones on the Employees of Nablus and Jenin Municipalities	Omar Sary Muhammad Abu Subha	2014-(87)
" The electric field and the magnetic field values were calculated from the measured power flux density, which were less than the standard levels for exposure to EMR of cell phone towers. The measurements of tympanic temperature, blood oxygen saturation, heart pulse rate and arterial blood pressure (systolic and diastolic) of the selected employees were measured before and after exposure to signals of cell phone towers. This study shows that the health effects of signals of cell phone towers depend on the power flux density."		
The Effect of Electromagnetic Radiation from Antennas on Children in Schools in Nablus Area	Reham Issam Thaher	2014-(77)
" Measurements of blood oxygen saturation, heart pulse rate, arterial blood pressure (systolic and diastolic) were taken for the selected sample before and after the exposure to electromagnetic radiation from antennas. Positive correlation (Pearson Correlation Coefficient) was found for all measured variables. The statistical results showed that Pearson correlation coefficient (R) between the dependent variables (SBP, DBP, HPR, SPO2%) before and after the exposure to electromagnetic radiations from antennas is strong and the Probability (P) is < 0.05. "		
DNA and Chromosomal Damage in Residents Near a Mobile Phone Base Station	G. Gandhi, Jasmine Naru, Maninder Kaur, Gurpreet Kaur	2014-(12)
Mobile Tower Exposure affects on memory and Motor Co-ordination on Mice	Sanjeev K Maurya, Sudhir K. Upadhyay	2014-(5)
Investigation and Analysis on Electromagnetic Radiation from Cellular Base Station Transmitters and the Implications to Human Body	Opara K. Felix, Adigwe U. Gabriel, Agbaraji C. Emmanuel	2014-(15)
-Comment to the Letter to the Editor: Subjective Symptoms Related to GSM Radiation from Mobile Phone Base Stations: A Cross-sectional Study in Reply to the Comments by Seyed Mohammad Javad Mortazavi-Subjective symptoms related to GSM radiation from mobile phone base stations: a cross-sectional study-Subjective symptoms related to GSM radiation from mobile phone base stations: a cross-sectional study	Claudio Gómez-Perretta, Enrique A Navarro, Jaume Segura, Manuel Portolés	2014-(2)2013-(9)
Effect of Mobile Phone and BTS Radiation on the Heart Rate Variability	Barjinder Singh Saini, Anukul Pandey	2013-(5)
Effects of mobile phone and mobile phone tower radiations on human health	Mushtaq Ahmed Bhat, Vijay Kumar, Gupta .G.K	2013-(5)
A population-based case–control study of radiofrequency exposure in relation to childhood neoplasm	Chung-Yi Lia, Chih-Ching Liuc, Ya-Hui Changa, Li-Ping Choud, Ming-Chung Ko	2012-(1)
" This study noted a significantly increased risk of all neoplasms in children with higher-than-median RF exposure to MPBS. The slightly elevated risk was seen for leukemia and brain neoplasm, but was not statistically significant."		
How does long term exposure to base stations and mobile phones affect human hormone profiles?	Emad F. Eskander, Selim F. Estefan, Ahmed A. Abd-Rabou	2011-(5)
Mortality by neoplasia and cellular telephone base stations in the Belo Horizonte municipality, Minas Gerais state, Brazil	Adilza C. Dode, Mônica M.D. Leão, Francisco de A.F. Tejo, Antônio C.R. Gomes, Daiana C. Dode, Michael C. Dode, Cristina W. Moreira, Vânia A. Condessa, Cláudia Albinatti, Waleska T. Caiaffa	2011-(17)

Mobile Phone Mast Effects on Common Frog (Rana temporaria) Tadpoles: The City Turned into a Laboratory	Alfonso Balmori	2010-(5)
Epidemiological evidence for a health risk from mobile phone base stations	Vini G. Khurana, Lennart Hardell, Joris Everaert, Alicja Bortkiewicz, Michael Carlberg, Mikko Ahonen	2010-(5)
<p>" This new study partially confirms our preliminary results about microwave sickness resulting from exposure to emissions from GSM mobile phone BSs. Fatigue, irritability, lack of appetite, sleep troubles, depression and lack of concentration were especially related with GSM exposure. These results were independent of the main sociodemographic variables, other EMF exposures and anxiety about being irradiated. Nevertheless, we confirm that apprehension about modern technology could predict some symptoms, especially those related with sleep problems. Our results agree with those who claimed that by distorting perceptions of risk, disproportionate precaution might paradoxically lead to illness that would not otherwise occur. [39] However, health changes related with GSM exposure seem to occur in a manner unrelated with those fears. Finally, exposure was very low during the period and also very low in comparison with Spanish recommendations [40] and international guidelines. [41]."</p>		
Preliminary Study on the Induction of Sperm Head Abnormalities in Mice, Mus musculus, Exposed to Radiofrequency Radiations from Global System for Mobile Communication Base Stations	A. A. Otitolaju, I. A. Obe, O. A. Adewale, O. A. Otubanjo, V. O. Osunkalu	2009-(4)

Various MW Freq. Hazards Experiments

/ Papers listed: 90

Various MW Freq. Hazards Experiments

Title	Used freq. and power	Hours day / days	Authors	Year (pages)
Amelioration of Cell Phone and Wi Fi induced Pancreatic Damage and Hyperglycemia (Diabetes Mellitus) with Pomegranate and Vit E in Rats ("chemical remedy")	900 MHz + 2.4 GHz	1h/56 d	Hadiya Sibghatullah, Sibghatullah Muhammad Ali Sangi, Elsamoual Ibrahim Ahmedani, Ali Alqahtani, Abdulhakim Bawadekji, Sreeharsha Nagaraja	2021-(12)
<p>" It was discovered in this study that cell phones and Wi Fi can cause pancreatic damage and hyperglycemia leading to Diabetes Mellitus and already existing Diabetes Mellitus may get aggravated. To some extent both the substances used in the study i.e. pomegranate and vitamin E were found effective in decreasing serum glucose levels as well as repair of the damage to the rat pancreas caused by mobile phones and Wi Fi. while vitamin E didn't produce significant reduction in serum glucose levels as well as couldn't repair damaged pancreas significantly. It is concluded that both cell phones and Wi Fi possess detrimental effects, causing damage to pancreas leading to hyperglycemia. Pomegranate repairs and controls pancreatic damage very well resulting in reduction in serum glucose levels. It may help manage Diabetes Mellitus. Vitamin E is found to possess preventive effects in pancreatic damage. It is suggested that the research studies should be conducted with large sample size in humans to verify the harmful effects of cell phones and Wi Fi on human health." {From the publication}</p>				
Original Findings Confirmed in Replication Study: Provocation with 2.4 GHz Cordless Phone affects the Autonomic Nervous System (ANS) as measured by Heart Rate Variability (HRV)	2.4 GHz - 0.003-0.008 mW/cm2	9-30m /1d	Magda Havas, Jeffrey Marrongelle	2021-(17)
The influence of microwave electromagnetic radiation on rat heart morphogenesis during thyroidectomy	1 GHz - 0.00011 mW/cm2	45m-2 h/1d	O. O. Drobakhin, V. I. Magro, V. V. Kosharnyi, V. H. Rutgaizer, L. V. Abdul-Ohly	2021-(9)
<p>Another example of specificity of the effects to the experimental parameters, in this case time has a pivotal role that can even invert outcome: " Under conditions of hypothyroidism modeling, destructive changes in muscle fibers are observed in the myocardium after thyroidectomy, but after microwave irradiation with an exposure of 45 minutes, a regenerative-compensatory reconstruction of the structural components of the myocardium of the heart wall occurs. After thyroidectomy and microwave irradiation with an exposure of 120 minutes, an increase in degenerative and destructive processes in the heart myocardium was observed. For the first time, a comparative ultramicroscopic study using electron microscopy was carried out. It showed that after electromagnetic irradiation with an exposure of 45 minutes, the general structure of the mitochondrial apparatus does not change. Irradiation with an exposure of 120 minutes causes the destruction of subsarcolemal and paranuclear organelles, edema and degradation of intermyofibrillar mitochondria. After exposure to electromagnetic radiation with the exposure of 45 minutes in a hypothyroid state, a compensatory restructuring of the energy apparatus of the contractile cardiomyocytes of the left ventricle occurs due to the formation of mitochondria and an increase in their contact interaction. After exposure to radiation for 120 minutes, the development of destructive-degenerative processes in the mitochondrial apparatus of left ventricular cardiomyocytes, deepening of damage to intermitochondrial contacts was observed. The most significant increase in the relative volume of the endothelium in the areas of the rat heart myocardium was observed for the case of microwave irradiation only (without experimental hypothyroidism) with exposure duration of 45 minutes. Immunohistochemical study both for the case of microwave irradiation only and for the case of microwave irradiation under conditions of experimental hypothyroidism allows us to conclude that morphogenetic transformations are highly active in the myocardium of the heart when the duration of exposure is 45 minutes. This study will make it possible to develop recommendations for persons with thyroid diseases on the duration of daily exposure of staying in electromagnetic field emitted by devices with characteristics similar to the case under study." {From the publication}</p>				
Changes in the Excitability of Primary Hippocampal Neurons Following Exposure to 3.0 GHz Radiofrequency Electromagnetic Fields	3 GHz - (SAR 0.3 W/kg)	60m/ 1d	Ibtissam Echchgadda, Jody C. Cantu, Gleb P. Tolstykh, Joseph W. Butterworth, Jason A. Payne, Bennett L. Ibey	2021-(11)
<p>" We showed that RF-EMF exposure decreased the amplitude of action potential (AP), depolarized neuronal resting membrane potential (MP), and increased neuronal excitability and synaptic transmission in cultured primary hippocampal neurons (PHNs). The results show that RF-EMF exposure can alter neuronal activity and highlight that more investigations should be performed to fully explore the RF-EMF effects and mechanisms." {From the publication}</p>				
Radiofrequency EMF irradiation effects on pre-B lymphocytes undergoing somatic recombination	720-1224 MHz - 0.0002-0.009 5 mW/cm2	24h/2 d	Elena Ioniță, Aurelian Marcu, Mihaela Temelie, Diana Savu, Mihai Șerbănescu, Mihai Ciubotaru	2021-(12)
<p>Pyruvate kinase (PK) is one of the energy supply enzymes. Exposed rats: In cortical and subcortical brain structures at 10 μW/cm2 increased PK while at 30 μW/cm2 it decreased. In mitochondrial subcellular fractions of the brain structures, PK activity decreased more at 10 μW/cm2 than at 30 μW/cm2. No differences in PK in the cytosolic subcellular fractions was detected instead.</p>				

Differential Effects of Decimetric Electromagnetic Microwaves on Pyruvate Kinase Activity in the Rat Brain during Ontogenesis	not specified (decimetric = 300-3000 MHz) - 0.01-0.03 mW/cm ²	20m/10d	A. M. Rashidova	2021-(1)
<p>Pyruvate kinase (PK) is one of the energy supply enzymes. Exposed rats: In cortical and subcortical brain structures at 10 μW/cm² increased PK while at 30 μW/cm² it decreased. In mitochondrial subcellular fractions of the brain structures, PK activity decreased more at 10 μW/cm² than at 30 μW/cm². No differences in PK in the cytosolic subcellular fractions was detected instead.</p>				
Influence of a low-intensity electromagnetic field on the process of self-assembly of the core histones H3.2 and H4	1 GHz - 0.0001 mW/cm ²	10m/1d	G. E. Brill, Anna V. Egorova, Olga V. Ushakova	2021-(1)
Electromagnetic Irradiation Evokes Physiological and Molecular Alterations in Rice (plant)	1837.5 MHz - 0.275 mW/cm ²	6h/12-32d	Ardhendu Kundu, Sathish Vangaru, Somnath Bhattacharyya, Amirul I. Mallick, Bhaskar Gupta	2021-(1)
<p>Exposed rice: Reduced seed germination rate. In 12-day-old seedlings phytochrome B and phytochrome C gene transcripts are upregulated. In 32-day-old plants calmodulin and phytochrome C are upregulated. There is a repression of the bZIP1 gene. However, the transcript abundance of bZIP1, phytochrome B, and phytochrome C genes was enhanced even in 12-day-old Satabdi seedlings following instantaneous short-duration (2 h 30 min) electromagnetic exposure. The rice plants perceived electromagnetic energy emitted by the wireless communication system as abiotic stress factor.</p>				
Effects of 2600 MHz Radiofrequency Radiation in Brain Tissue of Male Wistar Rats and Neuroprotective Effects of Melatonin	2600 MHz - (SAR 0.44 W/kg (1g))	30m/30d	Kevser Delen, Bahriye Sirav, Sinem Oruç, Cemile M. Seymen, Dilek Kuzay, Korkut Yeğın, Gülnur Take Kaplanoğlu	2021-(1)
Destructive Processes in the Cardiovascular System Under the Electromagnetic Radiation Action	650-800 MHz	-	U. K. Kayumov, G. M. Khamidova, M. L. Saipova, D. T. Khatamova, SH. Z. Musaeva, D. E. Nurmukhamedova	2020-(4)
<p>" We examined 119 people from 18 to 65 years old, professionally associated with exposure to radio frequency electromagnetic radiation (RFEMR) and various work experience. All subjects were divided into 6 main groups, depending on the service length, under systematic long-term conditions (up to 6 hours a day) RFEMR exposure to radio television stations (RTS) of the Republic of Uzbekistan. It has been established that the immune status dynamics and antigen-binding lymphocytes, specifically sensitized to tissue heart and blood vessels antigens, are the adverse effect reflection of electromagnetic radiation on the human body, which, with an increase in this effect duration, takes on a deeper and irreversible character, which is consistent with other authors data." {From the publication}</p>				
Morphological changes in the vertebrae and central canal of rat pups born after exposure to the electromagnetic field of pregnant rats	900 MHz	1h/8d	Ayşe İkinci Keleş	2020-(1)
Influences of exposure to 915-MHz radiofrequency identification signals on serotonin metabolites in rats: A pilot study	915 MHz (RFID) - (SAR 2 W/kg)	8h/10d	Hye Sun Kim, Man-Jeong Paik, Chan Seo, Hyung Do Choi, Jeong-Ki Pack, Nam Kim, Young Hwan Ahn	2020-(1)
Effect of mobile phone signal radiation on epigenetic modulation in the hippocampus of Wistar rat	900 MHz, 1800 MHz, 2450 MHz - (SAR ~0.0006 W/kg)	2h/30-180d	Ranjeet Kumar, Pravin S. Deshmukh, Sonal Sharma, Basu Dev Banerjee	2020-(10)
Radiofrequency electromagnetic field affects Heart Rate Variability in Rabbits	1788 MHz, GSM	2.5h/1d	Jakub Misek, Marcel Vetrník, Ingrid Tonhajzerova, Viera Jakusova, Ladislav Janousek, Jan Jakus	2020-(21)
Correlation of Blood Oxidative Stress Parameters to Indoor Radiofrequency Radiation: A Cross Sectional Study in Jordan	-	-	Yazan Akkam, Ahmed A. Al-Taani, Salam Ayasreh, Abeer Almutairi, Nosaibah Akkam	2020-(7)
<p>" This cross-sectional study evaluated the potential effect of electromagnetic radiation generated from various resources including cell phone towers on blood glutathione S transferase activity (e-GST) and total antioxidant activity of the Jordanian population. Methods: The power density of three districts in the city of Irbid, Jordan was mapped to generate "outside the houses" and "inside the houses" maps. The effect of categorical variables (gender, using a cell phone, presence of Wi-Fi modem, previous exposure to medical imaging) and continuous variables (distance from the base station, the elevation of the house, the duration of stay in the house, power density outside houses, power density inside houses) on e-GST and total antioxidant activity were investigated." {From the publication}</p>				

" Several factors such as building materials restricted the penetration of EMR reaching inside the houses. EMR generated inside rather than outside the houses had a proportional effect on e-GST." {From the publication}				
Modulation of Staphylococcus aureus biofilm by electromagnetic radiation (bacteria)	1-5 GHz	3h/1d	Samuel Bucko, Anna Čuvalová, Ján Labun, Ján Zbojovský, Dobroslava Bujňáková, Vladimír Kmeť	2020-(3)
" The aim of this study was to examine the effects of EMR on development of bacterial biofilm. Microtitration plates with four strains of Staphylococcus aureus were exposed to electromagnetic field of frequencies 1-5 GHz, which are used in mobile phones. The results showed mostly the inhibition of the development biofilm activity at frequencies 1, 2 and 3 GHz, however the significant stimulation of biofilm development occurred at frequencies 4 and 5 GHz. Our observations demonstrate that EMR exposure produced modulation effects on bacterial biofilms, which are very important in commensal and pathogen bacteria." {From the publication}				
Effect of Exposure to Electromagnetic Radiation on Sex Steroids and Systemic & Local Uterine Redox Status during Early and Late Pregnancy in Rats	900, 1800, 2450 MHz	24h/7-18d	Akmal Ahmed Hassan Diab, Mohamed Hussein, Mohamed Ibrahim, Shreen Elaraby Bedear, Eman Abdel Raouf Mohammed	2020-(10)
" The present study showed that EMR exerted a significant frequency and duration dependent reduction in serum estrogen, progesterone, plasma TAS, vitamin C and uterine GSH which was accompanied by significant increase in plasma and uterine MDA."				
Morphological and cytophysiological changes in selected lines of normal and cancer human cells under the influence of a radio-frequency electromagnetic field	2.5 GHz	24h/1-3d	Romuald Górski, Agnieszka Nowak-Terpiłowska, Paweł Śledziński, Mikołaj Baranowski, Stanisław Wosiński	2020-(9)
" It was found that the RF electromagnetic field exposure caused a significant decrease in the viability of fibroblasts, and a significant increase in cancer cells. Morphological analysis did not show significant changes in both cell lines after exposure to RF-EMF. Conclusions: On the basis of the obtained results, the hypothesis can be formulated that a high frequency electromagnetic field can have harmful effects on human cells." {From the publication}				
Autonomic Nervous System Disorder Due to Exposure RF Jamming	-	15-45 min / 1d	Ibrahim T. Ibrahim, Suad M. Al-Deen, Ajjal S. Hassan	2020-(9)
Protective Effects of Vitamin E on Mobile Phone Induced Injury in The Brain of Rats ("chemical remedy")	-	24h/5 6d	Sibghatullah Muhammad Ali Sangi, Abdulhakim Bawadekji, Nawaf M. Alotaibi, Ahmed M. Aljameeli, Samreen Soomro	2020-(8)
" From the histopathological results of our study, it is evident that exposure to cell phones and Wi-Fi, produces significant inflammatory process in the different areas of brain and these findings are similar to the studies conducted by [31, 32]. Although the duration of the study was not very long, the damaging effects were observed. Continuous exposure may lead to prolonged inflammation in the brain leading to the cerebral edema, loss or impairment into the function of the organs and systems which are being controlled by the area in which damage occurs and increased risk of cancer due to repeated mutations in the area [33-35]. In this research, it was observed that standard antioxidant Vit E, when used simultaneously with exposure to Wi-Fi and mobile phone, prevented the damage to brain cells and decreased inflammation was seen."				
Comparison of effects of 2.4GHz Wi-Fi and mobile phone exposure on human placenta and cord blood	-	-	Hava Bektas, Suleyman Dasdag, Mehmet Selcuk Bektas	2020-(1)
Paramagnetic property of proteins in aqueous solution can be highlighted even at low intensity electromagnetic fields	0.01 mW/cm ²	-	Emanuele Calabrò, Salvatore Magazù	2020-(1)
" The aim of this study is to show that typical proteins have a paramagnetic property that can be evidenced applying an electromagnetic field even at low intensity levels. ... Statistical analysis highlighted a significant increase in intensity of proteins Amide I band after exposure. This result can be explained assuming that proteins α -helix aligned with the direction of the applied electromagnetic field, due to the circumstance that the ligands of C=O and N-H are oriented along the α -helix axis, giving rise to the Amide I mode intensity. ... Given that proteins in bidistilled aqueous solution can well schematize biological cellular environment in which proteins are embedded to carry out their functions, the paramagnetic property of proteins under low intensity electromagnetic field can induce change in cellular functions."				
Testing of behavioral and cognitive development in rats after prenatal exposure to 1800 and 2400 MHz radiofrequency fields	1800 MHz (GSM), 2400 MHz (Wi-Fi) - 0.1-1 mW/cm ²	12h/2 1d	Zhi-qiang Li, Yuan Zhang, Yue-Meng Wan, Qiong Zhou, Chang Liu, Hui-Xin Wu, Yun-Zheng Mu, Yue-Feng He, Ritika Rauniyar, Xi-Nan Wu	2020-(10)
" The body weight of the 1800 MHz group and the 1800 MHz + WiFi group showed a downward trend. The eye opening time of newborn rats was much earlier in the WiFi group than in the control group. Compared to the control group, the overall path length of the 1800 MHz + WiFi group was shortened and the stationary time was delayed. The path length of the WiFi group was shortened and the average velocity was increased in the error arm. The 1800 MHz + WiFi group displayed an increased trend in path length, duration, entry times and stationary time in the central area. In both the 1800 MHz + WiFi and WiFi groups, NR2A and NR2B expression was down-regulated, while NR2D, NR3A and NR3B were up-regulated. Moreover, NR1 and NR2C in the WiFi group were also up-regulated. Prenatal exposure to 1800 MHz and WiFi radiofrequency may affect the behavioral and cognitive development of				

offspring rats, which may be associated with altered mRNA expression of NMDARs in the hippocampus." {From the publication}				
Weak radiofrequency fields affect the insect circadian clock	-	-	Premysl Bartos, Radek Netusil, Pavel Slaby, David Dolezel, Thorsten Ritz, Martin Vacha	2019-(1)
The electrical potential of nicotiana Benthamiana affected by microwave exposure (plant)	2.01 (CW)	-	M. D. H. J. Senavirathna, T. Asaeda	2019-(6)
May electromagnetic field exposure during pregnancy have a negative effect on anthropometric measurements of the newborn?	-	-	Özge Kömürcü Karuserci 1 , Nilgün Çöl 2 , Can Demirel	2019-(6)
" A negative correlation was identified between maternal single mobile phone usage during pregnancy and newborn's birth weight. Multiple mobile phone (more than mobile phone) usage during pregnancy was negatively correlated with the birth week, birth weight and birth length of the newborn. The head circumference of the newborn was negatively correlated with watching television (TV) and living close to a base station during pregnancy." {From the publication}				
Validation of potential effects on human health of in vivo experimental models studied in rats exposed to sub-thermal radiofrequency. Possible health risks due to the interaction of electromagnetic pollution and environmental particles	900 MHz, 2450 MHz - (SAR 0.04 - 1.3 W/kg)	0.5-2h /1d	Aaron A. Salas-Sánchez, Alberto López-Furelos, J. Antonio Rodríguez-González, Francisco J. Ares-Pena, M. Elena López Martín	2019-(13)
Exposed rats showed visible morphological and immune effects. The type of signal is more directly related to the effect of the oxidative stress in the brain than the additive effects of combined frequencies.				
The influence of low-intensity electromagnetic field on the process of self-organization of linker histone H1	1000 Mhz - 0.001 mW/cm2	-	G. E. Brill, A. V. Egorova, I. O. Bugaeva, D. E. Postnov, O. V. Ushakova	2019-(1)
The exposure significantly modifies the process of self-organization of linker histone, this can determine the possibility of the involvement of the genetic apparatus of the cell in the effects of this radiation.				
Assessment of the effects of radiofrequency radiation on human colon epithelium cells	1800-2600 MHz	3-6h/ 1d	A. Tomruk, Y. K. Terzi, G. Ozturk Guler	2019-(10)
Activation of endoplasmic reticulum stress in rat brain following low-intensity microwave exposure	900-2450 MHz - (SAR 0.0058 - 0.067 W/kg)	-/30d	Ranjeet Kumar, Pravin S. Deshmukh, Sonal Sharma, BasuDev Banerjee	2019-(1)
Exposed rats: There is an altered mRNA expression of transcription factors ATF4, CHOP, and XBP1, in correlation with increasing microwave frequency. Increased endoplasmic reticulum stress and unfolded protein response.				
A Prospective Cohort Study of Adolescents' Memory Performance and Individual Brain Dose of Microwave Radiation from Wireless Communication	-	-	Milena Foerster, Arno Thielens, Wout Joseph, Marloes Eeftens, Martin Röösli	2018-(13)
" We found decreased figural memory scores in association with an interquartile range (IQR) increase in estimated cumulative RF-EMF brain dose scores: -0.22 (95% CI: -0.47, 0.03; IQR: 953 mJ/kg per day) in the whole sample, -0.39 (95% CI: -0.67, -0.10; IQR: 953 mJ/kg per day) in right-side users (n=532), and -0.26 (95% CI: -0.42, -0.10; IQR: 341 mJ/kg per day) when recorded network operator data were used for RF-EMF dose estimation (n=274). Media usage unrelated to RF-EMF did not show significant associations or consistent patterns, with the exception of consistent (nonsignificant) positive associations between data traffic duration and verbal memory." " Our findings for a cohort of Swiss adolescents require confirmation in other populations but suggest a potential adverse effect of RF-EMF brain dose on cognitive functions that involve brain regions mostly exposed during mobile phone use."				
Exposure to high-frequency electromagnetic field triggers rapid uptake of large nanosphere clusters by pheochromocytoma cells	18 GHz - (SAR 0.85 W/kg)	1.5mi n/1d	Palalle G. Tharushi Perera, The Hong Phong Nguyen, Chaitali Dekiwadia, Jason V Wandiyanto, Igor Sbarski, Olga Bazaka, Kateryna Bazaka, Russell J Crawford, Rodney J Croft, Elena P Ivanova	2018-(14)
Influence of electromagnetic radiation of extremely high frequency on sensitivity of plants to cold stress	55-66 GHz - 0.066 mW/cm2	150mi n/1d	Alexander Nikitin, Diana Suhareva, Egor Mishchenko, Alesya Zubareva, Olga Shurankova, Ruslan Spirov	2018-(1)
It has been found that plants exposed to the frequency of 55 GHz reduces their resistance to temperature stress, with less germination, survival, and biological productivity, meanwhile 66 GHz exposure increased the resistance of the plants to those stressful effects of negative temperatures.				
Association between daily exposure to electromagnetic radiation from	1.8 GHz +	-	Shang-Shu Ding, Ping	2018-

4G smartphone and 2.45-GHz wi-fi and oxidative damage to semen of males attending a genetics clinic: a primary study	2.45 GHz - (SAR 3.19 W/kg (body))		Sun, Hong Tian, Yong-Wei Huo, Li-Rong Wang, Yan Han, Zhou Zhang, Xiang Liu, Jun-Ping Xing	(10)
3 groups of humans were separated taken in consideration daily network exposure time: less than 30 min, 31-120 min and more than 121 min per day. As more stended exposure time there is an increased reactive oxygen while total antioxidant capacity, glutathione and superoxide dismutase, and superoxide dismutase decreased. There is a decreased sperm count, vitality, and motility. Etc.				
Effects of Exposure to Electromagnetic Field From 915 MHz Radiofrequency Identification System on Circulating Blood Cells in the Healthy Adult Rat	915 MHz (RFID) - (SAR 2 W/kg)	8h/10 d	Hye Sun Kim, Jae Sung Park, Yeung-Bae Jin, Hyung Do Choi, Jong Hwa Kwon, Jeong-Ki Pack, Nam Kim, Young Hwan Ahn	2018-(9)
Effects of electromagnetic waves emitted from 3G+wi-fi modems on human semen analysis	(3G) + 2.4 GHz - (SAR 1.3 W/kg)	50min /1d	Koosha Kamali, Mohammadmehdi Atarod, Saeedeh Sarhadi, Javad Nikbakht, Maryam Emami, Robab Maghsoudi, Hormoz Salimi, Bita Fallahpour, Negar Kamali, Abdolreza Momtazan, Mojtaba Ameli	2017-(6)
Exposed sperm samples: Decreased sperm motility and velocity (more pronounced in non-progressive motile sperms).				
The effect of the low energy electromagnetic radiation of cell phone and Wi- Fi frequency on the calcium concentration in the exfoliated human buccal epithelium cells	1.8 GHz + 2.4 GHz - 0.0023 mW/cm ² + 0.0025 mW/cm ²	1-3h/ 1d	Andrey Mudrak, Nicolay Kolchigin, Igor Kovalenko, Yuriy Shckorbatov	2017-(4)
Exposed cells: Decreased calcium concentrations.				
Mechanism of Low-level Microwave Radiation Effect on Brain: Frequency Limits	450 MHz (14-217 Hz modulated) - (SAR 0.3 W/kg)	-	Hiie Hinrikus, Maie Bachmann, Jaanus Lass	2017-(1)
Exposed human brains: Increased EEG power at exposures to 14, 21, 40, 70 and 217 Hz modulated microwaves, so there are resonant effects outside the modulation frequencies within the brain's EEG spectrum. On the other side they do a review of published data which has led them to propose that the low-level microwave effects are limited to carrier frequencies up to around 100 GHz.				
Selective changes in locomotor activity in mice due to low-intensity microwaves amplitude modulated in the EEG spectral domain	10 GHz (2 Hz, 8 Hz modulated) - (SAR 0.3 W/kg)	-/6d	V. Van Eeghem, A. El Arfani, A. Anhoula, L. Walrave, A. Pourkazemi, E. Bentea, T. Demuyser, I. Smolders, J. Stiens	2017-(1)
Radiation from wireless technology elevates blood glucose and body temperature in 40-year-old type 1 diabetic male	-	-	Catherine E. Kleiber	2017-(1)
Non-thermal microwave radiation-induced brain tissue dehydration as a potential factor for brain functional impairment	90-160 GHz (4 Hz modulated) - (SAR 0.05 W/kg)	10min /1d	Anna Nikoghosyan, Armenuhi Heqimyan, Sinerik Ayrapetyan	2017-(8)
" Thus, on the basis of the obtained data it can be concluded that NT MW radiation changes physicochemical properties of skin and sub skin water contents, which in its turn leads to the activation of R Na+/Ca2+exchange. The latter is accompanied by the increase of intracellular contents of cAMP in healthy (young) animals, and leads to cell hydration which is a result of stimulation of oxidative processes-induced release of endogenous H2O. Whereas, in non-healthy (old) animals the cAMP-dependent activation of oxidative processes is in a dysfunctional state and NT MW radiation leads to neuronal dehydration because of the activation of R Na+/Ca2+. As Ca2+has multisided poisoning effect on neurons, we suggest that NT MW radiation serves as a potential factor leading to the brain functional impairment, especially when brain metabolic activity is depressed (e.g. during agin)." {From the publication}				
Modulation of 10 GHz microwaves induced biochemical changes in differernt organs of swiss albino mice by prunus domestica fruit extract ("chemical remedy")	10 GHz - 0.25 mW/cm ²	2h/30 d	Faiza Rifat, Rashmi Sisodia	2017-(9)
" Biochemical analysis showed highly significant (p<0.001) variations in Lipid Per Oxidation (LPO), Glutathione (GSH) and protein levels which could be ameliorated by supplementation of PDE prior to MW exposure. Exposure to 10 GHz leads to biochemical alterations in different organs studied in mice which can be ameliorated by PDE supplementation." {From the publication}				
Ten gigahertz microwave radiation impairs spatial memory, enzymes	10 GHz	2h/15	Archana Sharma,	2017-(1)

activity, and histopathology of developing mice brain		d	Kavindra Kumar Kesari, Virender Kumar Saxena, Rashmi Sisodia	
Evaluation of the Effect of Radiofrequency Radiation Emitted From Wi-Fi Router and Mobile Phone Simulator on the Antibacterial Susceptibility of Pathogenic Bacteria <i>Listeria monocytogenes</i> and <i>Escherichia coli</i>	900 MHz (GSM) - 2.4 GHz - (SAR 0.13 W/kg)	3-24h /1d	M. Taheri, S. M. J. Mortazavi, M. Moradi, S. Mansouri, G. R. Hatam, F. Nouri	2017-(8)
" In this study, we assessed if the exposure to 900 MHz GSM mobile phone radiation and 2.4 GHz radiofrequency radiation emitted from common Wi-Fi routers alters the susceptibility of microorganisms to different antibiotics. ... It is also shown that exposure to RF-EMFs within a narrow level of irradiation (an exposure window) makes microorganisms resistant to antibiotics. This adaptive phenomenon and its potential threats to human health should be further investigated in future experiments. Altogether, the findings of this study showed that exposure to Wi-Fi and RF simulator radiation can significantly alter the inhibition zone diameters and growth rate for <i>L. monocytogenes</i> and <i>E. coli</i> ." {From the publication}				
The aftermath of long-term exposure to non-ionizing radiation on laboratory cultivated pine plants (<i>Pinus halepensis</i> M.)	1882 MHz (DECT)	24h/5 0d	Aikaterina L. Stefi, Lukas H. Margaritis, Nikolaos S. Christodoulakis	2017-(14)
The effect of the non-ionizing radiation on exposed, laboratory cultivated maize (<i>Zea mays</i> L.) plants	1882 MHz (DECT)	24h/1 4d	Aikaterina L. Stefi, Lukas H. Margaritis, Nikolaos S. Christodoulakis	2017-(9)
The effect of the non ionizing radiation on exposed, laboratory cultivated upland cotton (<i>Gossypium hirsutum</i> L.) plants	1882 MHz (DECT)	24h/2 1d	Aikaterina L. Stefi, Lukas H. Margaritis, Nikolaos S. Christodoulakis	2017-(10)
Exposed plants: Decreased biomass production in the above ground part and in the root. Decreased photosynthetic pigments. Damaged chloroplast structures.				
Exposure to radiation from single or combined radio frequencies provokes macrophage dysfunction in the RAW 264.7 cell line	900 MHz, 2450 MHz	24h - 72h /1 d-3d	Alberto López-Furelos, Aarón A. Salas-Sánchez, Francisco J. Ares-Pena, José M. Leiro-Vidal, Elena López-Martín	2017-(1)
Evidence of cellular stress and caspase-3 resulting from a combined two-frequency signal in the cerebrum and cerebellum of Sprague-Dawley rats	900 MHz, 2450 MHz - (SAR 0.03-0.32 W/kg)	1-2h/ 1d	Alberto López-Furelos, José Manuel Leiro-Vidal, Aarón Ángel Salas-Sánchez, Francisco José Ares-Pena, María Elena López-Martín	2016-(16)
The effect of the non ionizing radiation on cultivated plants of <i>Arabidopsis thaliana</i> (Col.)	(DECT)	-	Aikaterina L. Stefi, Lukas H. Margaritis, Nikolaos S. Christodoulakis	2016-(1)
Exposed plants: Reduced plant biomass and altered leaf structure. Thinner leaves with fewer chloroplasts.				
Association between Exposure to Smartphones and Ocular Health in Adolescents	-	-	Joowon Kim, Yunji Hwang, Seunghoon Kang, Minhye Kim, Tae-Shin Kim, Jay Kim, Jeongmin Seo, Hyejeong Ahn, Sungjoon Yoon, Jun Pil Yun, Yae Lim Lee, Hyunsoo Ham, Hyeong Gon Yu, Sue K. Park	2016-(1)
Electrosmog and autoimmune disease	(silver-threaded cap protection)	-	Trevor G. Marshall, Trudy J. Rumann Heil	2016-(7)
The interaction of radio frequency and Lambda DNA	1.0-17.0 GHz	-	Mary Elizabeth Pearson	2016-(31)
" Based on the experiments that were run, the results suggest areas of interaction between Lambda DNA and RF energy have been observed. Even at the low power level of 0 dBm, interaction of certain RF energy with Lambda DNA were detected. Since the RF energy was kept at a very low power level, heating of the DNA molecule was not the cause of the interaction. ... Certain regions, between 14.0-16.0 GHz, measured the greatest error and therefore the resulting DNA signal may be affected. Based on the calculated p-values, the frequencies of greatest interaction with Lambda DNA occurred between: 2.15-3.72 GHz, 7.82-9.37 GHz, and 13.29-16.68 GHz." " Lambda DNA is extracted from the bacteriophage Lambda. A bacteriophage is a bacterial parasite that grows by inserting its genetic material into a host, in this case <i>E. coli</i> . It then overcomes the host cell and starts replicating and reproducing new strands of Lambda DNA."				
Radiofrequency radiations induced genotoxic and carcinogenic effects on chickpea (<i>Cicer arietinum</i> L.) root tip cells	900 MHz (GSM)-3.3	24h - 48h /1	Sadaf Tabasum Qureshi, Sajjad Ahmed	2016-(9)

	GHz	d-2d	Memon, Abdul Rasool Abassi, Mahboob Ali Sial, Farooque Ali Buglio	
<p>" Present study was under taken to predict the possible DNA damages (genotoxicity) and carcinogenicity caused by radiofrequency radiations (RF) to living tissue. Dry seeds of chickpea were treated with GSM cell phone (900 MHz) and laptop (3.31 GHz) as RF source for 24 and 48 h. Untreated seeds were used as (0 h) negative control and Gamma rays (250 Gray) as positive control. Plant chromosomal aberration assay was used as genotoxicity marker. All the treatment of RF inhibits seed germination percentage. 48 h laptop treatment has the most negative effect as compared to untreated control. A decrease was observed in mitotic index (M.I) and increase in abnormality index (A.I) with the increase in exposure duration and frequency in (Hz). Cell membrane damages were also observed only in 48 h exposure of cell phone and laptop (RF). Maximum nuclear membrane damages and ghost cells were again recorded in 48 h exposure of cell phone and laptop. The radiofrequency radiations (900 MHz and 3.31 GHz) are only genotoxic as they induce micronuclei, bi-nuclei, multi-nuclei and scattered nuclei but could be carcinogenic as 48 h incubation of RF induced fragmentation and ghost cells. Therefore cell phones and laptop should not be used unnecessarily to avoid possible genotoxic and carcinogenic effects." {From the publication}</p>				
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	900-1800 MHz + 2450 MHz	1h/-	Murat Yüksel, Mustafa Nazıroğlu, Mehmet Okan Özkaya	2015-(1)
The Histomorphological Changes in the Proximal Tubules of Metanephros of Developing Kidney of Chick Embryo Induced by Electromagnetic Radiations from Conventional and Advanced Mobile Phones	900 MHz (GSM), 900 MHz (GSM) + Wifi	15min, 30min / 15d	Sabah Rehman, Shadab Ahmed Butt, Naureen Waseem, Maria Yousaf	2015-(3)
<p>The groups are divided into conventional (GSM) and advanced (GSM) + (wifi download) groups: " statistically significant change in the tubular diameters was observed after advanced cellular radiations whereas conventional cellular radiations decreased the epithelial height significantly." {From the publication} " the changes induced by electromagnetic radiations from the advanced mobile phones affected the tubular diameters more by decreasing them while conventional decreased the epithelial height of the proximal tubule cells." {From the publication}</p>				
Experimental Study of Digital Enhanced Cordless Telecommunication Devices Electromagnetic Field Possible Hazard Health Effects	1890 MHz (DECT) - 0.25-0.5 mW/cm2	2h, 3h/20 d	N.B. Rubtsova, S.Y. Perov, O.V. Belaya, E.V. Bogacheva	2015-(3)
<p>" ... evaluated parameters: weight (body, spleen, adrenal glands, testis), behavioral parameters (open field test), the function of reproduction system (epididymis sperm count, sperm osmotic resistance). Exposure value 500 µW/cm2 : significant decrease of rats' behavioral parameters after 5 days; decrease of behavioral parameters, sperm osmotic resistance, spleen and testis weights after 10 days; decrease of sperm osmotic resistance and body weight after 20 days. exposure value 250 µW/cm2 : significant decrease of rats' sperm osmotic resistance after 20 days of exposure and 2 weeks after exposure, as well as significant decrease of adrenal glands weight and epididymis sperm count 2 weeks after exposure."</p>				
Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans	unknown freq. - (SAR 0.04-2 W/kg)	24h/5 04d	Alexander Lerchl , Melanie Klose, Karen Grote, Adalbert F.X. Wilhelm, Oliver Spathmann, Thomas Fiedler, Joachim Streckert, Volkert Hansen, Markus Clemens	2015-(6)
<p>Exposed mice: Higher numbers of tumors of the lungs and livers without a clear dose-response effect. Increased lymphomas. Many tumor-promoting effects not at maximum power but 0.04 and 0.4 W/kg SAR.</p>				
Possible cause for altered spatial cognition of prepubescent rats exposed to chronic radiofrequency electromagnetic radiation	900 MHz - (SAR 1.15 W/kg)	1h/28 d	Sareesh Naduvil Narayanan, Raju Suresh Kumar, Kalesh M. Karun, Satheesha B. Nayak, P. Gopalakrishna Bhat	2015-(1)
<p>Exposed rats: Decreased progressive learning abilities. Decreased spatial memory retention. Decreased viable cell count in dorsal hippocampal CA3 region. Arborization pattern of both apical and basal dendritic trees are influenced.</p>				
Cognitive Impairment and Neurogenotoxic Effects in Rats Exposed to Low-Intensity Microwave Radiation	900-1800-24 50 MHz - (SAR 0.58-0.66 W/ kg)	-/180 d	Pravin Suryakantrao Deshmukh, Namita Nasare, Kanu Megha, Basu Dev Banerjee, Rafat Sultana Ahmed, Digvijay Singh, Mahesh Pandurang Abegaonkar, Ashok Kumar Tripathi, Pramod Kumari Mediratta	2015-(1)
<p>Exposed rats: Decreased cognitive function. Increased HSP70 level and DNA damage in the brain.</p>				
Low intensity microwave radiation induced oxidative stress, inflammatory response and DNA damage in rat brain	900-1800-24 50 MHz - (SAR	2h/6d	Kanu Megha, Pravin Suryakantrao Deshmukh, Basu Dev	2015-(8)

	0.58-0.66 W/kg)		Banerjee , Ashok Kumar Tripathi, Rafat Ahmed, Mahesh Pandurang Abegaonkar	
Exposed rats: Increased oxidative stress markers malondialdehyde, protein carbonyl, and catalase. Decreased glutathione and superoxide dismutase. Increased pro-inflammatory cytokines IL-2, IL-6, TNF- α , and IFN- γ . Increased DNA damage.				
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	900-1800-24 50 MHz	1h/1d	Bilal Çiğ, Mustafa Nazroğlu	2015-(10)
" In the present study, the cytosolic ROS production, apoptosis, caspase-3 and caspase-9 values in the breast cancer cells increased after 900 MHz, 1800 MHz and 2450 MHz exposure. These data are in agreement with reports suggesting that EMR induces oxidative stress and apoptosis of cancer cells by inducing ROS [14], [27], [31]. We have shown also that the changes induced by EMR are very dependent on the distance from the source in the cancer cells. To our knowledge, it is the first report of the relationship between different distances and 900 MHz, 1800 MHz and 2450 MHz EMR in the MCF-7 breast cancer cells." {From the publication}				
The Effect of EMF Radiation Emitted by Mobile Phone to Insect Population using Drosophila melanogaster as a Model Organism	900-1800 MHz (GSM) - 2100 MHz (HSPA 4G)	24h/2 d	Ahmad Fauzi, Aloysius Duran Corebima	2015-(5)
A Challenging Issue in the Etiology of Speech Problems: The Effect of Maternal Exposure to Electromagnetic Fields on Speech Problems in the Offspring	-	-	S. Zarei, S.M.J. Mortazavi, A.R. Mehdizadeh, M. Jalalipour, S. Borzou, S. Taeb, M. Haghani, S.A.R. Mortazavi, M.B. Shojaei-fard, S. Nematollahi, N. Alighanbari, S. Jarideh	2014-(4)
" We found a significant association between either the call time (P=0.002) or history of mobile phone use (months used) and speech problems in the offspring (P=0.003). However, other exposures had no effect on the occurrence of speech problems. To the best of our knowledge, this is the first study to investigate a possible association between maternal exposure to electromagnetic field and speech problems in the offspring. Although a major limitation in our study is the relatively small sample size, this study indicates that the maternal exposure to common sources of electromagnetic fields such as mobile phones can affect the occurrence of speech problems in the offspring." {From the publication}				
Effects of fetal microwave radiation exposure on offspring behavior in mice (with some gender dependent effects)	9.41 GHz - (SAR 2 W/kg)	12h/1 5d	Yanchun Zhang, Zhihui Li, Yan Gao, Chenggang Zhang	2014-(8)
" ... mice showed less movement in the center of an open field and in an open arm which suggested that the mice had increased anxiety-related behavior. Mice demonstrated reduced immobility in suspension test and forced swimming test which suggested that the mice had decreased depression-related behavior, from the Morris water maze test, we observed that male offspring demonstrated decreased learning and memory, while females were not affected in learning and memory, which suggested that microwaves had gender-dependent effects." {From the publication}				
Effects of millimeter wave irradiation and equivalent thermal heating on the activity of individual neurons in the leech ganglion	60 GHz - 1-4 mW/cm ²	1min/ 1d	Sergii Romanenko, Peter H. Siegel, Daniel A. Wagenaar and Victor Píkov	2014-(9)
" However, narrowing of the action potential half-width was 5 times more pronounced compared with that during equivalent bath heating. more dramatic difference was noted in the firing rate, which was suppressed at all applied MMW power densities and increased in a dose-dependent manner during gradual bath heating. The mechanism of enhanced narrowing of action potentials and suppressed firing by MMW irradiation, compared with that by gradual bath heating, is hypothesized to involve specific coupling of MMW energy with the neuronal plasma membrane."				
Changes in mitochondrial functioning with electromagnetic radiation of ultra high frequency as revealed by electron paramagnetic resonance methods	465 MHz (pulsed), 2450 MHz (CW)- 6 mW/cm ²	17min, 15min /1d	Anatoly Burlaka, Marina Selyuk, Marat Gafurov, Sergei Lukin, Viktoria Potaskalova, Evgeny Sidorik	2014-(6)
Exposed rats: Disturbances in the electron transport chain of mitochondria. Decreased activity of FeS-protein N2 of NADH-ubiquinone oxidoreductase complex. Increased rates of superoxide production. Etc.				
Apoptotic cell death during Drosophila oogenesis is differentially increased by electromagnetic radiation depending on modulation, intensity and duration of exposure	100-900 MHz	6min, 60min/ 1d, 6d	Niki E. Sagioglou, Areti K. Manta, Ioannis K. Giannarakis, Aikaterini S. Skouroliakou, and Lukas H. Margaritis	2014-(1)
Exposed Drosophila melanogaster: Increased apoptotic cell death in egg chambers, even at very low electric field strengths. FM waves stronger effect than continuous waves. Non linear response of tissues to exposure, with dependences on frequency, modulation and temporal exposure pattern.				
10 Ghz Microwaves Induced Biochemical, Learning and Memory Alterations in Swiss Albino Mice Brain	10 GHz - 0.25 mW/cm ² (SAR 0.179 W/kg (body))	2h/30 d	Archana Sharma, Rashmi Sisodia, Deepak Bhatnagar	2014-(1)

Exposed mice: Decreased antioxidant enzyme activity of superoxide dismutase and glutathione. Increased catalase activity. Increased lipid peroxidation. Protein content of the brain depleted upto 7th day after microwave exposure. Decreased spatial learning and memory performance.				
The in vivo effects of low-intensity radiofrequency fields on the motor activity of protozoa	1-10 GHz - 0.005-0.05 mW/cm ²	0.1-10 h /1d	Elena I. Sarapultseva, Julia V. Igolkina, Viktor N. Tikhonov, Yuri E. Dubrova	2014-(1)
Exposed Spirostomum ambiguum: When the exposure is as low as 0.01 mW/cm ² there is a decrease in their motility. Motility of ciliates is inversely correlated with the applied flux density. The motility of the progeny is compromised transgenerationally along 10–15 generations at least.				
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	950 MHz - (SAR 1-1.3 W/kg)	30min /27d, 36d, 51d	Orlando V. Furtado-Filho, Juliana B. Borba, Alessandro Dallegrave, Tânia M. Pizzolato, João A. P. Henriques, José C. F. Moreira, Jenifer Saffi	2014-(1)
Exposed rats (only prenatally): Decreased thiobarbituric acid reactive levels. Decreased unsaturated fatty acids concentrations. Exposed rats (prenatally and postnatally 6-15 days): Altered polyunsaturated fatty acids concentrations. Exposed rats (prenatally and postnatally 15-30 days): DNA damage.				
The Effects of Low Power Microwaves at 500 MHz and 900 MHz on Yeast Cells Growth	500-900 MHz - (SAR 0.12 W/kg (single cell))	1-6h/ 1d	Hamad S. Alshuhaim, Vuk Vojisavljevic , and Elena Pirogova	2014-(4)
Exposed cells: Depending on the frequency and intensity the proliferation of yeast cell is inhibited or increased in a nonlinear fashion.				
Nanometer-scale elongation rate fluctuations in the Myriophyllum aquaticum (Parrot feather) stem were altered by radio-frequency electromagnetic radiation (plants)	2 GHz - 0.142 mW/cm ²	1h/1d	Mudalige Don Hiranya Jayasanka Senavirathna, Takashi Asaeda, Bodhipaksha Lalith Sanjaya Thilakarathne, Hirofumi Kadonoa	2014-(1)
Exposed plants: A Reduction of 51 ± 16% in the nanometric elongation rate.				
Short-duration exposure to radiofrequency electromagnetic radiation alters the chlorophyll fluorescence of duckweeds (Lemna minor) (plants)	2-8 GHz	30min, 1h, 24h/1 d	Mudalige Don Hiranya Jayasanka Senavirathna, Asaeda Takashi, Yuichi Kimura	2013-(1)
Exposed duckweeds: Changes in the non-photochemical quenching. Changes varied with the frequency of the EMR and were time-varying within a particular frequency.				
Ants can be used as bio-indicators to reveal biological effects of electromagnetic waves from some wireless apparatus (VERY INTERS. EFFECTS)	various	-	Marie-Claire Cammaerts, Olle Johansson	2013-(7)
" The smartphone statistically decreased the insects' linear speed, and increased their angular speed, exposed only for three minutes, but needed two to four hours for exhibiting their usual behavior again durin exposure ants presented locomotion ataxia, with phone in standby mode under the ants nest, the ants left their nest taking their brood (eggs, larvae and nymphs) with them, they relocated their nest far from the place under which the mobile phone was located. After the experimentation, when the mobile phone has been removed, the ants returned to their initial nest, transporting back their brood into the nest. this relocation lasted about one hour."				
Male reproductive health under threat: Short term exposure to radiofrequency radiations emitted by common mobile jammers	-	2h, 4h/1d	S.M.J Mortazavi, M.E. Parsanezhad , M. Kazempour , P. Ghahramani, A.R. Mortazavi, M. Davari	2013-(6)
Influence of electromagnetic fields on reproductive system of male rats	10 GHz - 0.21 mW/c ² (SAR 0.014 W/kg)	2h/45 d	Sanjay Kumar, J. Behari, Rashmi Sisodia	2013-(1)
Exposed rats: Shrinkage of the lumen of the seminiferous tubules. Apoptotic bodies. Decreased testosterone level. Shrinkage of testicular size				
Drosophila oogenesis as a bio-marker responding to EMF sources	various (GSM, DECT, WI-FI, etc.)	6-30min/ 3-7d	Lukas H. Margaritis, Areti K. Manta, Konstantinos D. Kokkalis, Dimitra Schiza, Konstantinos Alimisis, Georgios Barkas, Eleana Georgiou, Olympia Giannakopoulou, Ioanna Kollia, Georgia Kontogianni, Angeliki	2013-(1)

			Kourouzidou, Angeliki Myari, Fani Roumelioti, Aikaterini Skouroliaou, Vasia Sykioti, Georgia Varda, Konstantinos Xenos, Konstantinos Ziomas	
Exposed flies: Even at very low intensity levels there are effects regarding fecundity and cell death-apoptosis induction in all the EMF sources used. A non-linear cumulative effect is found when increasing the duration of exposure or when using one EMF source after the other.				
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	900-1800-2450 MHz	1h/42d + pregnancy	Alper Özorak, Mustafa Nazıroğlu, Ömer Çelik, Murat Yüksel, Derviş Özçelik, Mehmet Okan Özkaya, Hasan Çetin, Mehmet Cemal Kahya, Seyit Ali Kose	2013-(25)
" reduced glutathione (GSH) and total antioxidant status (TAS). variations on lipid peroxidation, vitamin A, iron concentration. Wi-Fi- and mobile phone-induced EMR caused oxidative damage by increasing the extent of lipid peroxidation and the iron level, while decreasing total antioxidant status, copper, and GSH values."				
Ionizing and non-ionizing radiation and the risk of childhood cancer – illustrated with domestic radon and radio frequency electromagnetic field exposure	-	-	Dimitri Daniel Haur	2013-(164)
" the analyses indicated no association between RF-EMF from broadcasting and childhood leukaemia. On the other hand, increased CNS tumour risks were found in some of the analyses."				
Reactive oxygen species elevation and recovery in Drosophila bodies and ovaries following short-term and long-term exposure to DECT base EMF	1.88-1.90 GHz - (SAR 0.008 W/kg)	0.5h, 1h, 6h, 24h, 96h	Areti K. Manta, Dimitrios J. Stravopodis, Issidora S. Papassideri, and Lukas H. Margaritis	2013-(1)
Exposed Drosophilas: Idle state of the DECT base radiation, albeit the very low SAR, induces free radical formation.				
Detection of low level microwave radiation induced deoxyribonucleic acid damage vis-à-vis genotoxicity in brain of fischer rats	900-800-2450 MHz - (SAR 0.0006 W/kg)	2h/30d	Pravin Suryakantrao Deshmukh, Kanu Megha, Basu Dev Banerjee, Rafat Sultana Ahmed, Sudhir Chandna, Mahesh Pandurang Abegaonkar, Ashok Kumar Tripathi	2013-(8)
" Based on the present findings, it is concluded that chronic microwave radiation exposure at low-level induces DNA damage. Prolonged exposure may lead to neurodegenerative disorders. Although, the energy of microwaves is not sufficient directly to break a chemical bond in DNA, genotoxic effects may be mediated by indirect mechanisms such as generation of oxygen free radicals or a disturbance in DNA-repair processes. In order to minimize the exposure, safe limits with respect to frequency and duration of microwave radiation must also be prescribed in view of its increased use in society. However, knowledge of the possible health effects of microwave radiation is still inadequate and inconclusive. Though, the present study seems preliminary, this study is providing the evidence of the effect of microwave radiation at very low-level of exposure and at the lower, middle and upper frequency used in mobile telecommunication." {From the publication}				
Swedish review strengthens grounds for concluding that radiation from cellular and cordless phones is a probable human carcinogen	-	-	Devra Lee Davis, Santosh Kesari, Colin L. Soskolne, Anthony B. Miller, Yael Stein	2013-(7)
Revealing Small Hidden Changes in Human EEG by Higuchi's Fractal Dimension	450 MHz (40-70 Hz modulated)	(1 min off, 1 min on)40 min/1d	M. Bachmann, A. Suhhova, J. Lass, H. Hinrikus	2012-(1)
Exposed human brains: 40 Hz modulated but not 70 Hz modulated microwaves reveals changes in EEG, confirming that microwave effect depends on modulation frequency.				
Relationship between Cognition Function and Hippocampus Structure after Long-term Microwave Exposure	unknown freq. - 2.5-5-10 mW/cm2 (SAR 1.05-2.1-4.2 W/kg)	6min/30d	Li Zhao, Rui Yum Peng, Ming Shui Wang, Li Feng Wang, Ya Bing Gao, Ji Dong, Xiang Li, Zhen Tao Su	2012-(7)
Exposed rats: In all exposed groups there is a decreased learning and memory activity, there is also a neuronal degeneration and enlarged perivascular spaces in the hippocampus among other histopathological changes. In 2.5 and 5 mW/cm2 groups increased concentrations of glutamate, aspartic acid, glycine, and gamma-aminobutyric acid neurotransmitter concentrations in hippocampus.				
Biochemical Changes in Rat Brain Exposed to Low Intensity 9.9 GHz Microwave Radiation	9.9 GHz - 0.125 mW/	2h/35d	R. Paulraj, J. Behari	2012-(1)

	cm ² (SAR 1 W/kg)			
Exposed rats: Increased calcium ion efflux. Increased ornithine decarboxylase activity. Decreased calcium-dependent protein kinase activity.				
Enzymatic alterations in developing rat brain cells exposed to a low-intensity 16.5 GHz microwave radiation	16.5 GHz	2h/35 d	R. Paulraj, J. Behari	2012-(1)
Exposed rats: Altered protein kinase C activity. Increased glial cell population.				
Insight into the biological effects of non-ionizing radiation through the properties of the electromagnetic waves	35 MHz – 3 GHz (environment)	6min, 30min, 1h, 24h/4d, 6d, 20d	A. S. Skouroliakou, N. E. Sagioglou, A. F. Fragopoulou, I. K. Giannarakis, A. K. Manta, M. P. Ntzouni, L. H. Margaritis	2012-(12)
" So far, we have shown, in mice, memory impairment, stress induction and brain protein expression changes and in insects, fecundity decrease and apoptotic cell death increase following microwave (MW) radiation. In addition, by using the NARDA SRM 3000 spectrum analyzer we have performed a mapping of frequencies and E field intensities near base stations and other radiation sources. ... A control group of flies was present in the same area inside a custom made Faraday type cage. Our results under these conditions indicate: a) decrease on Drosophila melanogaster reproduction and b) increase in apoptotic cell death during oogenesis, although at a lower degree compared to mobile phone signals." {From the publication}				
Parametric mechanism of excitation of the electroencephalographic rhythms by modulated microwave radiation	450 MHz (7-70 Hz modulated) - 0.16 mW/cm ²	-	Hiie Hinrikus, Maie Bachmann, and Jaanus Lass	2011-(9)
Exposed human brains: EEG power in all selected EEG frequency bands is increased with radiation modulated at 7, 14, 21, 40 and 70 Hz frequencies.				
Effect of microwave radiation on human EEG at two different levels of exposure	450 MHz (SAR 0.003-0.303 W/kg (1g))	(1 min off, 1 min on)x10 /1d	Anna Suhhova, Maie Bachmann, Deniss Karai, Jaanus Lass, Hiie Hinrikus	2011-(11)
" statistically significant increase in the EEG power in the EEG beta2, beta1 and alpha frequency bands at the higher SAR level, and in the beta2 frequency band at the lower SAR level. The study showed that decreasing the SAR 100 times reduced the related changes in the EEG three to six times and the number of affected subjects, but did not exclude the effect."				

Various MW Freq. Hazards Reviews

/ Papers listed: 97

Various MW Freq. Hazards Reviews

Title	Authors	Year (pages)
Impacts of smartphone radiation on pregnancy: A systematic review	Imteyaz El Jarrah, Mohammad Rabab	2022-(8)
<p>" The findings of this review showed that EMF radiation exposure is associated with hormonal, thermal, and cardiovascular changes among adults. However, the reviewed studies did not consider the impacts of EMF radiation exposure on pregnancy outcomes specifically, which makes it difficult to draw conclusions from this review. Only four of the reviewed studies were conducted among pregnant women. These studies reported that EMF radiation exposure during pregnancy is associated with miscarriages and fluctuations in the fetal temperature and heart rate variability, as well as infant anthropometric measures." {From the publication}</p>		
Mobile phone electromagnetic radiation and the risk of headache: a systematic review and meta-analysis	Sajjad Farashi, Saeid Bashirian, Salman Khazaei, Mojtaba Khazaei, Abdollah Farhadinasab	2022-(1)
<p>" ... results showed that increasing call duration and mobile phone use in older individuals increased the risk of headache."</p>		
Human-made electromagnetic fields: Ion forced oscillation and voltage-gated ion channel dysfunction, oxidative stress and DNA damage (Review) (modulation)	Dimitris J. Panagopoulos, Andreas Karabarbounis, Igor Yakymenko, George P. Chrousos	2021-(16)
<p>" Almost all human-made RF EMFs include ELF components in the form of modulation, pulsing and random variability. Thus, in addition to polarization and coherence, the existence of ELFs is a common feature of almost all human-made EMFs. The present study reviews the DNA damage and related effects induced by human-made EMFs. The ion forced-oscillation mechanism for irregular gating of voltage-gated ion channels on cell membranes by polarized/coherent EMFs is extensively described. Dysfunction of ion channels disrupts intracellular ionic concentrations, which determine the cell's electrochemical balance and homeostasis. The present study shows how this can result in DNA damage through reactive oxygen species/free radical overproduction. Thus, a complete picture is provided of how human-made EMF exposure may indeed lead to DNA damage and related pathologies, including cancer. Moreover, it is suggested that the non-thermal biological effects attributed to RF EMFs are actually due to their ELF components." {From the publication}</p>		
Effect of Radiation Emitted by Wireless Devices on Male Reproductive Hormones: A Systematic Review	Sofwatul Mokhtarah Maluin, Khairul Osman, Farah Hanan Fathihah Jaffar, Siti Fatimah Ibrahim	2021-(8)
<p>" Existing animal and human data on the effect of RF-EMR emitted from wireless devices on male reproductive hormones are inconsistent and difficult to evaluate due to the heterogeneity of study design. However, most studies are consistent with the assertion that long-term exposure to RF-EMR from mobile phones and Wi-Fi devices can disrupt male reproductive hormones, particularly testosterone. Thus, avoiding long-term and excessive use of mobile phone is advisable to reduce the detrimental effect of RF-EMR." {From the publication}</p>		
Threshold of radiofrequency electromagnetic field effect on human brain	Hiie Hinrikus, Jaanus Lass, Maie Bachmann	2021-(1)
<p>" According to the review of experimental data, the rate of detected RF EMF effects is 76.7% in resting EEG studies, 41.7% in sleep EEG and 38.5% in behavioral studies. The changes in EEG probably appear earlier than alterations in behavior become evident. The lowest level of RF EMF at which the effect in EEG was detected is 2.45 V/m (SAR = 0.003 W/kg). There is a preliminary indication that the dependence of the effect on the level of exposure follows rather field strength than SAR alterations. However, no sufficient data are available for clarifying linearity-nonlinearity of the dependence of effect on the level of RF EMF. The finding that only part of people are sensitive to RF EMF exposure can be related to immunity to radiation or hypersensitivity. The changes in EEG caused by RF EMF appeared similar in the majority of analyzed studies and similar to these in depression."</p>		
An Exploration of the Effects of Radiofrequency Radiation Emitted by Mobile Phones and Extremely Low Frequency Radiation on Thyroid Hormones and Thyroid Gland Histopathology	Tasnim Alkayyali, Olive Ochuba, Kosha Srivastava, Jasmine K. Sandhu, Christine Joseph, Sheila W. Ruo, Ashish Jain, Ahsan Waqar, Sujana Poude	2021-(10)
<p>" Our review revealed that mobile phone radiofrequency radiation (RFR) might be associated with thyroid gland insufficiency and alterations in serum thyroid hormone levels, with a possible disruption in the hypothalamic-pituitary-thyroid axis. The review also showed histopathological changes in the thyroid gland follicles after exposure of rats to non-ionizing radiation." {From the publication}</p> <p>" This article aimed to explore the effects of RF-EMF and ELF-EMF on the thyroid gland hormones and histopathology. Studies collected in this review showed that GSM mobile phone RFR could be associated with alterations in T3, T4, and TSH serum hormone levels. EMF emitted from mobile phones could disrupt the function of the HPT axis and lead to thyroid insufficiency. In addition, EMF could lead to hyperstimulation of thyroid gland follicles, causing oxidative stress and apoptosis of follicular cells. Most studies revealed a proportional correlation between thyroid gland dysfunction and the exposure duration, intensity, and SAR value of radiation. Moreover, non-ionizing radiation was seen to be significantly associated with histopathological changes in the thyroid gland follicles. The exposure duration and intensity also determined the degree of morphological damage occurring in the thyroid gland tissue. Non-ionizing EMF radiation might be responsible for the recent increase in the incidence of thyroid insufficiency and cancer in the general population." {From the publication}</p>		
Effects of Radiofrequency Electromagnetic Radiation on Neurotransmitters in the Brain	Cuicui Hu, Hongyan Zuo, Yang Li	2021-(15)

<p>As they analyze the conclusions of different studies for different neurotransmitters, they reach different mini-conclusions, such as: " In summary, these studies indicate that EMR can lead to metabolic disorders of monoamine neurotransmitters in the brain, depending on the intensity of radiation exposure, and might in theory result in abnormal emotional behavior." {From the publication} " Together, these results suggest that long-term exposure to EMR may lead to abnormal norepinephrine and epinephrine contents in the brain, depending on the dose of radiation." {From the publication} " These studies suggest that long-term exposure to microwave radiation can lead to an increase in 5-HT in the brain, indicating a disorder in the metabolism of the neurotransmitter." {From the publication} " These data suggest that EMR can lead to a decrease in excitatory amino acid neurotransmitters in the hippocampus, which may affect the excitatory-inhibitory balance of neurons, thus causing a decline in learning and memory ability." {From the publication} " These data further suggest the neurotransmitter disruption in the hippocampus might result in impairment of cognitive function caused by long-term microwave exposure." {From the publication} " Overall, the above studies suggest that EMR can cause metabolic disorders of the inhibitory neurotransmitters GABA and glycine, which may lead to neuronal dysfunction by affecting the neuronal excitation-inhibition balance." {From the publication} " These studies further suggested that disorders of Ach synthesis and metabolism are an important part of the cognitive dysfunction caused by EMR." {From the publication} " This further suggests that both endogenous opioid neurotransmitter and cholinergic systems in the brain are involved in microwave-induced spatial memory deficits." {From the publication}</p> <p>Others: " In a recent review, Leach et al. analyzed 2,653 papers captured in the database examine the bioeffect outcomes in the 300 MHz-3 GHz range. The results showed three times more biological "Effect" than "No Effect" papers (125). Although some studies report no effect on the tested indicators, there are studies find the significant effect in many cases." {From the publication}</p>		
Medicinal plants in mitigating electromagnetic radiation-induced neuronal damage: a concise review	Shamprasad Varija Raghu, Avinash Kundadka Kudva, Golgodu Krishnamurthy Rajanikant, Manjeshwar Shrinath Baliga	2021-(1)
<p>Proposes some classic medicinal plants to palliate radiofrequency induced damage, based on experimental evidence. The names of proposed plants: Green tea polyphenols, Ginkgo biloba, lotus seedpod procyanidins, garlic extract, Loranthus longiflorus, Curcuma amada, and Rosmarinus officinalis.</p>		
Biological and health effects of non-ionizing radiation that is used by 5G	Igor Belyaev	2021-(1)
<p>" Complex dependence of the non-thermal RF effects on various physical and biological variables, such as carrier frequency, polarization, modulation, intermittence, electromagnetic stray fields, genotype, physiological traits, and cell density during exposure account for an apparent inconsistency in the published data [2]. Health effects of 5G mobile communication, which, in addition to 2G-4G signals, uses also millimeter waves (MMW), are of significant public concern. It follows from available studies that RF in general and MMW in particular, at very low intensities below the ICNIRP guidelines can induce biological effects and affect human health. We have shown that MMW inhibited repair of DNA damage induced by ionizing radiation under exposure at specific frequencies and polarizations [3]. Fundamental role of MMW in regulation of homeostasis was postulated by H. Fröhlich [4] and confirmed in many studies [2]."</p>		
Development of health-based exposure limits for radiofrequency radiation from wireless devices using a benchmark dose approach	Uloma Igara Uche, Olga V. Naidenko	2021-(14)
<p>" The analysis presented here supports a whole-body SAR limit of 2 to 4 mW/kg for adults, an exposure level that is 20- to 40-fold lower than the legally permissible limit of 0.08 W/kg for whole-body SAR under the current U.S. regulations. A ten-fold lower level of 0.2–0.4 mW/kg whole-body SAR may be appropriate for young children. Both technology changes and behavior changes may be necessary to achieve these lower exposure levels. Simple actions, such as keeping the wireless devices farther away from the body, offer an immediate way to decrease RFR exposure for the user." {From the publication}</p>		
Impact of mobile phone radiation on salivary gland: A systematic review	M. P. Revanth, S. Aparna, Parangimalai Diwakar Madankumar	2021-(6)
<p>" Among the 11 studies taken for review, salivary gland changes were found to be highest in the parotid gland in the aspect of salivary flow rate and composition and a positive relation was seen between the radiations emitted by the mobile phone in majority of studies." {From the publication}</p>		
Effects of non-ionizing electromagnetic fields on flora and fauna, part 1. Rising ambient EMF levels in the environment	B. Blake Levitt, Henry C. Lai, Albert M. Manville	2021-(1)
Electromagnetic radiation as an emerging driver factor for the decline of insects	Alfonso Balmori	2021-(5)
Current progress on the effect of mobile phone radiation on sperm quality: an updated systematic review and meta-analysis of human and animal studies	Gang Yu, Zhiming Bai, Song Chao, Qing Cheng, Gang Wang, Zeping Tang, Sixing Yang	2021-(1)
Chemical polarization effects of electromagnetic field radiation from the novel 5G network deployment at ultra high frequency	Ugochukwu O. Matthew, Jazuli S. Kazaure	2021-(13)
Electromagnetic Fields and Calcium Signaling by the Voltage Dependent Anion Channel	Volker Ullrich, Hans-Jürgen Apell	2021-(30)
<p>" Here we report collected evidence from literature that voltage dependent anion channels (VDAC) located not only in the outer microsomal membrane but also in the cytoplasmic membrane convert to Ca²⁺ conducting channels of varying capacities upon subtle changes of the applied EMF even in non-excitabile cells like erythrocytes. Thus, VDAC can be targeted by external EMF in both types of membranes to release Ca²⁺ into the cytosol." {From the publication}</p>		
Radiofrequency Radiation: a Possible Threat to Male Fertility	Himanshi, Umesh Rai, Rajeev Singh	2021-(1)
Cell phone and wireless radiation hazard on TRPV1 channel activation: A	Kiarash Shibarandi, Amirmohammad	2020-(9)

Scoping Review study	Rezaei Rashnoudi, Gholamreza Hassanzadeh, Rasoul Akbari, Omid Mobinfar, Fakher Rahim	
" Our review shows that cell phone and wireless radiation have a possible effect on Ca ²⁺ signaling by TRPV1 channel activation. This reaction may induce ROS, Fenton and Haber-Weiss reaction which increase free radicals' level in the mitochondria."		
The Impact of Radiofrequency Waves on Male Infertility: A Systematic Review	Leili Darvish, Azadeh Amraee, Marjan Akhavan Amjadi, Zahra Atarodi Kashani, Masoumeh Ghazanfarpour, Nasibeh Roozbeh, Fatemeh Abdi	2020-(9)
" A total of 14 articles that met the inclusion criteria were ultimately assessed. Motile sperm, sperm vitality and membrane integrity, morphology, volume, total sperm count, sperm concentration, and sperm fertility were found to be influenced by radiofrequency waves." {From the publication}		
Exposure to radiofrequency radiation increases the risk of breast cancer: A systematic review and meta-analysis	Ya-Wen Shih, Anthony Paul O'brien, Chin-Sheng Hung, Kee-Hsin Chen, Wen-Hsuan Hou, Hsiu-Ting Tsai	2020-(11)
" A significant association between radiofrequency radiation exposure and breast cancer risk was detected [pooled relative risk (RR)=1.189; 95% confidence interval (CI), 1.056-1.339]. Subgroup analyses indicated that radiofrequency radiation exposure significantly increased the risk of breast cancer susceptibility among subjects aged ≥50 years (RR=2.179; 95% CI, 1.260-3.770). Pooled estimates revealed that the use of electrical appliances, which emit radiofrequency radiation, such as mobile phones and computers, significantly increased breast cancer development (RR=2.057; 95% CI, 1.272-3.327), while occupational radiofrequency exposure and transmitters did not increase breast cancer development (RR=1.274; 95% CI, 0.956-1.697; RR=1.133; 95% CI, 0.987-1.300, respectively). It was concluded that radiofrequency radiation exposure significantly increased the risk of breast cancer, especially in women aged ≥50 years and in individuals who used electric appliances, such as mobile phones and computers." {From the publication}		
Impacts of RF radiation from mobile phones on human health and its remedies	L. Vijayalakshmi, P. Nirmala Devi	2020-(10)
5G Wireless Deployment and Health Risks: Time for a Medical Discussion in Australia and New Zealand	Priyanka Bandara, Tracy Chandler, Robin Kelly, Julie McCredden, Murray May, Steve Weller, Don Maisch, Susan Pockett, Victor Leach, Richard Cullen, Damian Wojcik	2020-(8)
The enigma of headaches associated with electromagnetic hyperfrequencies: Hypotheses supporting non-psychogenic algogenic processes	D. H. Toffa, A. D. Sow	2020-(1)
Evidences of the (400 MHz – 3 GHz) radiofrequency electromagnetic field influence on brain tumor induction	Fernando Pareja-Peña, Antonio M. Burgos-Molina, Francisco Sendra-Portero, Miguel J. Ruiz-Gómez	2020-(1)
The Adversity of Wireless Connectivity on Birds: A Relook		2020-(6)
A meta-analysis of in vitro exposures to weak radiofrequency radiation exposure from mobile phones (1990–2015)	Malka N. Halgamuge, Efstratios Skafidas, Devra Davis	2020-(1)
They found that between different cells exposed more mature lymphocytes and glial cells are less reactive to microwaves than less mature and less differentiated cells such as epithelium and spermatozoa. Microwaves induce significant changes in human cells (45.3%), and in faster-growing rat/mouse cell dataset (47.3%).		
Adverse health effects of 5G mobile networking technology under real-life conditions	Ronald N. Kostoff, Paul Heroux, Michael Aschner, Aristides Tsatsakis	2020-(1)
Effects of Radiofrequency Electromagnetic Field Exposure on Neurophysiology	Chidiebere Emmanuel Okechukwu	2019-(5)
The influence of bioactive mobile telephony radiation at the level of a plant community – Possible mechanisms and indicators of the effects	Marek Czerwiński, Alain Vian, Amparo Lázaro	2019-(12)
Electromagnetism and plant development: a new unknown in a known world	João Paulo Ribeiro-Oliveira	2019-(6)
Adverse Effects of Wireless Radiation	Ronald N. Kostoff	2019-(649)
" 101 publications are exploited which have studied genotoxicity of radiofrequency electromagnetic fields (RF-EMF) in vivo and in vitro . Of these 49 report a genotoxic effect and 42 do not. In addition, 8 studies failed to detect an influence on the genetic material, but showed that RF-EMF enhanced the genotoxic action of other chemical or physical agents. The controversial results may in part be explained by the different cellular systems. Moreover, inconsistencies may depend from the variety of analytical methods being used, which differ considerably with respect to sensitivity and specificity. Taking altogether there is ample evidence that RF-EMF can alter the genetic material of exposed cells i n vivo and in vitro and in more than one way." {From the publication}		
On the Clear Evidence of the Risks to Children from Non-Ionizing Radio Frequency Radiation: The Case of Digital Technologies in the Home, Classroom and Society	Tom Butler	2019-(34)
The Contribution of In Vivo Mammalian Studies to the Knowledge of Adverse Effects of Radiofrequency Radiation on Human Health	Andrea Vornoli, Laura Falcioni, Daniele Mandrioli, Luciano Bua, Fiorella Belpoggi	2019-(27)

<p>" In conclusion, according to NTP, there is now clear evidence that RFR causes cancer in experimental animals. RFR re-evaluation has also been listed as a priority by IARC [87]. There is also stronger evidence that RFR exposure is responsible for causing alteration of various sperm parameters, thus, affecting male fertility. Although a clear quantification of the carcinogenic and reproductive risk is still lacking, these animal findings suggest that a precautionary approach should be promoted by regulatory and health agencies, especially for children and pregnant women. Caution should also be considered in the development and spread of the upcoming 5G technology, particularly in light of the proposed higher frequencies and intensities of the signal. Long-term animal studies are urgently necessary to verify the possible health effects of 5G technology." {From the publication}</p>		
5G Wireless Communication and Health Effects—A Pragmatic Review Based on Available Studies Regarding 6 to 100 GHz	Myrtil Simkó, Mats-Olof Mattsson	2019-(23)
<p>" Eighty percent of the in vivo studies showed responses to exposure, while 58% of the in vitro studies demonstrated effects. The responses affected all biological endpoints studied. There was no consistent relationship between power density, exposure duration, or frequency, and exposure effects. The available studies do not provide adequate and sufficient information for a meaningful safety assessment, or for the question about non-thermal effects." {From the publication}</p>		
Radiofrequency electromagnetic radiation-induced behavioral changes and their possible basis	Sareesh Naduvil Narayanan, Raghu Jetti, Kavindra Kumar Kesari, Raju Suresh Kumar, Satheesha B. Nayak, P. Gopalakrishna Bhat	2019-(1)
Risks to Health and Well-Being From Radio-Frequency Radiation Emitted by Cell Phones and Other Wireless Devices	Anthony B. Miller, Margaret E. Sears, L. Lloyd Morgan, Devra L. Davis, Lennart Hardell, Mark Oremus, Colin L. Soskolne	2019-(10)
<p>" Based on the accumulated evidence, we recommend that IARC re-evaluate its 2011 classification of the human carcinogenicity of RFR, and that WHO complete a systematic review of multiple other health effects such as sperm damage. In the interim, current knowledge provides justification for governments, public health authorities, and physicians/allied health professionals to warn the population that having a cell phone next to the body is harmful, and to support measures to reduce all exposures to RFR." {From the publication}</p>		
Adverse Effects of Wi-Fi Radiation on Male Reproductive System: A Systematic Review	Farah Hanan Fathihah Jaffar, Khairul Osman, Nur Hilwani Ismail, Kok-Yong Chin, Siti Fatimah Ibrahim	2019-(11)
<p>" A total of 23 articles were used for data extraction, including 15 studies on rats, three studies on mice, and five studies on human health. Sperm count, motility and DNA integrity were the most affected parameters when exposed to RF-EMR emitted by Wi-Fi transmitter. Unfortunately, sperm viability and morphology were inconclusive. Structural and/or physiological analyses of the testes showed degenerative changes, reduced testosterone level, increased apoptotic cells, and DNA damage. These effects were mainly due to the elevation of testicular temperature and oxidative stress activity. In conclusion, exposure towards 2.45 GHz RF-EMR emitted by Wi-Fi transmitter is hazardous on the male reproductive system."</p>		
The possible global hazard of cell phone radiation on thyroid cells and hormones: a systematic review of evidences	Jafar Fatahi Asl, Bagher Larijani, Mehrnoosh Zakerkish, Fakher Rahim, Kiarash Shirbandi, Rasoul Akbari	2019-(1)
Are rises in Electro-Magnetic Field in the human environment, interacting with multiple environmental pollutions, the tripping point for increases in neurological deaths in the Western World?	Colin Pritchard, Anne Silk, Lars Hansen	2019-(8)
<p>They conclude that the unprecedented neurological death rates, all within just twenty-five years, demands a re-examination of long-term EMF safety levels.</p>		
Benefits and hazards of electromagnetic waves, telecommunication, physical and biomedical: a review	S. Batool, A. Bibi, F. Frezza, F. Mangini	2019-(8)
A Longitudinal Study of Psychophysiological Indicators in Pupils Users of Mobile Communications in Russia (2006–2017) - [Full book here]	Yury G. Grigoriev, Natalia I. Khorseva	2018-(1)
Effect of radiofrequency radiation on reproductive health	Rajeev Singh, Ravindra Nath, Ajit Kumar Mathur, Radhey Shyam Sharm	2018-(8)
Planetary electromagnetic pollution: it is time to assess its impact	Priyanka Bandara, David O. Carpenter	2018-(3)
Radiations and male fertility	Kavindra Kumar Kesari, Ashok Agarwal, Ralf Henkel	2018-(16)
Role of Mitochondria in the Oxidative Stress Induced by Electromagnetic Fields: Focus on Reproductive Systems	Silvano Junior Santini, Valeria Cordone, Stefano Falone, Mahmut Mijit, Carla Tatone, Fernanda Amicarelli, Giovanna Di Emidio	2018-(19)
<p>" Numerous studies revealed the detrimental effects of EMFs from mobile phones, laptops, and other electric devices on sperm quality and provide evidence for extensive electron leakage from the mitochondrial electron transport chain as the main cause of EMF damage. In female reproductive systems, the contribution of oxidative stress to EMF-induced damages and the evidence of mitochondrial origin of ROS overproduction are reported, as well." {From the publication}</p>		
5G wireless telecommunications expansion: Public health and environmental implications	Cindy L. Russell	2018-(12)
Towards 5G communication systems: are there health implications?	Agostino Di Ciaula	2018-(27)
<p>" Further studies are needed to better and independently explore the health effects of RF-EMF in general and of MMW in particular.</p>		

<p>However, available findings seem sufficient to demonstrate the existence of biomedical effects, to invoke the precautionary principle, to define exposed subjects as potentially vulnerable and to revise existing limits."</p>		
A novel database of bio-effects from non-ionizing radiation	Victor Leach, Steven Weller, Mary Redmayne	2018-(8)
<p>" As of the 15th September 2017, the clear majority of 2653 papers captured in the database examine outcomes in the 300 MHz–3 GHz range. There are 3 times more biological "Effect" than "No Effect" papers; nearly a third of papers provide no funding statement; industry-funded studies more often than not find "No Effect", while institutional funding commonly reveal "Effects". Country of origin where the study is conducted/funded also appears to have a dramatic influence on the likely result outcome."</p>		
Electromagnetic Radiation from Cellphone Towers: A Potential Health Hazard for Birds, Bees, and Humans	Chanda Siddoo-Atwal	2018-(?)
The genomic effects of cell phone exposure on the reproductive system	Ahmad Yahyazadeh, Ömür Gülsüm Deniz, Arife Ahsen Kaplan, Gamze Altun, Kıymet Kübra Yurt	2018-(10)
Effects of mobile phone exposure on metabolomics in the male and female reproductive systems	Gamze Altun, Ömür Gülsüm Deniz, Kıymet Kübra Yurt, Devra Davis, Süleyman Kaplan	2018-(1)
Genotoxic and carcinogenic effects of non-ionizing electromagnetic fields	Adem Kocaman, Gamze Altun, Arife Ahsen Kaplan, Ömür Gülsüm Deniz, Kıymet Kübra Yurt, Süleyman Kaplan	2018-(1)
<p>" The inconsistent results between similar studies and the same research groups have made it very difficult to make any comprehensive interpretation. However, evaluation of current studies suggests that EMF may represent a serious source of concern and may be hazardous to living organisms."</p>		
Effects of electromagnetic fields exposure on the antioxidant defense system	Elfide Gizem Kıvrak, Kıymet Kübra Yurt, Arife Ahsen Kaplan, Işinsu Alkan, Gamze Altun	2018-(10)
Electromagnetic fields may act via calcineurin inhibition to suppress immunity, thereby increasing risk for opportunistic infection: Conceivable mechanisms of action	P. R. Doyon, O. Johansson	2017-(17)
Mobile Telephony EMFs Effects on Insect Ovarian Cells. The Necessity for Real Exposures Bioactivity Assessment. The Key Role of Polarization, and the "Ion Forced-Oscillation Mechanism"	Dimitris J. Panagopoulos	2017-(48)
<p>" ... A significant opposition is found between the results of experimental studies employing real exposures of biological samples from commercially available mobile phones, and the results of studies employing simulated exposures from generators or "test" phones as suggested by health authorities (Health Protection Agency 2012; IARC 2013). While experimental studies employing simulated EMF-emissions present a strong inconsistency among their results with nearly 50% of them reporting no effects, studies employing real-life emissions demonstrate an almost 100% consistency in showing adverse effects (Panagopoulos et al. 2015a). Finally, in the present chapter we show why polarized (man-made) EMFs are significantly more bioactive than natural (unpolarized) ones, and we describe the "Ion Forced-Oscillation Mechanism" for the action of polarized EMFs on biological systems."</p>		
Modified Health Effects of Non-ionizing Electromagnetic Radiation Combined with Other Agents Reported in the Biomedical Literature	Ronald N. Kostoff, Clifford G. Y. Lau	2017-(61)
Inaccurate official assessment of radiofrequency safety by the Advisory Group on Non-ionising Radiation	Sarah J. Starkey	2016-(11)
The effects of radiofrequency electromagnetic radiation on sperm function	B. J. Houston, B. Nixon, B. V. King, G. N. De Luliis, R. J. Aitken	2016-(14)
Brain Topography of Emf-Induced Eeg-Changes in Restful Wakefulness: Tracing Current Effects, Targeting Future Prospects	Biljana Gjoneska, Simona Markovska-Simoska, Hiie Hinrikus, Nada Pop-Jordanova, Jordan Pop-Jordanov	2016-(10)
Radiofrequency radiation at Stockholm Central Railway Station in Sweden and some medical aspects on public exposure to RF fields	Lennart Hardell, Tarmo Koppel, Michael Carlberg, Mikko Ahonen, Lena Hedendahl	2016-(10)
Review: Weak radiofrequency radiation exposure from mobile phone radiation on plants	Malka N. Halgamuge	2016-(23)
A review on Electromagnetic fields (EMFs) and the reproductive system	Ali Asghari , Amir Afshin Khaki, Asghar Rajabzadeh, Arash Khaki	2016-(8)
<p>" Many studies have shown that electromagnetic fields can have destructive effects on sex hormones, gonadal function, fetal development, and pregnancy. So people must be aware of the negative effects of EMFs. Although the impact of the waves varied at different frequencies, it is better to stay as far away as possible from their origin because of the risks associated with exposures to these waves. In addition, people can use of natural antioxidants to help reduce the effects of these waves." {From the publication}</p>		
Effects of Wireless Devices on Human Body	R. S. A. Larik, G. A. Mallah, M. M. A. Talpur, A. K. Suhag, F. A. Larik	2016-(6)
<p>" This study investigated three major diseases, i.e., brain tumor, male infertility and hearing impairment. The survey/investigations have been conducted from number of medical practitioners working in various hospitals and medical centers of District Sukkur and Khairpur Mirs'. The results, collected through interviews and survey, show the intensity of harm of different wireless devices." {From</p>		

<p>the publication} " A total of 300 Medical Doctors were surveyed about the effect of wireless devices on human body. On the basis of patients under their treatment, 99% medical doctors gave a positive response to the effect of wireless devices on human body ... " {From the publication}</p>		
<p>Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation</p>	<p>Igor Yakymenko, Olexandr Tsybulin, Evgeniy Sidorik, Diane Henshel, Olga Kyrylenko, Sergiy Kyrylenko</p>	<p>2015-(16)</p>
<p>In this review is concluded that low-intensity radiofrequency causes effects at molecular level in living cells including significant activation of key pathways generating reactive oxygen species (ROS), activation of peroxidation, oxidative damage of DNA and changes in the activity of antioxidant enzymes.</p>		
<p>Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression</p>	<p>Martin L. Pall</p>	<p>2015-(9)</p>
<p>This paper has a double intention: On the one hand it makes a review of the epidemiological literature that associate microwaves (MW) to neuropsychiatric and mood disorders concluding that a great association was founded, on the other hand however it proposes the action of MW on voltage gated calcium channels as the mechanism (unique mechanism) that mediate those biological effects, but along this website are viewed other mechanism that are surely in action, one of them for example include water or the liquid medium as the mediator for the biological effects. From the abstract of this paper: " ... these may be generated through roles of VGCC activation, producing excessive neurotransmitter/neuroendocrine release as well as oxidative/nitrosative stress and other responses. ... 18 more recent epidemiological studies, provide substantial evidence that microwave EMFs from cell/mobile phone base stations, excessive cell/mobile phone usage and from wireless smart meters can each produce similar patterns of neuropsychiatric effects, with several of these studies showing clear dose-response relationships. Lesser evidence from 6 additional studies suggests that short wave, radio station, occupational and digital TV antenna exposures may produce similar neuropsychiatric effects. Among the more commonly reported changes are sleep disturbance/insomnia, headache, depression/depressive symptoms, fatigue/tiredness, dysesthesia, concentration/attention dysfunction, memory changes, dizziness, irritability, loss of appetite/body weight, restlessness/anxiety, nausea, skin burning/tingling/dermographism and EEG changes." {From the publication} Is interestingly (and worrying) when it mentions: " While there is no question that many of these studies show high strength of association, it is also clear that it is becoming progressively more difficult to do these studies. As exposures become almost universal in countries around the world, it is getting difficult if not impossible to find good negative controls. There may be a similar problem in doing animal studies, such that it may be necessary to raise animals in Faraday cages in order to avoid exposures that would otherwise occur as a consequence of our near ubiquitous EMFs." {From the publication}</p>		
<p>Polarization: A Key Difference between Man-made and Natural Electromagnetic Fields, in regard to Biological Activity</p>	<p>Dimitris J. Panagopoulos, Olle Johansson, George L. Carlo</p>	<p>2015-(10)</p>
<p>" In the present study we analyze the role of polarization in the biological activity of Electromagnetic Fields (EMFs)/Electromagnetic Radiation (EMR). All types of man-made EMFs/EMR - in contrast to natural EMFs/EMR - are polarized. Polarized EMFs/EMR can have increased biological activity, due to: 1) Ability to produce constructive interference effects and amplify their intensities at many locations. 2) Ability to force all charged/polar molecules and especially free ions within and around all living cells to oscillate on parallel planes and in phase with the applied polarized field. Such ionic forced-oscillations exert additive electrostatic forces on the sensors of cell membrane electro-sensitive ion channels, resulting in their irregular gating and consequent disruption of the cell's electrochemical balance." {From the publication}</p>		
<p>Real versus Simulated Mobile Phone Exposures in Experimental Studies</p>	<p>Dimitris J. Panagopoulos, Olle Johansson, George L. Carlo</p>	<p>2015-(8)</p>
<p>It explains that there are differences on the quantity of effects found when comparing studies that used telephony radiation simulation generators (less effects) or radiation generated by real mobiles (more effects). " The aim of the present study is to review biological and clinical experimental studies on mobile phone radiation effects which have employed exposures with real mobile phone emissions, as opposed to the mainstream studies which employ simulated mobile phone emissions produced by generators or test phones." {From the publication} It's viewed that pulsed modulated and/or intermittent exposure (more realistic) is more bioactive than continuous signals. For example; Radiofrequency plus Extremely Low Frequency pulsing frequencies has been found to be more bioactive than a Radiofrequency carrier alone. " the phase of the carrier signal varies continuously during a phone-conversation, and the RF frequency constantly changes between different available frequency channels, especially in third generation (3G) radiation." {From the publication} " while within the group of studies with simulated emissions there is also a conflict between studies that find effects and studies that do not [50-50%], the group of studies with real exposures demonstrates an impressive consistency in showing effects almost at 100%." {From the publication}</p>		
<p>Effects of microwave radiation on brain energy metabolism and related mechanisms</p>	<p>Yan-Hui Hao, Li Zhao, Rui-Yun Peng</p>	<p>2015-(8)</p>
<p>The essay is centered on microwave (MW) radiation effects on brain metabolism that it supposes to be mediated through mitochondrial dysfunction and the reduction of the generated ATP. In mitochondria MW causes structural damage, with experiments that show that they are swollen and vacuolated, with cristae that were disordered and fewer in number, and exists a general mitochondrial degeneration demonstrated by myelin-like structures and occasional dense deposits. Also there are dysfunctions in the mitochondrial energy metabolism with a reduction in mitochondrial ATP synthesis, decreased succinate dehydrogenase (SDH) activity and suppressed cytochrome c oxidase (COX) activity (two of the key enzymes of mitochondrial energy metabolism). It also reviews abnormal expression of the genes encoding the respiratory chain that results in brain energy metabolism disorders. " [after radiation, gene expression] upregulated: syn1, ptpnj, CD74 and MHCII; downregulated: ttr, enpp2, folr1, cdh22, spata2, spp1, calb2, tacl and dnpi), some of which (syn1, ttr and enpp2) are closely related to the metabolic function of mitochondria." {From the publication} " MW radiation downregulates the COX I gene encoded by mitochondrial DNA in the cerebral cortex and hippocampus of rats in a dose-dependent manner. These results suggest that the changes in gene expression caused by MW radiation are important factors in mitochondrial dysfunction and brain energy failure." {From the publication}</p>		

<p>And damaged mitochondrial membrane: " The structural damage of the mitochondrial membrane is one of the most important mechanisms of MW radiation-induced disturbance of brain energy metabolism. Mitochondria are organelles wrapped by a double membrane, with the inner membrane forming cristae, which increase the surface area of the mitochondrial membrane greatly. As biofilms are targets of electromagnetic radiation [41], it can be inferred that the structural characteristics of mitochondria determine its high sensitivity to MW radiation-induced injury." (From the publication) And also affects mitochondrial DNA: " MW radiation can break mtDNA or change the expression of mtDNA, resulting in decreased ATP production." (From the publication)</p>		
Association between ELF and RF electromagnetic field and Leukemia	Majid Mahdavi, Reza Yekta, Saeed Hesami Tackallou	2015-(10)
Effect of Mobile Phone-Induced Electromagnetic Field on Brain Hemodynamics and Human Stem Cell Functioning: Possible Mechanistic Link to Cancer Risk and Early Diagnostic Value of Electronphonic Imaging	H. Bhargav, T. M. Srinivasan, S. Varambally, B. N. Gangadhar, P. Koka	2015-(8)
Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A) (Review)	L. Lloyd Morgan, Anthony B. Miller, Annie Sasco, Devra Lee Davi	2015-(7)
<p>Author criticizes the CERENAT French case-control study because it includes as telephony users only mobile phone users and they not take in account the digitally enhanced cordless telephony (DECT) users, which in France is used by over 50% of the population, so the reference category 'no regular use' included subjects who used a DECT. Also critiques that the participation rate was relatively low: 66% for cases and 45% for controls. " the authors of the INTERPHONE study acknowledged the possible selection bias from low participation rates and calculated that these resulted in a 10% underestimation of risk" Anyways is clear the augmentation of cancer risk: " 'Heavy mobile phone' use was associated with increased risks of meningioma (but somewhat weaker than the risks for glioma)" Finally shows evidence that electromagnetic radiation can act both as an initiator and as promoter of tumor. " The cerenat study corroborates the significant risks of glioma associated with exposure to radiofrequency fields reported by the Swedish team and by the 13-country INTERPHONE study, and adds weight to the epidemiological evidence that radiofrequency fields, classified by the international a gency for research on cancer as a group 2B (possible) carcinogen in 2011 should be reclassified as a Group 2A (probable) carcinogen."</p>		
Anthropogenic Radiofrequency Electromagnetic Fields as an Emerging Threat to Wildlife Orientation	Alfonso Balmori	2015-(3)
Electrosmog and species conservation	Alfonso Balmori	2014-(3)
Health Effects of Mobile Phone Usage	Angelo Levis, Laura Masiero, Paolo Orio, Susan Biggin, Spiridione Garbisa	2014-(36)
<p>The authors, after a review of published data, come to the conclusion that studies of electromagnetic effects can be divided in two groups; those that are funded by telecommunication industry and those that are not, with the first having numerous procedure fault to arrive to the conclusion of no effect of telephony, while others financed by public funds are more correctly designed and have other conclusions. " Uncertainty about the association between health risks and exposure to radiofrequency radiation emitted by cellular and cordless mobile phones can be addressed by a critical analysis of the methodology used in studies assessing this relationship. Studies funded by cellphone companies give reassuring conclusions but are affected by biases and flaws, whereas public-funded studies are without these errors and show acute and chronic effects, including head tumors, findings supported by biological evidence. " For example (taken from table 2) here there are some of the methodology errors that they detect in the Interphone negative studies, based on a "non-blind" protocol; and the reliability of Hardell positive studies, based on a "double-blind" protocol. They review cellphone-company funding of studies in this very interesting reading.</p>		
Why children absorb more microwave radiation than adults: The consequences	L. Lloyd Morgan, Santosh Kesari, Devra Lee Davis	2014-(8)
The Effects of Microwave Radiation on Microbial Cultures	Slobodan M. Janković, Milorad Z. Milošev, Milan LJ. Novaković	2014-(7)
Effects of Cellular Phone- and Wi-Fi-Induced Electromagnetic Radiation on Oxidative Stress and Molecular Pathways in Brain	Mustafa Nazıroğlu, Hatice Akman	2104-(19)
<p>" Electromagnetic radiation may induce some degenerative effects in the brain by increasing oxidative stress and DNA breakage plus interference with the blood-brain barrier permeability. There are also recent reports on the role of Wi-Fi and mobile phone frequencies on Ca²⁺ influx through Ca²⁺ channels. The EMR increases ROS production in the neurons through the activation of oxidant system including NADPH oxidase activity and nitric oxide production. These effects are accompanied by a decrease in brain tissue of enzymatic antioxidants such as superoxide dismutase, catalase, and glutathione peroxidase together with a fall in the levels of nonenzymatic antioxidants such as glutathione and vitamin C."</p>		
Mobile Phone Radiation and Human Serum Components: A Short Literature Review on Recent Findings	Hamid Nasri, Parto Nasri, Milad Baradaran-Ghahfarokhi, Daryoush Shahbazi-Gahrouei, Jafar Fattahi-asl	2014-(6)
Low intensity radiofrequency radiation: a new oxidant for living cells	Igor Yakymenko, Evgeniy Sidorik, Diane Henshel Sergiy Kyrylenko	2014-(3)
Effect of mobile telephones on sperm quality: A systematic review and meta-analysis	Jessica A. Adams, Tamara S. Galloway, Debapriya Mondal, Sandro C. Esteves, Fiona Mathews	2014-(7)
Association between mobile phone use and semen quality: a systemic	K. Liu, Y. Li, G. Zhang, J. Liu, J. Cao,	2014-(11)

review and meta-analysis	L. Ao, S. Zhang	
A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF)	S. Cucurachi, W.L.M. Tamis, M.G. Vijver, W.J.G.M. Peijnenburg, J.F.B. Bolte, G.R. de Snoo	2013-(25)
<p>" Information was collected from 113 studies from original peer-reviewed publications or from relevant existing reviews. A limited amount of ecological field studies was identified. The majority of the studies were conducted in a laboratory setting on birds (embryos or eggs), small rodents and plants. In 65% of the studies, ecological effects of RF-EMF (50% of the animal studies and about 75% of the plant studies) were found both at high as well as at low dosages. No clear dose-effect relationship could be discerned. Studies finding an effect applied higher durations of exposure and focused more on the GSM frequency ranges." {From the publication}</p>		
Biological and Health Effects of Microwave Radio Frequency: A Review of the Research Literature	Paul Dart, Kathleen Cordes, Andrew Elliott, James Knackstedt, Joseph Morgan, Pamela Wible, Steven Baker	2013-(85)
Feasibility for Microwaves Energy to Affect Biological Systems via Non-Thermal Mechanisms: a Systematic Approach	Francesca Apollonio, Micaela Liberti, Alessandra Paff, Caterina Merla, Paolo Marracino, Agnese Denzi, Carmela Marino, Guglielmo d'Inzeo	2013-(16)
Effect of Low Power Microwave Radiation on Microorganisms and other Life Forms	Toshi Mishra, Preemada Kushwah, Krunal Dholiya, Vijay Kothari	2013-(8)
Recent Reports of Wi-Fi and Mobile Phone-Induced Radiation on Oxidative Stress and Reproductive Signaling Pathways in Females and Males	Mustafa Nazıroğlu, Murat Yüksel, Seyit Ali Köse, Mehmet Okan Özkaya	2013-(1)
Wi-Fi technology – an uncontrolled global experiment on the health of mankind	Marko Markov, Yuri G. Grigoriev	2013-(9)
Cell phone radiation exposure on brain and associated biological systems	Kavindra Kumar Kesari, Mohd Haris Siddiqui, Ramovatar Verma Meena, Shivendra H. N. Kumar	2013-(14)
-Autism and EMF? Plausibility of a pathophysiological link – Part I-Autism and EMF? Plausibility of a pathophysiological link – Part II-Autism and EMF? Plausibility of a pathophysiological link – Part II	Martha R. Herbert, Cindy Sage	2013-(19)2013-(24)
Autism: An epigenomic side-effect of excessive exposure to electromagnetic fields	Yog Raj Ahuja, Sanjeev Sharma, Bir Bahadur	2013-(7)
Combined biological and health effects of electromagnetic fields and other agents in the published literature	Ronald N. Kostoff, Clifford G.Y. Lau	2013-(95)
Cancer induction molecular pathways and HF-EMF irradiation	Gérard Ledoigt, Dominique Belpomme	2013-(10)
<p>Numerous data and experimental results are shown in this review. " There are many examples of biological effects involving the epigenome. EMFs could trigger protein activation mediated by ligands, such as Ca²⁺, that alter the conformation of binding proteins, especially the NADPH plasmic membrane oxidase, so inducing increased formation of reactive oxygen species (ROS) that may alter proteomic functions. Classical anti-apoptotic and procarcinogenic signaling pathways that are commonly found activated in human malignancies and in inflammation mainly involve the transcription factor NF-κB. The microenvironment that exists during chronic inflammation can contribute to cancer progression. The data support the proposition that long term HF-EMF exposure associated with improper use of cell phones can potentially cause cancer." {From the publication} They are revised various possibles targets of radiation including water: " Microwave (MW) exposure at the water resonance frequency, i.e. exposure to radiofrequencies between about 1 GHz and 300 GHz, was able to induce alteration of the mitotic apparatus and apoptosis as a function of the applied power densities (5 and 10 mW/cm²), together with a moderate reduction in the rate of cell division." {From the publication} Microtubules...: " Microtubule fibers represent extremely dynamic structure which functioning depends on dynamical instability that is continuously binding and releasing of free tubule proteins. One can reasonably assume that the external EM radiation might interact with polar cytoskeletal structure." {From the publication} ..And membrane: " He concluded that conformational changes arising from alterations in charge distribution play a key role in membrane transport proteins, including ion channels. Thus, weak EMFs can control and amplify biological processes through their effects on charge distribution." {From the publication} " Panagopoulos et al. [39] have suggested that oscillating ions during forced vibration will also exert mechanical force-pressure on the plasma membrane able to upset the membrane electrochemical balance, under certain conditions, by opening or closing mechanically gated channel proteins, like some Ca influx channels." {From the publication} Also they point out how the oxidative stress that the radiation provoques can be associated with increases tumor risk.</p>		
Mobile Phones and Head Tumours: A Critical Analysis of Case-Control Epidemiological Studies	Angelo Gino Levis, Nadia Minicuci, Paolo Ricci, Valerio Gennaro, Spiridione Garbisa	2012-(12)
<p>The authors do a critique and a comparison of epidemiological studies and point to various defects in the protocols of the Intephone studies. " In studies funded by public bodies, blind protocols give positive results revealing cause-effect relationships between long-term latency or use of mobile phones (cellulars and cordless) and statistically significant increases of ipsilateral risk of brain gliomas and acoustic neuromas, with biological plausibility. In studies funded or co-funded by the cellphone companies non-blind protocols</p>		

<p>give overall negative results with systematic underestimation of risk; however, also in these studies a statistically significant increase in risk of ipsilateral brain gliomas, acoustic neuromas, and parotid gland tumours is quite common when only subjects with at least 10 years of latency or exposure to mobile phones (only cellulars) are considered." Some of the fails in Interphone study are, for example, that the Interphone protocol defines "exposed" subjects having used the phone "at least once a week for at least six months", so even if a risk exists it is diluted because they are included people with almost no use of mobile phones, other defect is that on majority of Interphone studies, fewer than 10% of the exposed cases and controls had completed at least 10 year of mobile phone continuous use. And more fails; that the Interphone protocol considers cordless phone users as not exposed, that the Interphone study fails to consider other types of malignant and benign head tumours, except gliomas, meningiomas, neuromas and parotid gland tumours. Etc...</p>		
<p>Long-term exposure to microwave radiation provokes cancer growth: evidences from radars and mobile communication systems</p>	<p>I. Yakymenko, E. Sidorik, S. Kyrylenko, V. Chekhun</p>	<p>2011-(9)</p>
<p>Non-thermal Cellular Effects of Low Power Microwave Radiation on the Lens and Lens Epithelial Cells</p>	<p>Y. Yu, K. Yao</p>	<p>2010-(8)</p>
<p>" It has been reported that exposure affects lens transparency, alters cell proliferation and apoptosis, inhibits gap junctional intercellular communication, and induces genetic instability and stress responses in LEC. [Lens Epithelial Cells]" {From the publication} As some examples; damage to LEC has found to be associated with the formation of cataracts with opacity in the lens cortex, and that the mechanism of action of the non-thermal (low power) induced cataracts are totally different than those of thermal energies: " In contrast to the thermal effect, the non-thermal effect was particularly pronounced in the vicinity of the sutures." {From the publication} Respect to apoptotic issues on LEC it has been found decreased cell viability, increased cell condensation, and inhibition of DNA synthesis and cell arrest at the G 0 /G 1 phase. In another experiment it was also found that " .. In the 5 mW/cm2 microwave radiation group, large numbers of LECs were in the initial phase of apoptosis and, in the group exposed to 10 mW/cm2 microwave radiation, many LECs had become secondary necrotic cells. Ye et al [26] also found that, when rabbit eyes were exposed to 10 mW/cm 2 of low-power 2450 MHz microwave radiation for 30 h, the ultrastructure of the LECs changed; apoptotic morphological changes, including small cell size, decreased number of mitochondria and balloon-shaped mitochondria" {From the publication} Finally it is also found an inhibition of Gap junctional intercellular communication in LECs, inducing a disruption of coordinated transport activity. It also affects the stress response pathways by the activation of heat shock protein (HSP): " Using Western blot analysis, Yu et al [38] confirmed that microwave exposure produced significant changes in HSP27 and HSP70 but not HSP90 expression in LECs." It explains how oxidative stress is a major factor leading to cataract formation. {From the publication}</p>		
<p>Genotoxic effects of radiofrequency electromagnetic fields</p>	<p>Hugo W. Ruediger</p>	<p>2009-(14)</p>
<p>" 101 publications are exploited which have studied genotoxicity of radiofrequency electromagnetic fields (RF-EMF) in vivo and in vitro . Of these 49 report a genotoxic effect and 42 do not. In addition, 8 studies failed to detect an influence on the genetic material, but showed that RF-EMF enhanced the genotoxic action of other chemical or physical agents. The controversial results may in part be explained by the different cellular systems. Moreover, inconsistencies may depend from the variety of analytical methods being used, which differ considerably with respect to sensitivity and specificity. Taking altogether there is ample evidence that RF-EMF can alter the genetic material of exposed cells i n vivo and in vitro and in more than one way." {From the publication}</p>		
<p>Mobile Phone Use and Risk of Tumors: A Meta-Analysis</p>	<p>Seung-Kwon Myung, Woong Ju, Diana D. McDonnell, Yeon Ji Lee, Gene Kazinets, Chih-Tao Cheng, Joel M. Moskowitz</p>	<p>2009-(8)</p>

High Frequency

/ Papers listed: 31

High Frequency

Title	Used freq. and power	Authors	Year (pages)
Evaluation of Cell Migration and Cytokines Expression Changes under the Radiofrequency Electromagnetic Field on Wound Healing In Vitro Model	27.1 MHz	Erica Costantini, Lisa Aielli, Federica Serra, Lorenzo De Dominicis, Katia Falasca, Pamela Di Giovanni, Marcella Reale	2022-(14)
" The results showed that RF-EMF treatment promotes keratinocytes' migration and regulates the expression of genes involved in healing, such as MMPs, tissue inhibitors of metalloproteinases, and pro/anti-inflammatory cytokines, to improve WH [Wound healing]." {From the publication}			
A Systematic Method to Explore Radio Frequency Non-Thermal Effect on the Growth of <i>Saccharomyces cerevisiae</i>	1 MHz, 3.16 MHz, 10 MHz - (SAR 0.0024 W/kg)	Duye Ye, Gabriel Cutter, Tom Caldwell, Sarah Harcum, Pingshan Wang	2021-(1)
" The results showed that the RF fields at 3.162 MHz reduced yeast growth rates by 15.1%; however, the RF fields at 1.0 MHz enhanced cell growth by 13.7%, while the observed 4.3% growth rate increase at 10 MHz is insignificant and the RF fields at 905 MHz had no effects on the cell growth. These results showed a clear RF NT effects on <i>S. cerevisiae</i> growth that was frequency dependent."			
Safety and Efficacy of amplitude-modulated radiofrequency electromagnetic fields in advanced hepatocellular carcinoma	27.12 MHz (0.1 Hz to 150 KHz modulated, tumor specific) - (SAR 0.001 W/kg (body))	Arthur W. Blackstock, Al B. Benson, Masatoshi Kudo, Hugo Jimenez, Preeya F. Achari, Callum McGrath, Volker Kirchner, Lynne I. Wagner, Nathaniel S. O'Connell, Kathy Walker, Valerie K. Pasche, Ralph D'Agostino Jr., Alexandre Barbault, Boris Pasche	2021-(13)
" Hepatocellular carcinoma (HCC) is the third leading cause of cancer death worldwide. Despite the recent approval of several new agents, long-term disease control remains elusive for most patients. Administration of 27.12 MHz radiofrequency (RF) electromagnetic fields (EMF) by means of a spoon-shaped antenna (TheraBionic P1 device) placed on the anterior part of the tongue results in systemic delivery of low and safe levels of RF EMF from head to toe." {From the publication} " Treatment of advanced HCC with the TheraBionic P1 device is well tolerated, even in patients with severely impaired liver function, and results in improved overall survival compared to historical controls without any significant adverse events, even after many years of continuous treatment." {From the publication}			
Non-thermal membrane effects of electromagnetic fields and therapeutic applications in oncology	-	Peter Wust, Ulrike Stein, Pirus Ghadjar	2021-(17)
" Our overview is intended to show that non-thermal effects exist in the RF range of 10–30 MHz that can be exploited for therapeutic purposes as a further development of conventional hyperthermia. Microscopic hot spots, which are often cited as an explanation for alleged non-thermal effects, were discussed in detail and could largely be excluded both in the clinical studies discussed and in the preclinical experiments (Section 5.1). Instead, we presented possible mechanisms at ion channels for non-thermal effects of sinusoidal RF (Section 5.2). The data suggest that additional AM with selected (tumor-specific) modulation frequencies might enhance the antiproliferative effects of sinusoidal RF (Sections 3.3 and 4.3). We presented membrane resonances as a possible explanation for such frequency-dependent behavior and could correlate the observed modulation frequencies (hertz to kilohertz) with elastic membrane properties that are characteristic for tumor cells (Section 5.3)." {From the publication} " In our model, transmembrane ion channels function like RF rectifiers and low-pass filters. cRF-HT induces ion fluxes and AM-RF-HT additionally promotes membrane vibrations at specific resonance frequencies, which explains the non-thermal antiproliferative membrane effects via ion disequilibrium (especially of Ca ²⁺) and/or resonances causing membrane depolarization, the opening of certain (especially Ca ²⁺) channels, or even hole formation. AM-RF-HT may be tumor-specific owing to cancer-specific ion channels and because, with increasing malignancy, membrane elasticity parameters may differ from that in normal tissues." {From the publication}			
Repeated electromagnetic field stimulation lowers amyloid-β peptide levels in primary human mixed brain tissue cultures	64 MHz - (SAR 0.4-0.9 W/kg)	Felipe P. Perez, Bryan Maloney, Nipun Chopra, Jorge J. Morisaki, Debomoy K. Lahiri	2021-(13)
" Late Onset Alzheimer's Disease is the most common cause of dementia, characterized by extracellular deposition of plaques primarily of amyloid-β (Aβ) peptide... PHB cultures at day in vitro 7 (DIV7) treated with 64 MHz, and 1 hour daily for 14 days (DIV 21) had significantly reduced levels of secreted Aβ40 (p = 0.01) and Aβ42 (p = 0.029) peptides, compared to untreated cultures. PHB cultures (DIV7) treated at 64 MHz, for 1 or 2 hour during 14 days also produced significantly lower Aβ levels. PHB cultures (DIV28) treated with 64 MHz 1 hour/day during 4 or 8 days produced a similar significant reduction in Aβ40 levels. 0.4 W/kg was the minimum SAR required to produce a biological effect." {From the publication}			
	10 MHz -	Jukka Luukkonen, Jonne	2020-(1)

Pilot study on the therapeutic potential of radiofrequency magnetic fields: growth inhibition of implanted tumours in mice	0.002 mT	Naarala, Jukka Juutilainen, Frank Barnes, Carlos F. Martino	
Changes in the gene expression in mouse astrocytes induced by pulsed radiofrequency: A preliminary study	0.48 MHz (pulsed)	Kumiko Tanabe, Shigeo Takashim, Hiroki Iida	2020-(1)
Arabidopsis cryptochrome is responsive to Radiofrequency (RF) electromagnetic fields (plant)	7 MHz - 0.002 mT	Maria Albaqami, Merfat Hammad, Marootpong Pooam, Maria Procopio, Mahyar Sameti, Thorsten Ritz, Margaret Ahmad, Carlos F. Martino	2020-(8)
<p>" Here we show that, in keeping with certain quantum physical hypotheses, a weak 7 MHz radiofrequency magnetic field significantly reduces the biological responsivity to blue light of the cryptochrome receptor cry1 in Arabidopsis seedlings. Using an in vivo phosphorylation assay that specifically detects activated cryptochrome, we demonstrate that RF exposure reduces conformational changes associated with biological activity. RF exposure furthermore alters cryptochrome-dependent plant growth responses and gene expression to a degree consistent with theoretical predictions." {From the publication}</p> <p>" Since cryptochromes are found in many organisms in the biological Kingdom including in humans, this study may lead to new biomedical applications developing RF signals to elicit desired cellular responses. Our results also may have more general implications for the capacity of living organisms to respond to man-made electromagnetic noise, by analogy with broad band RF16 which has been previously shown to disrupt orientation of birds." {From the publication}</p>			
Acceleration of germination and early growth of plant seeds by high frequency and low intensity alternating electric fields	100 MHz - 0.0066-2.653 mW/cm ²	Sumihiro Koyama, Yasuyuki Tamura, Gen Ishikawa, Yoichi Ishikawa	2020-(1)
Tumour-specific amplitude-modulated radiofrequency electromagnetic fields induce differentiation of hepatocellular carcinoma via targeting Ca v 3.2 T-type voltage-gated calcium channels and Ca ²⁺ influx	27.12 MHz (SAR 0.001-0.035 W/kg (body) 0.156-0.352 W/kg (1g))	Hugo Jimenez, Minghui Wang, Jacquelyn W. Zimmerman, Michael J. Pennison, Sambad Sharma, Trevor Surratt, Zhi-Xiang Xu, Ivan Brezovich, Devin Absher, Richard M. Myers, Barry De Young, David L. Caudell, Dongquan Chen, Hui-Wen Lo, Hui-Kuan Lin, Dwayne W. Godwin, Michael Olivier, Anand Ghanekar, Kui Chen, Lance D. Miller, Yijian Gong, Myles Capstick, Ralph B. D'Agostino, Jr, Reginald Munden, Philippe Merle, Alexandre Barbault, Arthur W. Blackstock, Herbert L. Bonkovsky, Guang-Yu Yang, Guangxu Jin, Liang Liu, Wei Zhang, Kounosuke Watabe, Carl F. Blackman, Boris C. Pasche	2019-(16)
Ca ²⁺ and CACNA1H mediate targeted suppression of breast cancer brain metastasis by AM RF EMF	27.12 MHz - (SAR 0.255 W/kg (brain))	Sambad Sharma, Shih-Ying Wu, Hugo Jimenez, Fei Xing, Dongqin Zhu, Yin Liu, Kerui Wu, Abhishek Tyagi, Dan Zhao, Hui-Wen Lo, Linda Metheny-Barlow, Peiqing Sun, John D. Bourland, Michael D. Chan, Alexandra Thomas, Alexandre Barbault, Ralph B. D'Agostino, Christopher T. Whitlow, Volker Kirchner, Carl Blackman, Boris Pasche, Kounosuke Watabe	2019-(15)
Use of Pulsed Radiofrequency Electromagnetic Field (Prfe) Therapy for Pain Management and Wound Healing in Total Knee and Reverse Shoulder Prosthesis: Randomized and Double-blind Study	27.12 MHz	Nicola Bianchi, Federico Sacchetti, Matteo Mordà, Carmine Citarelli, Rodolfo Capanna, Stefano Giannotti	2018-(7)
Repeated Electromagnetic Field Stimulation in Aging and Health	64 MHz - (SAR 0.6 W/kg)	Felipe P. Perez, Jorge J. Morisaki, Joseph P. Bandeira	2018-(1)
Exposed primary human neurons: Decreased beta amyloid level (up to 58.35%).			
In-vitro analysis of Quantum Molecular Resonance effects on human mesenchymal stromal cells	4-64 MHz	Sabrina Sella, Valentina Adami, Eliana Amati, Martina Bernardi, Katia Chierigato, Pamela Gatto, Martina Menarin, Alessandro Pozzato,	2018-(17)

		Gianantonio Pozzato, Giuseppe Astori	
" QMR technology exploits no-ionizing high-frequency waves in the range between 4 and 64 MHz at low intensity delivered through alternating electric fields. The effect of QMR stimulation relies on the induction of more frequencies at the same time, where the fundamental wave is at 4 MHz and the subsequent ones increase in harmonic content until 64 MHz with related decreasing amplitudes" {From the publication}			
Resonant Radiofrequency Fields Damaging <i>Saccharomyces Cerevisiae</i> (yeast)	28 MHz	W. S. Dias, E. H. M. Liquer, L. C. Gontijo, T. A. Oakes, G. S. Dias, C. Marques, H. S. Chavez	2018-(3)
Exposed yeast cells: Time life drastically reduced. The authors describe the mechanism of action by the coupling of external field with the ion charge density inside the cell.			
Amplitude-modulated radiofrequency electromagnetic fields target hepatocellular carcinoma stem cells through activation of Cav 3.2 T-type calcium channels	27.12 MHz - (SAR 0.0002-0.001 W/kg)	Hugo Jimenez, Minghui Wang, Jacquelyn W. Zimmerman, Michael J. Pennison, Sambad Sharma, Ivan Brezovich	2018-(1)
Biophysical control of the growth of <i>Agrobacterium tumefaciens</i> using extremely low frequency electromagnetic waves at resonance frequency (bacteria)	10 MHz (1 Hz modulated) - 0.000669 mT	M. Ali Fadel, Reem H. El-Gebaly, Shaimaa A. Mohamed, Ashraf M.M. Abdelbacki	2017-(1)
Exposed bacteria: Decreased bacterial growth (up to 49.2%). More effective antibiotics. Molecular and morphological changes as shown in DNA, dielectric relaxation and TEM.			
Pulsed electromagnetic fields in knee osteoarthritis: a double blind, placebo-controlled, randomized clinical trial	27.12 MHz (1000 Hz pulsed)	Gian Luca Bagnato, Giovanni Miceli, Natale Marino ¹ , Davide Sciortino, Gian Filippo Bagnato	2015-(8)
Pulsed Electromagnetic Fields Reduce Postoperative Interleukin-1 β , Pain, and Inflammation: A Double- Blind, Placebo-Controlled Study in TRAM Flap Breast Reconstruction Patients	27.12 MHz (2 Hz pulsed) - 0.0042 mW/cm (SAR 0.001 W/kg)	Christine H. Rohde, Erin M. Taylor, Amanda Alonso, Jeffrey A. Ascherman, Krista L. Hardy, Arthur A. Pilla	2015-(10)
Effect of Pulsed Electromagnetic Field (PEMF) on Infarct Size and Inflammation After Cerebral Ischemia in Mice	27.12 MHz (2 Hz pulsed) - (SAR 0.04 W/kg)	Juan Carlos Pena-Philippides, Yirong Yang, Olga Bragina, Sean Hagberg, Edwin Nemoto, Tamara Roitbak	2014-(10)
Exposed mice: Altered expression profile of pro- and anti-inflammatory factors in the hemisphere ipsilateral to ischemic damage. Reduced pro-inflammatory cytokine IL-1 α . Downregulated genes encoding members of the major pro-apoptotic tumor necrosis factor family.			
Increases in microvascular perfusion and tissue oxygenation via pulsed electromagnetic fields in the healthy rat brain	27.12-MHz (5 Hz pulsed) - 0.0095 mW/cm (SAR 0.04 W/kg)	Denis E. Bragin, Gloria L. Statom, Sean Hagberg, Edwin M. Nemoto	2014-(10)
Inhibition of cellular proliferation and enhancement of hydrogen peroxide production in fibrosarcoma cell line by weak radio frequency magnetic fields	10 MHz - 0.01 mT	Pablo R.Castello, Iain Hill, Frank Sivo, Lucas Portelli, Frank Barnes, Robert Usselman, Carlos F. Martino	2014-(5)
The Effects of Non-Invasive Radiofrequency Treatment and Hyperthermia on Malignant and Nonmalignant Cells	13.56 MHz	Steven A. Curley, Flavio Palalon, Kelly E. Sanders, Nadezhda V. Koshkina	2014-(12)
Non-Thermal Radio Frequency Stimulation of Tubulin Polymerization in Vitro: A Potential Therapy for Cancer Treatment	-	John T. Butters, Xavier A. Figueroa, Bennett Michael Butters	2014-(23)
Spin Biochemistry Modulates Reactive Oxygen Species (ROS) Production by Radio Frequency Magnetic Fields	7 MHz - 0.01 mT	Robert J. Usselman, Iain Hill, David J. Singel, Carlos F. Martino	2014-(9)
Targeted treatment of cancer with radiofrequency electromagnetic fields amplitude-modulated at tumor-specific frequencies	-	Jacquelyn W. Zimmerman, Hugo Jimenez, Michael J. Pennison, Ivan Brezovich, Desiree Morgan, Albert Mudry, Frederico P. Costa, Alexandre Barbault, Boris Pasche	2013-(9)
Electromagnetic fields instantaneously modulate nitric oxide signaling in challenged biological systems	27.12 MHz (2 Hz pused) - 0.0025 mT	Arthur A. Pilla	2012-(4)

Radio Frequency Energy for Bioelectric Stimulation of Plants (ICR)	1-50 MHz (16 Hz modulated) - max. 0.005 mT	Pieter Johannes Jacobus van Zyl	2012-(207)
<p>" .. Plant cell walls are covered with tightly-bonded, positively-charged calcium ions that affect the inflow of nutrients into the cell. As calcium ions have a mass twice that of the potassium ion, the fundamental harmonic of calcium is equal to the first harmonic of potassium (32Hz). Thousands (10k : 1) fewer positive potassium ions also exist around the cell wall and when stimulated at their resonance frequency (16Hz), they will bounce against the tightly bonded calcium ions so these calcium ions become dislodged from the cell wall. If this happens more nutrients can enter the cell causing acceleration in plant growth. A suitable electromagnetic wave for such an action is the amplitude modulated wave especially if it is modulated near the cyclotron resonance frequency of potassium (16Hz) or its even-harmonics of 32,64Hz etc.</p> <p>Applying sufficient energy in the lower modulated frequency when it is the same as the vibration frequency of the potassium ions surrounding the cell wall, these ions will then acquire some energy from the electrical wave. Controlling the process is important because if too many calcium ions are released it would cause plant stress and plant structure breakdown. The amplitude modulated wave will allow sufficient time for the calcium ions to return to the cell wall during the period without energy.</p> <p>To apply radio energy to a plant in the form of amplitude modulated signals requires a medium. One such medium is the use of transmitting energy into two leaky transmission lines to cause wave case standing waves, which could then be absorbed by the plants that are placed in between these transmission lines. The energy from the radio waves is then used to create window periods during which the calcium ions are dislodged allowing additional nutrients to enter the plant cell, enhancing plant growth and production."</p>			
Cancer cell proliferation is inhibited by specific modulation frequencies	27.12 MHz - (SAR 0.034 W/kg)	J. W. Zimmerman, M. J. Pennison, I. Brezovich, N. Yi, C. T. Yang, R. Ramaker, D. Absher, R. M. Myers, N. Kuster, F. P. Costa, A. Barbault, B. Pasche	2012-(7)
<p>" To understand the mechanism of this novel approach, hepatocellular carcinoma (HCC) cells were exposed to 27.12 MHz radiofrequency electromagnetic fields using in vitro exposure systems designed to replicate in vivo conditions. Cancer cells were exposed to tumour-specific modulation frequencies, previously identified by biofeedback methods in patients with a diagnosis of cancer. Control modulation frequencies consisted of randomly chosen modulation frequencies within the same 100 Hz–21 kHz range as cancer-specific frequencies. Results: The growth of HCC and breast cancer cells was significantly decreased by HCC-specific and breast cancer-specific modulation frequencies, respectively. However, the same frequencies did not affect proliferation of nonmalignant hepatocytes or breast epithelial cells. Inhibition of HCC cell proliferation was associated with downregulation of XCL2 and PLP2. Furthermore, HCC-specific modulation frequencies disrupted the mitotic spindle." {From the publication}</p>			
Treatment of advanced hepatocellular carcinoma with very low levels of amplitude-modulated electromagnetic fields	27.12 MHz (100 Hz-21kHz modulated) - (SAR max. 2 W/kg (10g))	F.P. Costa, A.C. de Oliveira, R. Meirelles, M.C.C. Machado, T. Zanesco, R. Surjan, M.C. Chammas, M. de Souza Rocha, D. Morgan, A. Cantor, J. Zimmerman, I. Brezovich, N. Kuster, A. Barbault, B. Pasche	2011-(9)
<p>" ... There is emerging evidence that the growth of cancer cells may be altered by very low levels of electromagnetic fields modulated at specific frequencies ... In all, 14 patients (34.1%) had stable disease for more than 6 months. Median progression-free survival was 4.4 months (95% CI 2.1–5.3) and median overall survival was 6.7 months (95% CI 3.0–10.2). There were three partial and one near complete responses. CONCLUSION: Treatment with intrabuccally administered amplitude-modulated electromagnetic fields is safe, well tolerated, and shows evidence of antitumour effects in patients with advanced HCC." {From the publication}</p>			
Electromagnetic fields as first messenger in biological signaling: Application to calmodulin-dependent signaling in tissue repair	27.12 MHz (pulsed) - (SAR 0.0001 W/kg)	Arthur Pilla, Robert Fitzsimmons, David Muehsam, June Wu, Christine Rohde, Diana Casper	2011-(10)

Microwave

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Various experimental findings on microwave electromagnetic field application

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Some experimental application of radiofrequencies acting through "Rife" resonance

Various experimental findings on microwave electromagnetic field application effects

Title	Used freq. and power	Authors	Year (pages)
Quantifying Physiological Biomarkers of a Microwave Brain Stimulation Device	2.4 GHz + 5.2 GHz (35 Hz modulated) - (SAR 0.838 W/Kg + 1.175 W/kg)	Iqram Hussain, Seo Young, Chang Ho Kim, Ho Chee Meng Benjamin, Se Jin Park	2021-(16)
<p>" The purpose of this double-blind, randomized, sham-controlled study is to quantify the physiological biomarkers of the neural and cardiovascular systems induced by a microwave brain stimulation (MBS) device. ... In the active MBS group, the power of high-alpha, high-beta, and low-beta bands in the EEG increased, and the power of low-alpha and theta waves decreased, relative to the sham group. RR Interval and QRS interval showed a significant association with MBS stimulation. Heart rate variability features showed no significant difference between the two groups. A wearable MBS modality may be feasible for use in biomedical research; the MBS can modulate the neurological and cardiovascular responses to cognitive workload." (From the publication)</p>			
Evidence of bystander effect induced by radiofrequency radiation in a human neuroblastoma cell line	1950 MHz (3G UMTS) - (SAR 0.3 W/kg)	Olga Zeni, Stefania Romeo, Anna Sannino, Rosanna Palumbo, Maria Rosaria Scarfi	2021-(7)
<p>The measured effect is detected both in exposed cells and near, but separated, non-exposed cells. This "bystander" effect have been show in other experiments to be mediated by biophotons emitted from the exposed cells, that are capable to send information to the other cells. See paper [1] and subsection [2] for more. [1] Jooyan, N., Goliaei, B., Bigdeli, B., Faraji-Dana, R., Zamani, A., Entezami, M., & Mortazavi, S. M. J. (2019). Direct and indirect effects of exposure to 900 MHz GSM radiofrequency electromagnetic fields on CHO cell line: Evidence of bystander effect by non-ionizing radiation. Environmental research, 174, 176-187. [2] EMMIND › Endogenous Fields & Mind › Biophotons › Biophotons - Various › Biophotons and intercellular or intersubject communication.</p>			
[Action features of the low-intensity electromagnetic radiation at an early stage of development of the experimental metabolic syndrome induced by a diet high in carbohydrates and fats] (in Russian)	1 GHz - 0.001 mW/cm ²	Yu. N. Korolev	2021-(1)
<p>In the abstract (using automatic translation): " The use of low-intensity EMR UHF against the background of the development of MS caused an increase in a number of adaptive changes: the level of insulin in the blood increased, the content of total protein in the liver increased, and the severity of fatty degeneration decreased. The ultrastructural reorganization of hepatocytes was manifested in the activation of the protein synthesis apparatus (the phenomenon of hyperplasia of the granular endoplasmic reticulum, as well as ribosomes and polysomes). At the same time, the total area of mitochondria decreased, although their bioenergetic potential increased due to the condensation of the matrix. The revealed adaptive shifts were due to the antioxidant and membrane-stabilizing effects of microwave EMR on general neuroendocrine and local mechanisms."</p>			
Influence of Weak Microwaves on Spatial Collision and Energy Distribution of Water Molecules	2.45 GHz, 5.8 GHz - 0.0000026-0.026 mW/cm ²	Dezhi Gou, Kama Huang, Ying Liu, Hongxiao Shi	2020-(1)
<p>" The results show that the polarization of microwaves makes the change of spatial collision and energy distribution. The spatial collision probability of water molecules increases obviously in the direction of electric field and the proportion of high energy molecules decreases while the proportion of intermediate energy molecules increases."</p>			
AFM Imaging of Protein Aggregation in Studying the Impact of Knotted Electromagnetic Field on A Peroxidase	2.3 GHz - 0.00000001 mW/cm ²	Yuri D. Ivanov, Tatyana O. Pleshakova, Ivan D. Shumov, Andrey F. Kozlov, Irina A. Ivanova, Anastasia A. Valueva, Vadim Yu. Tatur, Mikhail V. Smelov, Nina D. Ivanova, Vadim S. Ziborov	2020-(9)
<p>" ... we have observed changes in the aggregation state of HRP after the irradiation of its solution, while no change in its enzymatic activity has been registered. This indicates that the exposure to KEMF influences only the spatial structures of the protein, but does not affect its active site. In our present work, the effect of KEMF, with a radiation power at the level slightly higher than that of the background, on the properties of HRP enzyme has been studied. This radiation has a different spatial topography than the</p>			

commonly used transversely polarized one." {From the publication}			
Effect of microtubule resonant frequencies on neuronal cells	91 MHz, 281 MHz, 3.0 GHz - 0.24 mW/cm ² (SAR 0.000012-0.0053 W/kg)	Yousef Rafati, Jody C. Cantu, Anna Sedelnikova, Gleb P. Tolstykh, Xomalin G. Peralta, Christopher Valdez, Ibtissam Echchgadda	2020-(1)
Exposed cells exhibited less fluorescence in the neurite projections, in the fluorescence imaging of microtubules, with a more diffuse pattern and stronger fluorescence in the cell body. Importantly exposed cells' resting membrane potentials were more depolarized, so the exposure of neurons to microtubular and tubulin (microtubules compounds) resonant frequencies (3 GHz for microtubules, 91 MHz and 281 MHz for tubulins) might affect microtubular normal behavior, leading to neurophysiological changes.			
Microwave pretreatment of tomato seeds and fruit to enhance plant photosynthesis, nutritive quality and shelf life of fruit	9.3 GHz - (SAR 0.05-0.17 W/kg)	Shalini Verma, Vinay Sharma, Nilima Kumari	2019-(1)
Effects of 171 MHz Low-Intensity Electromagnetic Field on Glucocorticoid and Mineral Corticoid Activity of the Adrenal Glands of Rats	171 MHz - 0.06-0.32 mW/cm ²	Sergey Perov, Nina Rubtsova, Quirino Balzano	2019-(1)
Exposed rats: Increased adrenal gland activity. Increased daily excretion of corticosterone and Na ⁺ (higher Na ⁺ /K ⁺ ratio). Decrease of previous parameters over time.			
The Effect of Repeated Electromagnetic Fields Stimulation in Biological Systems (water)	50 MHz, 64 MHz, etc. - (SAR 0.4-0.6 W/kg)	Felipe P. Perez, James Rizkalla, Matthew Jeffers, Paul Salama, Cristina N. Perez Chumbiauca, Maher Rizkalla	2019-(18)
" In this paper we will examine the effects of the repeated electromagnetic field stimulation (REMFS) on cell cultures, mouse models, and computer simulations for diagnostic purposes. In our biological experiments we used 50 MHz and 64 MHz since this is approved in MRI systems. REMFS upregulated pathways that control the aging process such as proteostasis. REMFS delayed and reversed cellular senescence in mouse and human cell cultures. More recently we determined that REMFS decreases toxic protein beta amyloid levels, which is the cause of Alzheimer's disease (AD), in human neuronal cultures. The mechanism of these effects is the reactivation of the heat shock factor 1 (HSF1). HSF1 activation is a quantum effect of the EMF-oscillations on the water that surrounds a long non-coding RNA, allowing it to then bind and activate the HSF1." {From the publication}			
A Clinical Trial of Transcranial Electromagnetic Treatment in Alzheimer's Disease: Cognitive Enhancement and Associated Changes in Cerebrospinal Fluid, Blood, and Brain Imaging	915 MHz (217 Hz modulated) - (SAR 1.18 W/kg)	Gary Arendash, Chuanhai Cao, Haitham Abulaban, Rob Baranowski, Gary Wisniewski, Lino Becerra, Ross Anedel, Xiaoyang Lin, Xiaolin Zhang, David Wittwer, Jay Moulton, John Arrington, Amanda Smith	2019-(26)
Effects of Radiofrequency Exposure and Co-Exposure on Human Lymphocytes: the Influence of Signal Modulation and Bandwidth	1950 MHz (CW & modulated) - (SAR 0.15-1.24 W/kg)	Stefania Romeo, Anna Sannino, Olga Zeni, Leopoldo Angrisani, Rita Massa, Maria Rosaria Scarfi	2019-(1)
The Effect of Environmental Electromagnetic Radiation on Associate Formation in Aqueous Solutions (water)	-	S. V. Avakyan, L. A. Baranova	2019-(7)
" We present the results of studies of the nature of the features known in modern biophysics in the manifestation of the associative properties of aqueous solutions of biologically active substances... Comparison of the developed ideas and the experiments on electromagnetic shielding of biological solutions diluted to various degrees confirms the reality of the proposed relation of the phenomena in biological media with microwave radiation."			
Brain stimulation by modulated microwave radiation: a feasibility study	450 MHz (40 Hz modulated) - 0.16 mW/cm ²	Maie Bachmann, Jaanus Lass, Andreas A. Ioannides, Hiie Hinrikus	2018-(1)
Fas/FasL pathway and cytokines in keratinocytes in atopic dermatitis – Manipulation by the electromagnetic field	900 MHz - 0.1 mW/cm ² (SAR 0.024 W/kg)	Lukasz Szymanski, Aleksandra Cios, Sławomir Lewicki, Paweł Szymanski, Wanda Stankiewicz	2018-(12)
Use of non-ionizing electromagnetic fields for the treatment of cancer	-	Hugo Jimenez, Carl Blackman, Glenn Lesser, Waldemar Debinski, Michael Chan, Sambad Sharma, Kounosuke Watabe, Hui-Wen Lo, Alexandra Thomas, Dwayne Godwin, William Blackstock, Albert Mudry,	2018-(14)

		James Posey, Rodney O'Connor, Ivan Brezovich, Keith Bonin, Daniel Kim-Shapiro, Alexandre Barbault, Boris Pasche	
Non-Ionizing Electromagnetic Fields for Food Safety (in Spanish)	2.41 GHz, 2.46 GHz	Arturo B. Rodriguez, Angélica Ganga, Liliana Godoy	2018-(8)
Experimenters expose of Escherichia coli bacterias to microwaves from wi-fi router, causing a great descent in their viability. This is viewed from the perspective of a possible anti contaminant usage (But this must be viewed also as a possible ecological and biological hazard).			
Normothermic Microwave Irradiation Induces Death of HL-60 Cells through Heat-Independent Apoptosis	2.45 GHz	Mamiko Asano, Satoshi Tanaka, Minoru Sakaguchi, Hitoshi Matsumura, Takako Yamaguchi, Yoshikazu Fujita, Katsuyoshi Tabuse	2017-(12)
" Collectively, these results suggest that the cell death pathway activated by our 37 °C microwave irradiation method differs from that induced during other heating methods and support the use of normothermic microwave irradiation in clinical cancer treatments."			
Breast cancer-specific amplitude modulated radiofrequency electromagnetic fields (AM RF EMF) inhibits brain metastasis of breast cancer	-	Sambad Sharma, Hugo Jimenez, Fei Xing, Carl Blackman, Boris Pasche, Kounosuke Watabe	2017-(1)
Mechanism of Low-level Microwave Radiation Effect on Brain: Frequency Limits	450 MHz (7-1000 Hz modulated) - (SAR 0.3 W/kg)	Hiie Hinrikus, Maie Bachmann, Jaanus Lass	2017-(1)
Exposed human brains: Increased EEG power (in all modulation frequencies 14, 21, 40, 70 and 217 Hz, so effects on brain bioelectrical oscillations are not limited to modulation frequencies within the EEG spectrum).			
Microwaves as a Skin Permeation Enhancement Method	-	Hamid R. Moghimi, Azadeh Alinaghi	2017-(1)
Exposed humans: Increased permeation of drugs through the skin. Fourier transform infrared spectroscopy shows that the effect can be generated through the disruption of intercellular lipids of the stratum corneum.			
Precision knockdown of EGFR gene expression using radio frequency electromagnetic energy	-	Ilya V. Ulasov, Haidn Foster, Mike Butters, Jae-Geun Yoon, Tomoko Ozawa, Theodore Nicolaidis, Xavier Figueroa, Parvinder Hothi, Michael Prados, John Butters, Charles Cobbs	2017-(8)
First they use new technical appliance (using a SQUID device) to record the radio frequency electromagnetic field originating from a biomolecule (from the pure population of the same biomolecules in a solution): the siRNA of epidermal growth factor receptor (EGFR). Secondly they exposed cells to this recorded electromagnetic signal, that causes cells to have a 30–70% reduction of EGFR mRNA expression and ~60% reduction in EGFR protein expression, decreased cell viability, a lactato deshidrogenasa release and Caspase 3 cleavage. So RFE signal can induce a specific siRNA-like effect on cells.			
Epitaxy of the bound water phase on hydrophilic surfaces of biopolymers as key mechanism of microwave radiation effects on living objects (water)	-	Denis B. Kuznetsov , Ekaterina V. Orlova, Valery A. Neschislyae, Igor L. Volkhin, Igor V. Izmetstiev, Igor V. Lunegov, Alevtina V. Balandina, Dina G. Dianova	2017-(1)
The authors found that the key factor in the mechanism of microwave effects on living and water-containing objects is the transformation of the dynamic-structural state of adsorbed water phases on biopolymer surfaces.			
Evaluation of the Effect of Radiofrequency Radiation Emitted From Wi-Fi Router and Mobile Phone Simulator on the Antibacterial Susceptibility of Pathogenic Bacteria Listeria monocytogenes and Escherichia coli	900 MHz, 2.4 GHz - (SAR 0.13 W/kg & others)	M. Taheri, S. M. J. Mortazavi, M. Moradi, S. Mansouri, G. R. Hatam, F. Nouri	2017-(8)
Extremely low-level microwaves attenuate immune imbalance induced by inhalation exposure to low-level toluene in mice	8.15–18 GHz - 0.001 mW/cm ²	Elena G. Novoselova, Olga V. Glushkova, Maxim O. Khrenov, Tatyana V. Novoselova, Sergey M. Lunin, Eugeny E. Fesenko	2017-(1)
Exposure to microwaves alone also resulted in the enhancement of the plasma cytokine values and activation of various pathways in splenic lymphocytes.			
The role of p38 protein kinase in mouse responses to low-intensity electromagnetic radiation of the centimeter range	8.15–18 GHz - 0.001 mW/cm ²	Olga V. Glushkova, Maxim O. Khrenov, E.V. Vinogradova, Sergey M. Lunin, Eugeny E. Fesenko, Elena G. Novoselova	2016-(7)

Plant Responses to High Frequency Electromagnetic Fields (review)	(300 MHz–3 GHz)	Alain Vian, Eric Davies, Michel Gendraud, Pierre Bonnet	2016-(14)
Mechanism of low-level microwave radiation effect on nervous system	450 MHz (7, 40 & 1000 Hz pulse) - 0.16 mW/cm ²	Hiie Hinrikus, Maie Bachmann, Denis Karai, Jaanus Lass	2016-(1)
Effectiveness of an Innovative Pulsed Electromagnetic Fields Stimulation in Healing of Untreatable Skin Ulcers in the Frail Elderly: Two Case Reports	10.5 GHz (pulsed) 0.0000005–0.0001 mW/cm ²	Fabio Guerriero, Emanuele Botarelli, Gianni Mele, Lorenzo Polo, Daniele Zoncu, Paolo Renati, Carmelo Sgarlata, Marco Rollone, Giovanni Ricevuti, Niccolò Maurizi, Matthew Francis, Mariangela Rondanelli, Simone Perna, Davide Guido, Piero Mannu	2015-(7)
<p>They describe the first reported case of an innovative PEMF therapy - Emysymmetric Bilateral Stimulation (EBS) - used to successfully treat refractory skin ulcers in two elderly and fragile patients.</p> <p>" EBS stands different than the conventional PEMF stimulation devices as it adopts low power stimulations to cover a wide range of frequency bands, shapes, and durations of pulses of the EMF. The core principle is the utilization of PEMF noise-like stimuli to trigger self-arrangements in the living system of treated subjects and improve wound regeneration. Recently, the group led by Montagnier has detected experimentally the presence of electromagnetic signals originating in the water surrounding biomolecules [21]. To us this should be the key-point of EBS stimulation technique: the stimuli involved in the interaction between human body and extremely weak electromagnetic signals are not energetic but potential and phase based actors, able to produce a phase shift in domains of coherent bound-water constituting cells." {From the publication}</p>			
Inter-individual and intra-individual variation of the effects of pulsed RF EMF exposure on the human sleep EEG	900 MHz (2 Hz pulse) - (max. SAR 2 W/kg (10g))	Caroline Lustenberger, Manuel Murbach, Laura Tüshaus, Flavia Wehrle, Niels Kuster, Peter Achermann, Reto Huber	2015-(1)
Microwave effect on diffusion: a possible mechanism for non-thermal effect (water)	450 MHz - 0.160 mW/cm ² (SAR 0.4 W/kg)	Hiie Hinrikus, Jaanus Lass, Denis Karai, Kristjan Pilt, Maie Bachmann	2014-(7)
<p>Is found experimentally than that a microwave exposure makes faster the process of diffusion in water, being 1.7 times shorter the time required for the reduction of initial resistance of the solution by 10%. The authors propose that this supports the idea of the role of microwave radiation and dipolar water molecules, that causes high-frequency alterations of hydrogen bonds between water molecules (altering viscosity and making faster diffusion). This is a possible mechanism for non-thermal effects.</p>			
Mobile Phone Radiation Alters Proliferation of Hepatocarcinoma Cells	900-1800 MHz - (SAR 2 W/kg)	Elcin Ozgur, Goknur Guler, Gorkem Kismali, Nesrin Seyhan	2014-(9)
Detection of Pathogenic Bacteria in Aqueous Media: Assessing the Potential of Real-Time Electromagnetic Wave Sensing	2-10 GHz	I. Nakouti, O. Korostynska, A. Mason and A. I. Al-Shamma'a	2014-(6)
Microwave absorption and permittivity of protein and microtubule solution	0.2-50 GHz	Ondrej Krivosudský	2014-(80)
Investigation of Antibacterial Effects of Electromagnetic Waves Emitted by Mobile Phones	1800 MHz - (SAR 0.76 W/kg)	Ayhan Akbal, Hasan H. Balik	2013-(6)
The role of the NF- κ B, SAPK/JNK, and TLR4 signalling pathways in the responses of RAW 264.7 cells to extremely low-intensity microwaves	8.15-18 GHz - 0.0014 mW/cm ²	Olga V. Glushkova, Maxim O. Khrenov, Tatyana V. Novoselova, Sergey M. Lunin, Svetlana B. Parfenyuk, Stanislav I. Alekseev, Eugeny E. Fesenko, Elena G. Novoselova	2014-(19)
Effect of low power microwave radiation on pigment production in bacteria	2.4 GHz (owen)	Shreya Raval, Vimla Chaudhari, Haren Gosai, Vijay Kothari	2014-(5)
Effect of Low Power Microwave on Bacterial Growth, Protein Synthesis, and Intracellular Enzyme (Glucose-6-phosphatase and β -galactosidase) Activity	2.4 GHz (owen)	Toshi Mishra, Preemada Kushwah, Vijay Kothari	2013-(7)
<p>" Glucose-6-phosphatase activity in all the test organisms experienced a significant increase following MW treatment for either one or both exposure times. β galactosidase activity in all the three test organisms experienced a significant decrease following MW treatment estimations of protein content and enzyme activity were made on the cell population originated from MW treated inoculum, and not directly on the MW treated cells. Therefore, the alterations in protein content or enzyme activity might have been transferred from the originally MW treated cells to their daughter cells (who did not receive direct MW exposure). As thermal effect of MW was avoided by putting the inoculum in ice during MW treatment, whatever alterations have been observed are most likely a result of MW specific athermal effects." {From the publication}</p>			

Radio electric asymmetric conveyer (REAC) technology for cellular differentiation

Title	Used freq. and power	Authors	Year (pages)
REAC technology as optimizer of stallion spermatozoa liquid storage	2.4-5.8 GHz	Fiammetta Berlinguer, Valeria Pasciu, Sara Succu, Ignazio Cossu, Sabrina Caggiu, Daniela Addis, Alessandro Castagna, Vania Fontani, Salvatore Rinaldi, Eraldo Sanna Passino	2017-(12)
REAC technology modifies pathological neuroinflammation and motor behaviour in an Alzheimer's disease mouse model	2.4 GHz	Luca Lorenzini, Alessandro Giuliani, Sandra Sivilia, Vito Antonio Baldassarro, Mercedes Fernandez, Matteo Lotti Margotti, Luciana Giardino, Vania Fontani, Salvatore Rinaldi, Laura Calzà	2016-(12)
Radio Electric Asymmetric Conveyer: A Novel Neuromodulation Technology in Alzheimer's and Other Neurodegenerative Diseases	2.4-5.8 GHz	Salvatore Rinaldi, Laura Calzà, Luciana Giardino, Gabriele E. M. Biella, Antonio G. Zippo, Vania Fontani	2015-(4)
Neurological morphofunctional differentiation induced by REAC technology in PC12. A neuro protective model for Parkinson's disease	2.4 GHz - 0,00004 mW/cm2 (SAR 0,00012 W/kg)	Margherita Maioli, Salvatore Rinaldi, Rossana Migheli, Gianfranco Pigliaru, Gaia Rocchitta, Sara Santaniello, Valentina Basoli, Alessandro Castagna, Vania Fontani, Carlo Ventura, Pier Andrea Serra	2015-(8)
Stem cell senescence. Effects of REAC technology on telomerase-independent and telomerase-dependent pathways	2.4 GHz - (SAR 0.00012 W/kg)	S. Rinaldi, M. Maioli, G. Pigliaru, A. Castagna, S. Santaniello, V. Basoli, V. Fontani, C. Ventura	2014-(8)
Anti-senescence efficacy of radio-electric asymmetric conveyer technology	2.4 GHz - (SAR 0.00012 W/kg)	Margherita Maioli, Salvatore Rinaldi, corresponding author Sara Santaniello, Alessandro Castagna, Gianfranco Pigliaru, Alessandro Delitala, Matteo Lotti Margotti, Luigi Bagella, Vania Fontani, Carlo Ventura	2014-(12)
Radio Electric Conveyed Fields Directly Reprogram Human Dermal Skin Fibroblasts Toward Cardiac, Neuronal, and Skeletal Muscle-Like Lineages	2.4 GHz - (SAR 0.00012 W/kg)	Margherita Maioli, Salvatore Rinaldi, Sara Santaniello, Alessandro Castagna, Gianfranco Pigliaru, Sara Gualini, Claudia Cavallini, Vania Fontani, Carlo Ventura	2013-(7)

Some experimental application of radiofrequencies acting through "Rife" resonance

Title	Authors	Year (pages)
Is Victory over Pancreatic Cancer Possible, with the Help of Tuned Non-Invasive Physiotherapy? A Case Study Says Yes	Pierre Le Chapellier, Badri Matta	2014-(18)
<p>" Could the conventional treatment of pancreatic cancer effectively be supplemented by a low level and non-invasive bio-electromagnetic treatment? A case study, based on the regular exposure of a patient to an electromagnetic field, EMF, emitted by a Rife-Bare technology device, suggests so. The plasma confined in a tube of this apparatus emitted radiofrequency solitons. These low level emissions were modulated by an "audio" frequency generator, pre-programmed for the treatment of this disease. After less than two months of exposure to these EMFs, the tumor completely disappeared in approximately two weeks. The explanation of the action mechanism includes a physics aspect relating to the properties of the dissipative soliton which is emitted-absorbed by any non-linear system, a biophysics aspect relating to the coherent structuring of the cellular bath by incident solitons, and finally a biological aspect. The latter is characterized by a critical resonance frequency leading the "unicellular" tumoral cell to adopt a self-destructive behavior. On the other hand EMFs with low level solitons have no effect on the tissues of complex multicellular organisms." {From the publication}</p> <p>In Pancreatic cancer treatment where classical therapy only rescues about 10% of the patients, the authors explore and apply another kind of treatment based on targeting the cancer microenvironment by low intensity electromagnetic waves.</p> <p>" By admitting that their living nature really exists, the EMF bio-effect which causes a micro-organism seizure that can lead to a lethal resonance would have to be described more than in a merely mechanical way. Now this bio-effect, resulting from a specific</p>		

<p>EMF treatment, could allow elimination of the parasitic pathogenic viruses, the ones which are acting within the "mutated" cells, or those which are present in the aqueous external medium." {From the publication}</p> <p>Recently also is showed that low level EMF of 27.12 MHz, modulated by a wavelength between 400 Hz and 21 Khz, causes significant tumor shrinkage, and in the cancer cells is viewed a increased rate in the intracellular calcium (that can be associated with IP3/DAG signaling pathway, and that is the PI3K pathway which is generally involved in the Hepato-Cellular-Carcinoma genesis)</p> <p>They use the technique used by Rife (a pioneering in this type of treatment) who previously shown that:</p> <p>" pulsed EMFs could have considerable bioeffects according to their frequency. Because each micro-organism would respond to a precise frequency, up to being destroyed, once entering a seizure, with agitation and change in form. When the specimen was exposed to an EMF flash at some Hertz of its resonance frequency, it reached a moment of seizure, and then recovered in a few seconds. But when the germ was exposed exactly on its critical frequency, it literally exploded. These effects, which were repeated thousands of times by Rife on germs and unicellular beings, never occurred in any multicellular tissues of complex organisms." {From the publication}</p> <p>And the authors think this can be due to an intrinsic specific mode of bioelectromagnetic communication between the human thought and the living nature of simple bacteria.</p> <p>" With the help of his first prototypes, Rife was able to cure animals having various specific infections, and study the different bio-effects. It appeared to him that tumor cells did not explode like bacteria, though they also died, but in another way. Rife then turned to viruses, (the infectious agents "which cross the filters"). After thousands of experiments, he formed the conviction that a cancer virus could be isolated and that his machine, by destroying the virus infects the tumoral cell, could cure cancer." {From the publication}</p> <p>The authors do a clinical application of these ideas to a cancer patient, with very positive results.</p> <p>It must be taken in consideration the special characteristic of the emitted radiation:</p> <p>" the radiofrequency solitons propagating in space out of the tube are discontinuous signals. They can be named as Photons, because they are electromagnetic waves of frequency F meeting Maxwell's wave equation. But they are also solitary topological defects propagating in the physical vacuum, therefore they are spinors, (complex direction fields,) which satisfy the null eikonal Equation (4), [39]. These solitons are thus discontinuous radio frequencies signals which are more than merely waves. Such active agents differ from the visible or infra-red light which is emitted by the tube. Because that light is only a wave which is a solution of the wave equation, it is not a signal with curative capacity." {From the publication}</p>		
Morphological transformations of human cancer cells and microtubules caused by frequency specific pulsed electric fields broadcast by an enclosed gas plasma antenna	Gerard Dubost, Anthony Holland, James Bare, Frederic Belossi	2013-(9)
Cytotoxicity test on the effect of modulated electromagnetic wave on non-pathogenic E.Coli culture	Sandy F. Sanchez Jr., Greg Martin E. Teo, Romeric F. Pobre	2013-(8)
<p>" Cytotoxicity test showed that from 12,342.60 Hz to 12,413.72 Hz modulating frequency, there is a significant reduction of E. coli bacterial growth under 37.5 °C incubation temperature. Other modulating frequencies showed a significant increase in E. coli bacterial growth under the same cytotoxicity test."</p>		
Was Rife right? A 32-year-old infection cured in 2 hours by a plasma tube radiation	Andre Bellossi, Gerard Dubost, James Bare, Jose Luis Bardasano Rubio	2010-(5)
<p>In this experimental application of low intensity electromagnetic radiation on a subject (that has a type of osteitis with two unfavorable features: an undiscovered bacterial source and total ineffectiveness of medical treatments) the results were positive and spectacular.</p> <p>The theoretical physical basis from which is applied this treatment is as follow:</p> <p>" Since then the theoretical explanation of bacterial destruction by electromagnetic fields has been given (1). It is due to half-wave resonance of irradiated bacteria DNA, half-wave resonance being linked to the water dipoles associated to DNA. The half-wave resonance frequencies depend on the base-pair number within the DNA of the micro organism, and so a unique treatment frequency is a characteristic of a particular species or strain of bacterium. Half-resonance frequencies for the most part of bacteria range from 4 to 8 GHz, values given by the cylindrical plasma antenna, are obtained from the pulsed modulation frequency of the 27.12 MHz carrier. Recently our theoretical explanation of bacterial destruction given in (1) has been confirmed by means of a wide bandwidth horn tied with a spectrum analyser used to measure the plasma antenna radiation in the range from 1.5 to 18 GHz (see photo 4). We measured a significant power density at frequencies about 3.05 GHz for a modulation frequency equal to 1.4 KHZ, and at frequencies about 6.1 GHz for a modulation frequency equal to 0.7 KHZ."</p>		
Half-Wave resonance of bacteria DNA irradiated from 4 to 8 GHz	Andre Bellossi, Gerard Dubost	2009-(3)
<p>" A new theoretical concept is presented to explain the disruptive effects on some bacteria irradiated by an electromagnetic field. We suppose a half-wave resonance of their DNA. Proof-of-concept experiments by two electronic devices associated with various gas plasma antennas is given."</p>		

Millimeter & Submillimeter Wave

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Millimeter Wave

Title	Used freq. and power	Authors	Year (pages)
Study of the Effects of Ultra-Low Intensity Electromagnetic Fields on Biological Objects	50-60 GHz - 0.000000000 001 mW/cm ²	Yuliia Voloshyn, Sergey Kulish, Volodymyr Oliinyk, Andrei Frolov	2021-(8)
<p>" The seeds of wheat and interaction of millimeter range electromagnetic oscillations with bone marrow cells of rats were used as biological objects for investigating the effect of millimeter range electromagnetic oscillations. A biosensory effect was obtained when exposed to broadband radiation of ultra-low intensity, compared to the control sample. A change in the properties of the seeds, in particular, heat resistance, is observed. According to the experimental data, seeds turn out to be less susceptible to heat as a result of their pretreatment with EMF. The biological response is observed to depend on the frequency and time of irradiation. Also, the dependence of the decrease in the number of dead cells on the time of EMF irradiation was experimentally proved. The equation of dependence of selective average proportion of dead cells in rat bone marrow on irradiation time was calculated. Biosensory effect of exposure to broadband ultra-low intensity EMF of the developed emitter was revealed." {From the publication}</p> <p>" It is believed that low-intensity electromagnetic radiation is a universal mechanism for transmitting information both between living objects and between cells within a biological object." {From the publication}</p> <p>" Hypothesis put forward in [8, 12, 13] suggests that the external EMFs of the microwave range, simulating the body's own microwave radiation, synchronize, using the principle of resonance, «healthy» rhythms lost in the disease, and restore electromagnetic homeostasis. In this case, the primary processes occur in cell membranes, and the transfer of information to organs is carried out through nerve fibers. The therapeutic effect of the EMFs of the microwave range is based on their resonant interaction with the natural oscillations of molecular oscillators of the sick body. Due to this, the restoration of «normal» resonant frequencies and phase synchronization of molecular oscillations occurs under the action of the EMFs [14]. Thus, the «information» effect of the EMFs of the microwave range consists in the purposeful transmission of microwave energy quanta to «deformed» molecular oscillators of the body." {From the publication}</p> <p>" In the course of the experiment, the dependence of the number of dead cells on the time of exposure to EMR of MMR was established. The dependence of a decrease in the selective average proportion of dead cells with an increase in the time of exposure to radiation from 10 to 30 minutes was experimentally proved. With an increase in the exposure time from 30 to 60 minutes, this figure increases. Thus, the established minimum time with the maximum positive effect of the impact on the bone marrow cells of rats was 30 minutes. This was confirmed by the calculated dependency level. The obtained results show that the effect of informational electromagnetic radiation is able to modify the immune status of the organism of bioobjects, exert anti-inflammatory effect, activate physiological and reparative regeneration. But it is necessary to take into account the duration of radiation, as well as design features of the emitter." {From the publication}</p>			
Comparative Evaluation of the Effect of Low-Intensity Electromagnetic Noise Signals in the Microwave Range on the Induction of Metabolic and Vascular Adaptation Reactions in Experimental Thermal Burns	53.6-78.3 GHz, 130-170 GHz - 0.05 mW/cm ²	A. G. Polyakova, A. G. Soloveva, P. V. Peretyagin	2021-(9)
<p>Exposures:• Animals of the 3rd group 53.6-78.3 GHz (it not contains frequencies of messenger molecules).• Animals of the 2rd group 130-170 GHz (contains the molecular spectrum of radiation and absorption of O₂ and NO).• Animals of the 4rd group 150.2-150.7 GHz (contains the molecular spectrum of radiation and absorption of NO).</p> <p>" The obtained data reliably revealed a more pronounced favorable effect on the level of adaptive reactions in the range of 150,179-150.664 GHz, which contains the frequencies of radiation and absorption of nitric oxide."</p>			
Feasibility study on transcutaneous auricular vagus nerve stimulation using millimeter waves	60 GHz - 0.241 mW/cm ²	Hi Yuen Song, Dong Woo Shin, Seung Moon Jung, Yong Jeong, Bumseok Jeong, Chul Soon Park	2021-(1)
<p>" The objective of this study is to develop a region-specific non-invasive vagus nerve stimulation (VNS) technique using the millimeter wave (MMW) as a stimulus for the auricular branch of the vagus nerve (ABVN). Approach: A numerical simulation was conducted to ascertain whether the MMW could excite the ABVN in the human outer-ear with a millimeter-scale spatial resolution. Additionally, MMW-induced neuronal responses in seven mice were evaluated. Transcutaneous auricular VNS (ta-VNS) was applied to the cymba conchae innervated by the AVBN using a 60-GHz continuous wave (CW). As a control, the auricle's exterior margin was stimulated and referred to as transcutaneous auricular non-vagus nerve stimulation (ta-nonVNS). During stimulation, the local field potential (LFP) in the nucleus tractus solitarius (NTS), an afferent vagal projection site, was recorded simultaneously. Main results: The ta-VNS with a stimulus level of 13 dBm showed a significant increase in the LFP power in the NTS. The mean increases in power (n = 7) in the gamma high and gamma very high bands were 8.6 ± 2.0% and 18.2 ± 5.9%, respectively. However, the ta-nonVNS with a stimulus level of 13 dBm showed a significant decrease in the LFP power in the NTS. The mean decreases in power in the beta and gamma low bands were 11.0 ± 4.4% and 10.8 ± 2.8%, respectively."</p>			
Features of using Extremely High-Frequency Low-Intensity Electromagnetic Radiation in Medical Practice (review)	-	A. A. Sentsov, I. G. Bukaeva, G. I. Neuimina	2021-(1)

Effect of millimeter range electromagnetic waves on some biophysical characteristics of human serum albumin	41.8 GHz, 51.8 GHz	Mariam Shahinyan, Ara Antonyan, Marieta Mikaelyan, Poghos Vardevanyan	2021-(2)
<p>" The other side of the intensive studies is conditioned by the fact that MM EMW affect the biological systems being on any level of organization [3,4]. It is worthwhile to mention that the waves show non-thermal effect, in other words they induce biological system response not by heating the system, which is the third no less important peculiarity of these waves. There exist several approaches for the MM EMW effect explanation, but there is no still a single-valued solution of the effect mechanism. Nevertheless, in the separate cases the effect mechanism can be explained either by water participation in response formation or by direct influence on the target."</p> <p>" The choice of frequencies is conditioned by the fact that 51.8 GHz is a frequency resonant for water dipole molecules; on the other hand there exist results in the literature indicating that the interval 41.8-42.2 GHz has a pronounced effect on biological objects [7,8]."</p> <p>" Based on these data one can assume that the irradiation by 41.8 GHz leads to the higher stabilization which in turn may be connected to the direct impact of these waves on the protein as compared to the irradiation by 51.8 GHz, when the effect, probably, is mediated through the water. The other group of experiments is done measuring the own fluorescence intensity change of albumin depending on MM EMW effect. It was shown that the irradiation of the albumin solution by 51.8 GHz and 41.8 GHz frequencies leads to the increasing of the fluorescence maximal intensity."</p>			
Sensitivity to Electromagnetic Stimuli: Entwined Histories of Wireless Signals and Plant Ecologies	-	Rahul Mukherjee	2020-(9)
<p>" Bose invented and used "dielectric lenses, a horn antenna ('funnel'), wave guides, and polarisers" (Shepherd 2012) to measure very small movements of plants (see figure 1ab). His work creating millimeter wave and microwave technologies from 1894 to 1899 was highly regarded by many physicists including Bose's former teacher Lord Rayleigh at Cambridge. Bose was extending the work started by James Clerk Maxwell and other scientists on understandings of electromagnetic fields." {From the publication}</p> <p>" Based on his experiments, Bose characterizes human sense organs as acting like "antennae" responsive to wireless signals, thereby arguing that impulses within the body vibrate and interfere with electromagnetic fields. At another point, Bose notes that his findings clearly suggest that plants are sensitive to invisible electromagnetic rays, which leads him to intuit that plants have "nervous" (nerve) impulses and not merely automatic biomechanical movements (Bose 1929; 1926)." {From the publication}</p>			
Growth properties and hydrogen yield in green microalga <i>Parachlorella kessleri</i> : Effects of low-intensity electromagnetic irradiation at the frequencies of 51.8 GHz and 53.0 GHz	51.8 GHz, 53 GHz	Jemma Manoyan, Lilit Gabrielyan, Vitaly Kalantaryan, Armen Trchounian	2020-(1)
The Role of Polyamine Metabolism in the Regulation of Male Gamete Apoptosis	42.2 GHz - 0.1 mW/cm ²	A. M. Ibragimova, F. Y. Dautova, N. N. Grigorian	2020-(3)
<p>" Spermine (SPM) and spermidine (SPD) are polyamines (PA) that are widely present in body tissues and body fluids, and are vital essential for cell growth, cell proliferation, and differentiation."</p> <p>" The millimeter-wave electromagnetic radiation range (EMI MM-range) is often used in complex therapy of various diseases, including diseases of the male reproductive system."</p> <p>" These effects are realized after a 24-hour incubation of cells with polyamines. the decrease in the concentration of PA, the increase in the resistance of sperm membranes, and the decrease in the number of apoptotic gametes after a short-term exposure to sperm of men of the EMM MM-band with the described characteristics were revealed."</p>			
The Effects of Low-Intensity Millimeter-Wavelength Radiation and Electromagnetic Shielding on Pain Sensitivity in Rats	42.3 GHz - 0.1 mW/cm ²	E. N. Chuyan, E. R. Dzheldubaeva, N. S. Tribat	2020-(9)
Exposed rats: Changes in pain sensitivity with higher antinociception (that is, reduced sensitivity to pain).			
Effect of millimeter range electromagnetic waves on complex-formation of ethidium bromide and Hoechst 33258 with DNA	64.5 GHz - 0.05 mW/cm ²	M. A. Shahinyan, M. S. Mikaelyan, M. A. Torosyan, A. T. Karapetyan	2020-(7)
<p>" It has been shown that the millimeter wave irradiation of water-saline solutions of DNA complexes with ligands leads to significant changes in the water structure, which in turn results in relevant alteration of the thermodynamic characteristics of DNA-ligand complexes. It has also been shown that the irradiation of the water-saline solutions of DNA-H33258 complexes with millimeter waves of 64.5 GHz frequency results in the manifestation of the ligand specific interaction at the high ionic strengths, which is not observed in the absence of irradiation. With the millimeter wave irradiation, as a consequence of increasing of the degree of DNA hydration, the interaction mode of EtBr with DNA is non-specific to sequences, but the intercalation mode does not change."</p>			
Mechanism of non-thermal effect of Millimeter Wave irradiation on Cell Growth	85-105 GHz - 0.8-1.4 mW/cm ²	Ayan Barbora, Shailendra Rajput, Konstantin Komoshvili, Jacob Levitan, Asher Yahalom, Stella Liberman-Aronov	2020-(14)
<p>" Our results demonstrate that non-thermal MMW irradiation has the potential for future use in treating pathogenic fungal infections. Additionally, we study and report no mutagenic effects arising from this nonionizing radiation therapy. Our experiments demonstrate that the MMW irradiation allows the cells to retain their unmodified genetic material and likely affects the proteome by interacting with the water molecules. This accounts for the observed phenomenon of inhibited cell growth without genetic perturbation." {From the publication}</p>			
Apoptosis-Promoting Effects on A375 Human Melanoma Cells Induced by Exposure to 35.2-GHz Millimeter Wave	35.2 GHz - 0.16 mW/cm ²	Ruiting Zhao, Yonghong Liu, Sida Liu, Tong Luo, Guang Yuan Zhong, Anqi Liu, Qiang Zeng, Sherman Xuegang Xin	2020-(8)
Biological Risks of Using Non-Thermal Non-Ionizing Electromagnetic Fields (review)	-	Olena Nizhelska, Lolita Marynchenko, Vasyi Piasetskyi	2020-(15)

<p>It underlines the risk of using millimeter radiation as a therapeutic tool by reviewing the existing experimental data on the using of these frequencies as non-thermal irradiation therapeutic tool, paying special attention to experimental data, until now not considered, from the URSS soviet nations and epoch.</p> <p>" Particular attention is paid to the use of non-thermal microwaves for physiotherapy procedures, pain relief, correction of psycho-emotional disorders, ulcer healing, in particular stomach and duodenum, etc. It is noted that the so-called "therapeutic" frequencies of EHF-EMF, even if controlled, can cause negative effects, although they are not perceived as damaging. Changes in objective vital signs in the case of targeted exposure by low-intensity millimeter-wave radiation, namely, hemodynamics, temperature increase in the exposure zone, muscle activity, and the speed of the passage of a nerve impulse, an encephalogram were established. Precautionary recommendations based on the scientific and practical experience of using microwave acupuncture methods in the conditions of medical institutions are formulated. The synergistic effect of various influences, in particular electromagnetic fields, may not be a direct trigger of the disease, but a factor of not compensated stress. Therefore, clinical studies conducted many years ago cannot simply be dismissed on the grounds that the millimeter radiation penetrates only the outer layer of the skin. Skin cells can also secrete mediators that cause changes in ionic calcium channels and the level of calcium in the cells. The interest in these works is justified by the fact that currently the sources of monochromatic millimeter radiation will be spread with new communication systems. The risks of their biological action should be taken into account when emitters are installed." {From the publication}</p>			
W-Band Millimeter Waves Targeted Mortality of H1299 Human Lung Cancer Cells without Affecting Non-tumorigenic MCF-10A Human Epithelial Cells In Vitro	75-105 GHz - 0.2 mW/cm ²	Konstantin Komoshvili, Katya Israel, Jacob Levitan, Asher Yahalom, Ayan Barbora, Stella Liberman Aronov	2020-(20)
On the Possibility of Using Non-Ionizing Electromagnetic Radiation (Millimeter Waves) in Oncology	48.3-64.5 GHz - 0.01 mW/cm ²	V. P. Kalantaryan, R. Martirosyan, Y. Babayan, R. Khazaryan	2020-(9)
Morphological changes in H1299 human lung cancer cells following Millimeter-wave irradiation	75-105 GHz - 0.2 mW/cm ²	Konstantin Komoshvili, Tzippi Becker, Jacob Levitan, Asher Yahalom, Boris Kapilevich, Ayan Barbora, Stella Liberman-Aronov	2020-(15)
<p>" Microscopic analyses of physical parameters measured indicate MMW irradiation induces significant morphological changes characteristic of apoptosis and senescence. The Immediate short-term stress responses translate into long-term effects, retained over the duration of the experiment(s); reminiscent of the phenomenon of Accelerated Cellular Senescence (ACS) achieving terminal tumorigenic cell growth. Further, results were observed to be treatment-specific in energy (dose) dependent manner and were achieved without the use of chemotherapeutic agents, ionizing radiation or thermal ablation employed in conventional methods; thereby overcome associated side effects." {From the publication}</p>			
Dynamics of Brain-Specific Proteins and Melatonin Before and After Microwave Resonance Therapy in Patients with Aftereffects of Mild Brain Injury	37.5-53.6 GHz	Volodymyr Korshnyak	2019-(4)
<p>" The study of brain-specific proteins (S-100, MBP, EP, 3G-9-D6, GFAP) and melatonin hormone in patients with long-term effects of mild closed traumatic brain injury, before and after microwave resonance therapy was undertaken. Results: The dynamic observation of 20 patients with aftereffects of mild closed traumatic brain injury showed that microwave resonance therapy (MRT) leads to normalization of hormone melatonin and cerebrospinal proteins' state in this group of patients." {From the publication}</p> <p>" For each patient the individual, so-called resonance therapeutic frequency of exposure, was titrated, that caused the specific sensory responses, and using a fluoroplastic waveguide the researches were placing the source of emission to the targeted biologically active point." {From the publication}</p> <p>" After MRT procedure the AAB content to proteins S-100, GFAP, and 3G-9-D6 decreased and was close to the control group indices, and the AAB content to the EP has increased, although before the treatment, this figure was three times higher than in the control group, this may indicate the prolonged neuroimmune processes against neurons and glia associated with damage to the brain blood-brain barrier in patients with CTBI. MRT reduces the activity of these reactions and balances the indicators of humoral regulation." {From the publication}</p> <p>" Against this background, an increase in melatonin level was observed, which, on the one hand, is a manifestation of a compensatory reaction, and, on the other hand, is an attempt to normalize and inhibit the inflammatory autoimmune reactions that occur in the remote period of traumatic brain injury. In this case, the secondary mobilization of melatonin excretion by the pineal gland is considered as an auxiliary, protective phenomenon, aimed at those dysregulative disorders that occur in the remote period of closed traumatic brain injury." {From the publication}</p>			
Aggregative properties of erythrocyte under the influence of millimeter range electromagnetic waves	51.8 GHz - 0.064 mW/cm ²	M. A. Shahinyan, M. S. Mikaelyan, M. R. Darbinyan, P. O. Vardevanyan	2018-(6)
<p>Exposed rat blood cells (erythrocytes): Decreased absolute value of the surface charge density of erythrocytes. Faster acidic hemolysis of erythrocytes. Decreased erythrocytes density in suspension occurs along with an enhancement in their concentration.</p>			
The Effect of Electromagnetic Radiation at Frequencies of 51.8 and 53.0 GHz on Growth, Pigment Content, Hydrogen Photoemission, and F0F1-ATPase Activity in the Purple Bacterium Rhodobacter sphaeroides	51.8 GHz, 53 GHz - 0.06 mW/cm ²	L. Gabrielyana , V. Kalantaryana, A. Trchouniana	2018-(6)
Effect of athermal millimeter electromagnetic radiation on DNA structure of tumor tissue in vivo	48.3-50.3 GHz	A. A. Tadevosyan	2017-(3)
<p>It was shown, that under the effect of millimeter electromagnetic waves of 50.3 GHz (which coincides with resonant frequencies of oscillations of water molecular structures) during an hour, the content of 5-methylcytosine, the melting parameters of DNA of Sarcoma-45 tumor (in tumor carrying rats) changed, approaching the values of DNA extracted from the liver of healthy animals.</p>			
Influence of millimeter wave electromagnetic radiation of nonthermal intensity on density of aqueous solutions	48.3-64.5 GHz -	A. A. Tadevosyan	2017-(5)

	0.05-0.06 mW/cm2		
The distinguishing effects of low-intensity electromagnetic radiation of different extremely high frequencies on <i>Enterococcus hirae</i> : growth rate inhibition and scanning electron microscopy analysis	51.8-53.0 GHz - 0.06 mW/cm2	Lilit Gabrielyan, Harutyun Sargsyan, Armen Trchounian	2017-(6)
Action of Non-Ionizing Radiation on Tumor and Healthy DNA	38.5-78.8 GHz - 0.01 mW/cm2 (SAR 0.2 W/kg)	V. Kalantaryan, R. Martirosyan, Y. Babayan, L. Nersesyan, H. Stepanyan, R. Vardapetyan	2016-(6)
" Thus, it has been experimentally shown that the low-intensity electromagnetic fields do not act directly on DNA molecules, and the influence takes place through a mediated influence of the EMWs on the water, stimulating structural change of the water shell surrounding the DNA. Thereby, we may conclude that the primary targets of the influence of the electromagnetic fields on the DNA water solutions are the water molecules." {From the publication}			
Biohydrogen production by purple non-sulfur bacteria <i>Rhodobacter sphaeroides</i> : Effect of low-intensity electromagnetic irradiation	51.8-53.0 GHz - 0.06 mW/cm2	Lilit Gabrielyan, Harutyun Sargsyan, Armen Trchounian	2016-(1)
The Effect of Non-Thermal Microwave-Treated Physiological Solution on Isolated Heart Muscle of Snail	60 GHz (4 Hz modulated) - (SAR max. 0.58 W/kg)	Gayane Ayrapetyan, Hovik Hayrapetyan, Sinerik Ayrapetyan	2016-(7)
Millimeter waves or extremely high frequency electromagnetic fields in the environment: what are their effects on bacteria? (review)	(50-100 GHz)	Diana Soghomonyan, Karen Trchounian, Armen Trchounian	2016-(11)
One of the interesting opinions that appear here is that exogenously applied millimeter waves can imitate the cellular endogenous control signals and induce bacteria to vibrate at specific frequencies. The authors conclude that millimeter wave can affect many bacteria depressing their growth and changing properties and activity. And that different targets of radiation in bacteria are possible: for example water, cell plasma membrane, and genome.			
Links between extremely high frequency electromagnetic waves and their biological manifestations	-	Emil Anton , Anatol Rotaru , Daniel Covatariu, Alin Ciobica, Daniel Timofte, Radu Popescu, Carmen Anton	2015-(4)
Preliminary Results of Influence of Nonionizing Electromagnetic Radiation on Tumor and Healthy DNA and Role of Water	38.5-78.8 GHz - 0.01 mW/cm2 (SAR 0.2 W/kg)	Vitali Kalantaryan, Radik Martirosyan, Yuri Babayan, Lusine Nersesyan, Hrachya Stepanyan	2014-(8)
For the authors the various changes observed brings to the conclusion that electromagnetic fields (one of them 64.5 GHz which is a resonant frequency for oscillations of molecular hexagonal water structures) do not act directly on DNA but rather are mediated by water, stimulating structural change of the water shell surrounding the DNA which in turn affects the compaction of the macromolecule. " After 15 sessions of exposure without cytostatic drugs, at animals of the irradiated 0,5 hour was observed an inhibition of tumor growth by 33.5% compared with a control group and a sharp suppression of the level of DNA-methylation in 2.1 times. The tDNA [tumor sarcoma DNA]has the high level of methylation (4.7 mol%), which after 0.5 hour daily exposure becomes (2.2 mol%) close to the corresponding value for hDNA [healthy mice DNA](1.9 mol%). Differential melting curves (DMC) of tDNA are shifted relatively DMC of the hDNA to lower temperatures, and in the DMC of tDNA the additional peaks in the 52-60°C range are appeared, which are absent for DMC of liver hDNA. The obtained results are correlated with the spectrophotometric data. Under the influence of EMFs the values of temperature and interval of melting of tDNA are changed and approach to the corresponding values of hDNA." There is also a proof of the existence of Exclusion Zone waters around biomolecules and cellular structures and walls [1], because they have been done density measures after the irradiation on solutes that they bring different results from pure water and that implies that, in the first case, free water molecules (that they not pertain to compositions of the most common hexagonal structures) are structured around the dissolved ions or macromolecules. [1] EMMIND > Endogenous Fields & Mind > Water & Electromagnetic Fields > Electromagnetism & Water - Exclusion Zones			
Non-thermal influence of a weak microwave on nerve fiber activity	-	M.N. Shneider, M. Pekker	2014-(30)
Non-Thermal Mechanism of Weak Microwave Fields Influence on Nerve Fiber	30-300 GHz	M.N. Shneider, M. Pekker	2013-(25)
The influence of millimeter waves on the physical properties of large and giant unilamellar vesicles	52–72 GHz - 0.0035–0.010 mW/cm2	Katia Cosentino, Amerigo Beneduci, Alfonsina Ramundo, Orlando, Giuseppe Chidichimo	2013-(16)
Regulatory effects of terahertz waves (review)	150 GHz	Vyacheslav F. Kirichuk, Alexey N. Ivanov	2013-(7)
Effect of Millimeter Waves with Low Intensity on Peroxidase Total Activity and isoenzyme Composition in Cells of Wheat Seedling Shoots	49-53 GHz - 0.06 mW/cm2	Anahit V. Nerkararyan, Mariam A. Shahinyan, Marieta S. Mikaelyan, Poghos O. Vardevanyan	2013-(7)
Bactericidal effects of low-intensity extremely high frequency electromagnetic field: an overview with phenomenon, mechanisms,	40-100 GHz	Heghine Torgomyan, Armen Trchounian	2013-(10)

targets and consequences (review)			
<p>The authors revise 3 factible targets for this low intensity radiation: Water: changes in H₂O cluster structure and properties might be leading to increase of chemical activity or hydration of proteins and other cellular structures. Cell membrane: where surface characteristics, substance transport and energy-conversing processes can be altered. Genome: causing conformational changes in DNA. Finally also propose that those fields can affect the cell-to-cell interactions in bacterial populations, since bacteria might interact with each other through EMF of sub-extremely high frequency range.</p>			
Microwave induced shift of the main phase transition in phosphatidylcholine membranes	53–78 GHz - (SAR 0.002-0.008 W/kg)	Amerigo Beneduci, Luigi Filippelli, Katia Cosentino, Maria L. Calabrese, Rita Massa, Giuseppe Chidichimo	2012-(7)
Cell bathing medium as a target for non thermal effect of millimeter waves	90-160 GHz (4 Hz modulated) - (SAR 1.49 W/kg)	Anush Deghoyan, Armenuhi Heqimyan, Anna Nikoghosyan, Erna Dadasyan, Sinerik Ayrapetyan	2012-(11)
Escherichia coli Growth Changes by the Mediated Effects After Low-Intensity Electromagnetic Irradiation of Extremely High Frequencies	51.8, 53, 70.6, 73 GHz - 0.06 mW/cm ²	Heghine Torgomyan, Karlen Hovnanyan, Armen Trchounian	2012-(10)
Influence of low intensity coherent electromagnetic millimeter radiation (EMR) on aqua solution of DNA	64.5 GHz - 0.05 mW/cm ²	V. P. Kalantaryan, Y. S. Babayan, E. S. Gevorgyan, S. N. Hakobyan, A. P. Antonyan, P. O. Vardevanyan	2010-(8)
<p>The authors irradiated DNA solutions with the resonance frequency of the oscillations of hexagonal structures of water (66.5 GHz). " It is shown that the thermostability of DNA and density of its solutions are increased, depending on time of irradiation. It is expected that under the influence of millimeter electromagnetic radiation the hydration of DNA and ions of Na⁺ that are present in solution decrease. As a result, the physicochemical characteristics of DNA are changed." Currently, the concept that non-thermal effect of MMWs on biological systems is determined by the effect of MMWs on water, causing changes of bound water properties is rather acknowledged. (Water can be a main target because is extended over all parts of biological systems and is sufficiently systemic to account for the variety of effects, having some curious interactions with electromagnetic waves [1].) " Thus, the research of influence MMWs on structure and physical and chemical properties of water and water solutions of biological objects is essential. It is shown that rather weak physical influence including the MM-waves, impacts the properties of water solutions due to change of structure of water in an environment of the dissolved substances. Moreover, it is revealed, that functional changes of biological objects occur at irradiation of solutions of MM-waves." They say that molecular structures of biological tissues and water oscillate with a resonance frequency similar to those used in the new telecommunication systems. [1] EMMIND › Endogenous Fields & Mind › Water & Electromagnetic Fields › Electromagnetism & Water - Coherence Domains</p>			
Extremely High Frequency Electromagnetic Radiation Enforces Bacterial Effects of Inhibitors and Antibiotics	51.8-53 GHz - 0.06 mW/cm ²	Hasmik Tadevosyan, Vitaly Kalantaryan, Armen Trchounian	2008-(7)
<p>" The coherent electromagnetic radiation (EMR) of the frequency of 51.8 and 53 GHz with low intensity (the power flux density of 0.06 mW/cm²) affected the growth of Escherichia coli K12(λ) under fermentation conditions: the lowering of the growth specific rate was considerably (~2-fold) increased with exposure duration of 30–60 min; a significant decrease in the number of viable cells was also shown. Moreover, the enforced effects of the N,N'-dicyclohexylcarbodiimide (DCCD), inhibitor of H⁺-transporting FOF1-ATPase, on energy-dependent H⁺ efflux by whole cells and of antibiotics like tetracycline and chloramphenicol on the following bacterial growth and survival were also determined after radiation. In addition, the lowering in DCCD-inhibited ATPase activity of membrane vesicles from exposed cells was defined. The results confirmed the input of membranous changes in bacterial action of low intensity extremely high frequency EMR, when the FOF1-ATPase is probably playing a key role. The radiation of bacteria might lead to changed metabolic pathways and to antibiotic resistance. It may also give bacteria with a specific role in biosphere." It's interesting to note that although 2.4 GHz is the most used frequency in Wi-fi connections, there are also other higher frequencies in the more newly protocols, for example Wi-fi 802.11ad uses a 60 GHz frequency band, there are accumulating evidences that those frequencies affect, without a doubt, at very low level emission intensities.</p>			

Submillimeter Wave / Terahertz Radiation

Title	Used freq. and power	Authors	Year (pages)
Theoretical investigation on the effect of terahertz wave on Ca ²⁺ transport in the calcium channel	-	Lianghao Guo, Wenfei Bo, Kaicheng Wang, Shaomeng Wang, Yubin Gong	2021-(20)
<p>" In this work, we established a mathematical physical model of the Ca²⁺ channel by the Brownian dynamic method. The time domain and frequency domain characteristics of calcium ion movement in the channel have been analyzed. The results show that the Ca²⁺ transmembrane transport is a rapid signal change process on a short timescale, and its spontaneous radiation spectrum is mainly concentrated in the THz range. Meanwhile, the changes in temperature and the number of ions in the channel were proved to have significant effects on the spectral characteristics, as the frequency increases, the radiation spectrum of calcium ions shifted toward higher frequencies. In addition, under the external THz field irradiation, the oscillation spectrum of the irritated Ca²⁺ is significantly enhanced, which is expected to be applied in future nondestructive testing. It was also found from the simulation</p>			

<p>results that the transport process of Ca²⁺ across the ion channel is related to the frequency and amplitude of the THz wave. Under a certain amplitude, the ion permeability gradually increases as the frequency of the THz field increases; under a certain frequency, the ion permeability also increases as the amplitude increases. The finding in this paper provides a theoretical basis for the future treatment of THz waves in the neurological field." (From the publication)</p>			
<p>Terahertz Exposure Enhances Neuronal Synaptic Transmission and Oligodendrocyte Differentiation in vitro</p>	<p>3.1 THz - 0.07 mW/cm²</p>	<p>Xianghui Zhao, Ming Zhang, Yuming Liu, Haiying Liu, Keke Ren, Qian Xue, Haifeng Zhang, Na Zhi, Wenting Wang, Shengxi Wu</p>	<p>2021-(22)</p>
<p>" In the current study, we report that irradiation with a single-frequency THz laser on mice cortical neuron cultures increases excitatory synaptic transmission and neuronal firing activities. Microarray assay reveals gene expression dynamics after THz exposure, which is consistent with morphology and electrophysiology results. Besides, certain schedule of THz irradiation inhibits the proliferation of oligodendrocyte precursor cells (OPCs) and promotes OPC differentiation. Of note, the myelination process is enhanced after THz exposure. In summary, our observations suggest that THz irradiation can modulate the functions of different neuronal cells, with different sensitivity to THz." (From the publication)</p>			
<p>Impact of Sub-Millimeter Waves on the Assembly Kinetics of Microtubules</p>	<p>-</p>	<p>Xomalin G. Peralta, Jody C. Cantu, Cesario Z. Cerna, Ibtissam Echchgadda</p>	<p>2018-(1)</p>
<p>Exposed rat blood cells (erythrocytes): Decreased absolute value of the surface charge density of erythrocytes. Faster acidic hemolysis of erythrocytes. Decreased erythrocytes density in suspension occurs along with an enhancement in their concentration.</p>			
<p>Numerical and experimental studies of mechanisms underlying the effect of pulsed broadband terahertz radiation on nerve cells (in vitro)</p>	<p>0.1-2 THz - 0.00007-0.01 1 mW/cm²</p>	<p>M. V. Duka, L. N. Dvoretzkaya, N. S. Balbekin, M. K. Khodzitskii, S. A. Chivilikhin, O. A. Smolyanskaya</p>	<p>2014-(6)</p>
<p>" As the incident power was decreased, we observed first a depressive and then a stimulating effect of THz radiation on neurite growth. The growth stimulation effect reached 147±22% (significance level p < 0.05) relative to the controls at a THz power density of about 1.1 μW/cm²."</p>			
<p>Changing growth of neurites of sensory ganglion by terahertz radiation (in vitro)</p>	<p>0.05-2 THz - 0.0005-0.05 mW/cm²</p>	<p>M. V. Tsurkan, O. A. Smolyanskaya, V. G. Bespalov, V. A. Penniyainen, A. V. Kipenko, E. V. Lopatina, B. V. Krylov</p>	<p>2012-(1)</p>
<p>They applied broadband pulsed THz radiation (frequency: 0.05 ~ 2 THz, power density: 0.5 ~ 50 μW/cm²) to the sensory ganglion of chicken embryos and found 0.5 but not 5 and 50 μW/cm² power accelerated ganglion growth. Interestingly, during the experiment, the sample's temperature remained constant, indicating a non-thermal effect of THz irradiation.</p>			