References and extracts of over 60 scientific studies published in 2015 and up to April 2016 reporting potential harm at or below Safety Code 6 (2015), Health Canada's guidelines for safe human exposure to radiofrequency/microwave radiation

Canadians for Safe Technology (C4ST)

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Summary

The Parliamentary Standing Committee on Health (HESA) held three hearings on Safety Code 6[1] in early 2015. Its final report was tabled in the House of Commons on June 17th, 2015.

Canadians for Safe Technology previously summarized 140 studies[2] that were missing from the Safety Code 6 review, of which Health Canada determined that 36 were "in scope" (they should have been considered). Here we document 63 more recent studies reporting potential harm at or below Safety Code 6 limits. These studies, published in 2015 and up to April 2016, were identified since the HESA hearings. These include several studies on humans' biochemical and DNA damage with phone use, sperm damage, behaviour and depression, and electromagnetic hypersensitivity (EHS). As well, many animal studies demonstrate significant biological effects, including damage to the developing brain and organs, biochemical damage and harms to sperm and offspring. Extracts and brief summaries are presented in Table 1.

A graph summarizing data from 30 studies reporting the Specific Absorption Rate (SAR – a measure of radiofrequency radiation dose) can be found in Figure 2, on the final page. A preponderance of studies that reported SAR found effects at levels below 0.1 W/kg, while the Safety Code 6 limit is 1.6 W/kg.

Canadians for Safe Technology is again providing evidence that should have been acted upon by Health Canada. A comprehensive systematic review coupled with a rigorous updating system would permit Health Canada to act upon the best scientific evidence, to protect Canadians' health. The process and how the evidence is evaluated should be open to the public - unlike the present situation. We herein provide further indications that under Safety Code 6, current standards are not protective.

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[1] Health Canada's guidelines for safe human exposure to radiation in the radiofrequency/microwave range.
[2] http://www.c4st.org/HCSubmissions

Table 1. References and extracts of 63 relevant scientific studies published in 2015 and up to April 2016 reporting potential harm at or below Safety Code 6 (2015), Health Canada's guidelines for safe human exposure to radiofrequency/microwave radiation. This list includes some publications on electrosensitivity (EHS). Exposure levels, when provided in the study, are listed in [square brackets][3]. The Safety Code 6 level for specific absorption rate (SAR) is 1.6 W/Kg for all frequencies. The Safety Code 6 level expressed as power density varies with frequency: for 800 MHz for the general public it is 2,520 mW/m^2, for 2450 MHz (commonly used for Wi-Fi) it is 5,420 mW/m^2 and for 6,000 MHz and above it is 10,000 mW/m^2. The value in [square brackets] is SAR unless otherwise indicated. Human, animal and cell culture studies. Listed in alphabetical order by first author. The 2015 publications are listed first, followed by the 2016 publications.

2015 **References and extracts**		**Effects**
(1)	**Abu Khadra, K. M., Khalil, A. M., Abu Samak, M., & Aljaberi, A. (2015). Evaluation of selected biochemical parameters in the saliva of young males using mobile phones. *Electromagnetic Biology and Medicine*, *34*(1), 72–76** http://www.ncbi.nlm.nih.gov/pubmed/24499288 "... Cell phone radiation induced a significant increase of superoxide dismutase (SOD); there was a statistically significant ..." [1.09 W/Kg] [68.12 % of Safety Code 6]	**Biochemical changes**
(2)	**Aydoğan, F., Aydın, E., Koca, G., Özgür, E., Atilla, P., Tüzüner, A., ... Samim, E. E. (2015a). The effects of 2100-MHz radiofrequency radiation on nasal mucosa and mucociliary clearance in rats. *International Forum of Allergy & Rhinology* doi:10.1002/alr.21509** http://www.ncbi.nlm.nih.gov/pubmed/25885019 CONCLUSION: "Radiofrequency radiation at 2100 MHz 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." [0.4 W/Kg] [25.00 % of Safety Code 6]	**Damage to nasal tissue**

[3] Determined from the abstract, the original publication or from EMF Portal, which is an information platform hosted by the University of Aachen, Germany. EMF Portal website: http://www.emf-portal.de/

(3)	**Aydogan, F., Unlu, I., Aydin, E., Yumusak, N., Devrim, E., Samim, E. E., … Seyhan, N. (2015b). The effect of 2100 MHz radiofrequency radiation of a 3G mobile phone on the parotid gland of rats.** ***American Journal of Otolaryngology*****, *36*(1), 39–46** http://www.ncbi.nlm.nih.gov/pubmed/25456509 CONCLUSION: "The parotid gland of rats showed numerous histopathological changes after exposure to 2100 MHz radiofrequency radiation, both in the short and relatively long terms. Increased exposure duration led to an increase in the histopathological changes." [0.4 W/Kg] [25.00 % of Safety Code 6]	**Damage to parotid gland**
(4)	**Belpomme, D., Campagnac, C., & Irigaray, P. (2015). Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder.** ***Reviews on Environmental Health*****, *30*(4), 251–271** http://www.ncbi.nlm.nih.gov/pubmed/26613326 "...We report here our preliminary data, based on 727 evaluable of 839 enrolled cases: 521 (71.6%) were diagnosed with EHS [electrohypersensitivity], 52 (7.2%) with MCS [multiple chemical sensitivity], and 154 (21.2%) with both EHS and MCS. ... Our data strongly suggest that EHS and MCS can be objectively characterized and routinely diagnosed by commercially available simple tests. Both disorders appear to involve inflammation-related hyper-histaminemia, oxidative stress, autoimmune response, capsulothalamic hypoperfusion and BBB [blood-brain barrier] opening, and a deficit in melatonin metabolic availability; suggesting a risk of chronic neurodegenerative disease..."	**Objective tests for electrosensitivity (EHS)**

(5)	**Belyaev, I., Dean, A., Eger, H., Hubmann, G., Jandrisovits, R., Johansson, O., … Thill, R. (2015). EUROPAEM EMF Guideline 2015 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses. *Reviews on Environmental Health*, *30*(4), 337–371** http://www.ncbi.nlm.nih.gov/pubmed/26613329 "... A comprehensive medical history, which should include all symptoms and their occurrences in spatial and temporal terms and in the context of EMF [electromagnetic field] exposures, is the key to the diagnosis...Based on our current understanding, a treatment approach that minimizes the adverse effects of peroxynitrite - as has been increasingly used in the treatment of multisystem disorders - works best. This EMF Guideline gives an overview of the current knowledge regarding EMF-related health risks and provides concepts for the diagnosis and treatment and accessibility measures of EHS to improve and restore individual health outcomes as well as for the development of strategies for prevention."	**Diagnostic and treatment for electrosensitivity (EHS)**
(6)	**Cao, H., Qin, F., Liu, X., Wang, J., Cao, Y., Tong, J., & Zhao, H. (2015). Circadian Rhythmicity of Antioxidant Markers in Rats Exposed to 1.8 GHz Radiofrequency Fields. *International Journal of Environmental Research and Public Health*, *12*(2), 2071–2087** http://www.ncbi.nlm.nih.gov/pubmed/25685954 " ... circadian rhythms in the synthesis of Mel [melatonin] and antioxidant enzymes, GSH-Px [glutathione peroxidase] and SOD [superoxide dismutase], were shifted in RF-exposed rats..." [0.05653 W/Kg] [SAR is 3.5 % of Safety Code 6] [Power density: 201.7 µW/cm2]	**Circadian rhythm antioxidant changes**
(7)	**Carpenter, D. O. (2015). The microwave syndrome or electro-hypersensitivity: historical background. *Reviews on Environmental Health*, *30*(4), 217–222** http://www.ncbi.nlm.nih.gov/pubmed/26556835 "...There is increasing evidence that the 'microwave syndrome' or 'electro-hypersensitivity' (EHS) is a real disease that is caused by exposure to EMFs [electromagnetic fields], especially those in the microwave range. The reported incidence of the syndrome is increasing along with increasing exposure to EMFs from electricity, WiFi, mobile phones and towers, smart meters and many other wireless devices..."	**Reported incidence of electrosensitivity (EHS) is increasing**

(8)	**Dasdag, S., Akdag, M. Z., Erdal, M. E., Erdal, N., Ay, O. I., Ay, M. E., … Yegin, K. (2015a). Effects of 2.4 GHz radiofrequency radiation emitted from Wi-Fi equipment on microRNA expression in brain tissue. *International Journal of Radiation Biology*, *91*(7), 555–561** http://www.ncbi.nlm.nih.gov/pubmed/25775055 "RESULTS: The results revealed that long-term exposure of 2.4 GHz Wi-Fi radiation can alter expression of some of the miRNAs [micro RNAs]... CONCLUSION: Long-term exposure of 2.4 GHz RF may lead to adverse effects such as neurodegenerative diseases originated from the alteration of some miRNA expression..." [7,127 uW/Kg -maximum] [0.45 % of Safety Code 6]	**MicroRNA in brain tissue is altered**
(9)	**Dasdag, S., Akdag, M. Z., Erdal, M. E., Erdal, N., Ay, O. I., Ay, M. E., … Yegin, K. (2015b). Long term and excessive use of 900 MHz radiofrequency radiation alter microRNA expression in brain. *International Journal of Radiation Biology*, 1–6** http://www.ncbi.nlm.nih.gov/pubmed/25529971 "Conclusion: 900 MHz RF [radiofrequency] radiation can alter some of the miRNA [micro RNA]..." [0.0369 W/Kg] [2.31 % of Safety Code 6]	**Expression of microRNA in the brain is altered**
(10)	**Dasdag, S., Taş, M., Akdag, M. Z., & Yegin, K. (2015). Effect of long-term exposure of 2.4 GHz radiofrequency radiation emitted from Wi-Fi equipment on testes functions. *Electromagnetic Biology and Medicine*, *34*(1), 37–42** http://www.ncbi.nlm.nih.gov/pubmed/24460421 "... Head defects increased in the exposure group ($p < 0.05$) while weight of the epididymis and seminal vesicles, seminiferous tubules diameter and tunica albuginea thickness were decreased … In conclusion, we observed that long-term exposure of 2.4 GHz RF [radiofrequency] emitted from Wi-Fi (2420 µW/kg, 1 g average) affects some of the reproductive parameters of male rats. We suggest Wi-Fi users to avoid long-term exposure of RF emissions from Wi-Fi equipment." [2420 µW/Kg] [0.15 % of Safety Code 6]	**Testes abnormalities**

(11)	**Deshmukh, P. S., Nasare, N., Megha, K., Banerjee, B. D., Ahmed, R. S., Singh, D., … Mediratta, P. K. (2015). Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation. *International Journal of Toxicology*, *34*(3), 284–290** http://www.ncbi.nlm.nih.gov/pubmed/25749756 "...The results indicated that, chronic low-intensity microwave exposure in the frequency range of 900 to 2450 MHz may cause hazardous effects on the brain..." [6.672 × 10(-4) W/Kg -highest] [0.040 % of Safety Code 6]	**Brain cognitive impairment and genotoxicty**
(12)	**Eris, A. H., Kiziltan, H. S., Meral, I., Genc, H., Trabzon, M., Seyithanoglu, H., … Uysal, O. (2015). Effect of Short-term 900 MHz low level electromagnetic radiation exposure on blood serotonin and glutamate levels. *Bratislavské Lekárske Listy*, *116*(2), 101–103** http://www.ncbi.nlm.nih.gov/pubmed/25665475 "... It was found that a single 45 min of LLER [low level electromagnetic radiation] exposure increased the blood 5-HT [serotonin] level significantly... Increased 5-HT level may lead to a retarded learning and a deficit in spatial memory..." [Power density: 608 mW/m2]	**Blood serotonin**
(13)	**Furtado-Filho, O. V., Borba, J. B., Maraschin, T., Souza, L. M., Henriques, J. A. P., Moreira, J. C. F., & Saffi, J.. (2015). Effects of chronic exposure to 950 MHz ultra-high-frequency electromagnetic radiation on reactive oxygen species metabolism in the right and left cerebral cortex of young rats of different ages. *International Journal of Radiation Biology*, *91*(11), 891–897** http://www.ncbi.nlm.nih.gov/pubmed/26272641 "... there was an increase in the levels of CP [carbonylated proteins] in the RCC [right cerebral cortex] of the 6-day-old ER [exposed rat]. Interestingly, the concentration of blood glucose was decreased in this group... This study is the first to demonstrate the use of UHF-EMR[ultra-high-frequency electromagnetic radiation] causes different damage responses to proteins in the LCC [left cerebral cortex] and RCC." [1.32-1.14 W/Kg] [82.50 % of Safety Code 6]	**Damage to brain proteins**

(14)	**Gandhi, O. P. (2015). Yes the Children Are More Exposed to Radiofrequency Energy From Mobile Telephones Than Adults. *IEEE Access*, *3*, 985–988** doi:**10.1109/ACCESS.2015.2438782** http://bit.ly/1SnFyBs "… the main reason for higher exposure of children (also women and men with smaller heads and likely thinner pinnae) to radiofrequency energy from mobile phones is the closer placement of the cell phone radiation source by several millimeters to the tissues of the head, e.g., the brain...."	**Children's exposure to radiation from mobile phones is higher than adults**
(15)	**Ghosn, R., Yahia-Cherif, L., Hugueville, L., Ducorps, A., Lemarechal, J.-D., Thuroczy, G., … Selmaoui, B.. (2015). Radiofrequency signal affects alpha band in resting electroencephalogram. *Journal of Neurophysiology*, Apr 1; 113(7):2753-9** http://www.ncbi.nlm.nih.gov/pubmed/25695646 "...real exposure in double-blind, counterbalanced, crossover design...the exposure session showed a statistically significant ($p < 0.0001$) decrease of the alpha band spectral power during closed eyes condition..." [0.93 W/Kg- peak] [58.13 % of Safety Code 6]	**Brain waves altered**
(16)	**Gulati, S., Yadav, A., Kumar, N., Kanupriya, Aggarwal, N. K., Kumar, R., & Gupta, R. (2015). Effect of GSTM1 and GSTT1 Polymorphisms on Genetic Damage in Humans Populations Exposed to Radiation From Mobile Towers. *Archives of Environmental Contamination and Toxicology*** doi:**10.1007/s00244-015-0195-y** http://www.ncbi.nlm.nih.gov/pubmed/26238667 "...There was a significant increase in BMN [micronucleus assay in buccal cells] frequency and TM [tail moment] value in exposed subjects (3.65 ± 2.44 and 6.63 ± 2.32) compared with control subjects (1.23 ± 0.97 and 0.26 ± 0.27)..." [towers]	**Mouth cell abnormalities**

(17)	**Güler, G., Ozgur, E., Keles, H., Tomruk, A., Vural, S. A., & Seyhan, N. (2015). Neurodegenerative changes and apoptosis induced by intrauterine and extrauterine exposure of radiofrequency radiation.** ***Journal of Chemical Neuroanatomy*** doi:**10.1016/j.jchemneu.2015.10.006** http://www.ncbi.nlm.nih.gov/pubmed/26520616 ... only intrauterine exposure significantly causes MDA [malondialdehyde] level increase for the male infants... Gliosis were mildly positive in brain tissues of rabbits that are exposed only intrauterine period, also the group exposed both intrauterine and extrauterine periods..." [18mW/Kg] [1.13 % of Safety Code 6]	**Nerve cell damage in young**
(18)	**Hancı, H., Türedi, S., Topal, Z., Mercantepe, T., Bozkurt, I., Kaya, H., … Odacı, E. (2015). Can prenatal exposure to a 900 MHz electromagnetic field affect the morphology of the spleen and thymus, and alter biomarkers of oxidative damage in 21-day-old male rats?.** ***Biotechnic & Histochemistry: Official Publication of the Biological Stain Commission***, ***90***(**7**), **535–543** http://www.ncbi.nlm.nih.gov/pubmed/25985826 "Transmission electron microscopy showed pathological changes in cell morphology in the thymic and splenic tissues of newborn rats exposed to EMF. Exposure to 900 MHz EMF during the prenatal period can cause pathological and biochemical changes that may compromise the development of the male rat thymus and spleen." [0.025 W/Kg] [1.56 % of Safety Code 6]	**Spleen and thymus cells altered from prenatal exposure**

(19)	**İkinci, A., Mercantepe, T., Unal, D., Erol, H. S., Şahin, A., Aslan, A., … Odacı, E. (2015). Morphological and antioxidant impairments in the spinal cord of male offspring rats following exposure to a continuous 900MHz electromagnetic field during early and mid-adolescence. *Journal of Chemical Neuroanatomy*** doi:**10.1016/j.jchemneu.2015.11.006** http://www.ncbi.nlm.nih.gov/pubmed/26708410 "... Biochemistry results revealed significantly increased malondialdehyde and glutathione levels ...TEM [transmission electron microscopic] revealed marked loss of myelin sheath integrity and invagination into the axon and broad vacuoles in axoplasm. The study results show that biochemical alterations and pathological changes may occur in the spinal cords of male rats following exposure to 900MHz EMF for 1h a day on PD [postnatal days] 21-46." [0.01W/Kg] [0.63 % of Safety Code 6]	**Spinal cord myelin sheath - biochemical and pathological changes**
(20)	**Lee, D., Lee, J., & Lee, I. (2015). Cell phone-generated radio frequency electromagnetic field effects on the locomotor behaviors of the fishes Poecilia reticulata and Danio rerio. *International Journal of Radiation Biology,* 91(10):843-50.** http://www.ncbi.nlm.nih.gov/pubmed/26073525 "RESULTS: We demonstrated that a cellular phone-induced temperature elevation was not relevant ... there were significant changes in the locomotion of the fish after feeding under the RF EMF. CONCLUSIONS: The locomotion of the fed fish was affected in terms of changes in population and velocity distributions under the presence of the RF EMF emitted by the cell phone."	**Fishes - locomotion affected** **Non-thermal**

(21)	**Lerchl, A., Klose, M., Grote, K., Wilhelm, A. F. X., Spathmann, O., Fiedler, T., … Clemens, M. (2015). Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. *Biochemical and Biophysical Research Communications*, *459*(4), 585–590** http://www.ncbi.nlm.nih.gov/pubmed/25749340 "...We have performed a replication study using higher numbers of animals per group and including two additional exposure levels (0 (sham), 0.04, 0.4 and 2 W/kg SAR). We could confirm and extend the originally reported findings. Numbers of tumors of the lungs and livers in exposed animals were significantly higher ... Since many of the tumor-promoting effects in our study were seen at low to moderate exposure levels (0.04 and 0.4 W/kg SAR [specific absorption rate]), thus well below exposure limits for the users of mobile phones..." [0.04, 0.4 W/Kg] [2. 50 % and 25.00% of Safety Code 6]	**Tumour initiating and promoting** **Non-linear**
(22)	**Liu, Q., Si, T., Xu, X., Liang, F., Wang, L., & Pan, S. (2015). Electromagnetic radiation at 900 MHz induces sperm apoptosis through bcl-2, bax and caspase-3 signaling pathways in rats. *Reproductive Health*, *12*, 65** http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4523914/ "...CONCLUSION: RF-EMR increases the ROS [reactive oxygen species] level and decreases TAC [total antioxidant capacity] in rat sperm. Excessive oxidative stress alters the expression levels of apoptosis-related genes and triggers sperm apoptosis through bcl-2, bax, cytochrome c and caspase-3 signaling pathways." [0.66 W/kg] [41.25 % of Safety Code 6]	**Sperm abnormalities** **Oxidative stress**
(23)	**Mahmoudabadi, F. S., Ziaei, S., Firoozabadi, M., & Kazemnejad, A. (2015). Use of mobile phone during pregnancy and the risk of spontaneous abortion. *Journal of Environmental Health Science and Engineering*, *13* , 34** http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4416385/ "... Conclusion: Our result suggests that use of mobile phones can be related to the early spontaneous abortions." [mobile phone]	**Indications of increased risk in human spontaneous abortions**

(24)	**Marjanovic, A. M., Pavicic, I., & Trosic, I. (2015). Cell oxidation-reduction imbalance after modulated radiofrequency radiation. *Electromagnetic Biology and Medicine*, *34*(4), 381–386** http://www.ncbi.nlm.nih.gov/pubmed/25119294 "... In exposed samples, ROS [reactive oxygen species] level significantly ($p < 0.05$) increased after 10 min of exposure. Decrease in ROS level was observed after 30-min treatment indicating antioxidant defence mechanism activation..." [1.6W/Kg] [100.00 % of Safety Code 6]	**Imbalance of cell oxidation-reduction**
(25)	**Megha, K., Deshmukh, P. S., Banerjee, B. D., Tripathi, A. K., Ahmed, R., & Abegaonkar, M. P. (2015). Low intensity microwave radiation induced oxidative stress, inflammatory response and DNA damage in rat brain. *Neurotoxicology*, *51*, 158–165** http://www.ncbi.nlm.nih.gov/pubmed/26511840 "...a frequency dependent significant increase in oxidative stress markers viz. malondialdehyde (MDA), protein carbonyl (PCO) and catalase (CAT) in microwave exposed groups in comparison to sham exposed group ($p<0.05$)... A significant increase in levels of pro-inflammatory cytokines (IL-2, IL-6, TNF-α, and IFN-γ) was observed in microwave exposed animal ($p<0.05$). Furthermore, significant DNA damage was also observed ... the present study suggests that low intensity microwave radiation induces oxidative stress, inflammatory response and DNA damage in brain by exerting a frequency dependent effect..." [0.59, 0.58 and 0.66mW/Kg] [0.040 % of Safety Code 6]	**DNA damage - brain** **Oxidative stress**
(26)	**Megha, K., Deshmukh, P. S., Ravi, A. K., Tripathi, A. K., Abegaonkar, M. P., & Banerjee, B. D. (2015). Effect of Low-Intensity Microwave Radiation on Monoamine Neurotransmitters and Their Key Regulating Enzymes in Rat Brain. *Cell Biochemistry and Biophysics*** doi:**10.1007/s12013-015-0576-x** http://www.ncbi.nlm.nih.gov/pubmed/25672490 "... Results showed significant reduction in levels of DA [dopamine], NE [norepinephrine], E [epinephrine] and 5-HT [serotonin] in hippocampus ... significant downregulation in mRNA expression of TH [tyrosine hydroxylase], TPH1 and TPH2 [tryptophan hydroxylase 1 and 2] was also observed in microwave-exposed animals ($p < 0.05$)." [5.953 × 10(-4) and 5.835 × 10(-4) W/Kg] [0.040 % of Safety Code 6]	**Brain - neurotransmitters and regulating enzymes**

(27)	**Misa-Agustiño, M. J., Jorge-Mora, T., Jorge-Barreiro, F. J., Suarez-Quintanilla, J., Moreno-Piquero, E., Ares-Pena, F. J., & López-Martín, E.. (2015). Exposure to non-ionizing radiation provokes changes in rat thyroid morphology and expression of HSP-90.** ***Experimental Biology and Medicine (Maywood, N.J.),*** **240(9):1123-35.** http://www.ncbi.nlm.nih.gov/pubmed/25649190 "...Morphological changes in the thyroid tissue may indicate a glandular response to acute or repeated stress from radiation in the hypothalamic-pituitary-thyroid axis." [non-thermal specific absorption rates (SARs)]	**Thyroid changes** **Non-thermal**
(28)	**Misa-Agustiño, M. J., Leiro-Vidal, J. M., Gomez-Amoza, J. L., Jorge-Mora, M. T., Jorge-Barreiro, F. J., Salas-Sánchez, A. A., … López-Martín, E.. (2015). EMF radiation at 2450 MHz triggers changes in the morphology and expression of heat shock proteins and glucocorticoid receptors in rat thymus.** ***Life Sciences*****,** ***127*****, 1–11** http://www.ncbi.nlm.nih.gov/pubmed/25731700 "...Our results indicate that non-ionizing sub-thermal radiation causes changes in the endothelial permeability and vascularization of the thymus, and is a tissue-modulating agent for Hsp90 [heat shock protein 90] and GR [glucocorticoid receptors]." [Non-thermal SARs]	**Thymus changes** **Non-thermal**
(29)	**Narayanan, S. N., Kumar, R. S., Karun, K. M., Nayak, S. B., & Bhat, P. G.. (2015). Possible cause for altered spatial cognition of prepubescent rats exposed to chronic radiofrequency electromagnetic radiation.** ***Metabolic Brain Disease, 30*****(5), 1193-206.** http://www.ncbi.nlm.nih.gov/pubmed/26033310 "RF-EMR exposed rats exhibited poor spatial memory retention when tested 48 h after the final trial...RF-EMR exposure affected the viable cell count in dorsal hippocampal CA3 region. RF-EMR exposure influenced dendritic arborization pattern of both apical and basal dendritic trees in RF-EMR exposed rats. ..." [SAR -1.15 W/Kg] [71.88 % of Safety Code 6] [Power density- 146.60 µW/cm^2]	**Behaviour**

(30)	**Odacı, E., Hancı, H., İkinci, A., Sönmez, O. F., Aslan, A., Şahin, A., … Baş, O. (2015a). Maternal exposure to a continuous 900-MHz electromagnetic field provokes neuronal loss and pathological changes in cerebellum of 32-day-old female rat offspring. *Journal of Chemical Neuroanatomy*** doi:**10.1016/j.jchemneu.2015.09.002** http://www.ncbi.nlm.nih.gov/pubmed/26391347 "... prenatal exposure to EMF affects the development of Purkinje cells in the female rat cerebellum and that the consequences of this pathological effect persist after the postnatal period." [0.01 W/Kg] [0.63 % of Safety Code 6]	**Maternal exposure-** **brain alterations**
(31)	**Odacı, E., & Özyılmaz, C. (2015b). Exposure to a 900 MHz electromagnetic field for 1 hour a day over 30 days does change the histopathology and biochemistry of the rat testis. *International Journal of Radiation Biology*, *91*(7), 547–554** http://www.ncbi.nlm.nih.gov/pubmed/25786704 "... alterations in adult rat testicular morphology and biochemistry." [0.025 W/Kg] [1.56 % of Safety Code 6]	**Testes abnormalities**
(32)	**Odacı, E., Ünal, D., Mercantepe, T., Topal, Z., Hancı, H., Türedi, S., … Çolakoğlu, S. (2015c). Pathological effects of prenatal exposure to a 900 MHz electromagnetic field on the 21-day-old male rat kidney. *Biotechnic & Histochemistry: Official Publication of the Biological Stain Commission*, *90*(2), 93–101** http://www.ncbi.nlm.nih.gov/pubmed/25158858 "... pathological changes in kidney tissue in 21-day-old male rats owing to oxidative stress and decreased antioxidant enzyme levels." [0.024 W/Kg] [1.50 % of Safety Code 6]	**Kidney - prenatal exposure** **Pathological changes**
(33)	**Ohtani, S., Ushiyama, A., Maeda, M., Ogasawara, Y., Wang, J., Kunugita, N., & Ishii, K. (2015). The effects of radio-frequency electromagnetic fields on T cell function during development. *Journal of Radiation Research*, *56*(3), 467–474** http://www.ncbi.nlm.nih.gov/pubmed/25835473 "...the *Il5* gene was significantly regulated in spleen tissues, *Il4*, *Il5* and *Il23a* genes were significantly upregulated in thymus tissues ..." [0.2 W/Kg] [12.5 % of Safety Code 6]	**Immune system - genes**

(34)	**Panagopoulos, D. J., Johansson, O., & Carlo, G. L. (2015). Real versus Simulated Mobile Phone Exposures in Experimental Studies. *BioMed Research International*, *2015*, 607053** doi:**10.1155/2015/607053** http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4539441/ "... While experimental studies employing simulated EMF-emissions present a strong inconsistency among their results with less than 50% of them reporting effects, studies employing real mobile phone exposures demonstrate an almost 100% consistency in showing adverse effects... in order for experimental findings to reflect reality, it is crucially important that exposures be performed by commercially available mobile phone handsets."	**Real mobile phones exposures must be used in experimental studies, to reflect reality**
(35)	**Peñuela-Epalza, M. E., Páez-Jiménez, D. A., Castro-Cantillo, L. D. C., Harvey-Ortega, J. C., Eljach-Cartagena, J. A., & Banquett-Henao, L. A. (2015). [Prevalence of insomnia in adults aged 18 to 60 years and exposure to electromagnetic fields in households of Barranquilla, Colombia]. *Biomédica: Revista Del Instituto Nacional De Salud*, *35 Spec*, 120–129** http://www.ncbi.nlm.nih.gov/pubmed/26535748 "... a higher prevalence of insomnia in the neighborhood with greater exposure to radio antennas and cell towers (85.4%) than in the one with lower exposure (63.3%), prevalence ratio 1.34 (CI 95% 1.14-1.57). CONCLUSIONS: This study suggests a higher prevalence of insomnia among persons living in areas with higher exposure to electromagnetic fields where the number of radio antennas and cell towers was greater." [radio antennas and cell towers]	**Human insomnia more prevalent near radio antennas and cell towers**
(36)	**Petrosyan, M. S., Nersesova, L. S., Gazaryants, M. G., Meliksetyan, G. O., Malakyan, M. G., Bajinyan, S. A., & Akopian, J. I. (2015). [Effect of Low-Intensity 900 MHz Frequency Electromagnetic Radiation on Rat Brain Enzyme Activities Linked to Energy Metabolism]. *Radiatsionnaia Biologiia, Radioecologiia / Rossiĭskaia Akademiia Nauk*, *55*(6), 625–631** http://www.ncbi.nlm.nih.gov/pubmed/26964348 "the most radiosensitive enzyme is the brain creatine kinase [CK]... According to the analysis of the changing dynamics of the CK, ALT [alanine aminotransferase] and AST [aspartate aminotransferase] activity level, with time these changes acquire the adaptive character and are directed to compensate the damaged cell energy metabolism." [Power density: 25 µW/cm2]	**Brain -enzyme changes**

(37)	**Roggeveen, S., van Os, J., Viechtbauer, W., & Lousberg, R. (2015). EEG Changes Due to Experimentally Induced 3G Mobile Phone Radiation. *PloS One*, *10*(6), e0129496** doi:**10.1371/journal.pone.0129496** http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4459698/ "...Significant radiation effects were found for the alpha, slowbeta, fastbeta, and gamma bands. ...The results support the notion that EEG [electroencephalogram] alterations are associated with mobile phone usage and that the effect is dependent on site of placement..." [mobile phone]	**Women - electroencephalogram (EEG) alterations**
(38)	**Şahin, A., Aslan, A., Baş, O., İkinci, A., Özyılmaz, C., Fikret Sönmez, O., … Odacı, E. (2015). Deleterious impacts of a 900MHz electromagnetic field on hippocampal pyramidal neurons of 8-week-old Sprague Dawley male rats. *Brain Research* 1624, 232-8.** http://www.ncbi.nlm.nih.gov/pubmed/26239913 "... Stereological analyses showed that the total number of pyramidal neurons in the cornu ammonis of the EMF-EG [EMF exposed] rats was significantly lower ...pyramidal neuron loss and histopathological changes in the cornu ammonis of 8-week-old male rats may be due to the 900MHz EMF exposure." [0.024 W/Kg] [1.50 % of Safety Code 6]	**Brain cell loss**
(39)	**Shahin, S., Banerjee, S., Singh, S. P., & Chaturvedi, C. M. (2015). 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. *Toxicological Sciences: An Official Journal of the Society of Toxicology 148*(2), 380-99.** http://www.ncbi.nlm.nih.gov/pubmed/26396154 "...These findings led us to conclude that exposure to continuous-wave MW [microwave] radiation leads to oxidative/nitrosative stress induced p53 dependent/independent activation of hippocampal neuronal and non-neuronal apoptosis associated with spatial memory loss." [0.0146 W/Kg] [0.91 % of Safety Code 6] [Power density: 0.0248 mW/cm^2]	**Brain cell loss** **Memory loss**

(40)	**Shivashankara, A. R., Joy, J., Sunitha, V., Rai, M. P., Rao, S., Nambranathayil, S., & Baliga, M. S. (2015). Effect of Cell Phone Use on Salivary Total Protein, Enzymes and Oxidative Stress Markers in Young Adults: A Pilot Study. *Journal of Clinical and Diagnostic Research : JCDR*, *9*(2), BC19–BC22** http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4378728/ "... High mobile users had significantly higher levels of amylase (p = 0.001), LDH [lactate dehydrogenase] (p = 0.002) and MDA [malondialdehdye] (p = 0.002) in saliva... Significant changes in salivary enzymes and MDA suggest adverse effect of high use of cell phones on cell health." [mobile phone]	**Mouth cells - oxidative stress**
(41)	**Sieroń-Stołtny, K., Teister, Ł., Cieślar, G., Sieroń, D., Śliwinski, Z., Kucharzewski, M., & Sieroń, A. (2015). The influence of electromagnetic radiation generated by a mobile phone on the skeletal system of rats. *BioMed Research International*, *2015*, 896019** doi:**10.1155/2015/896019** http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4331479/ "... it alters the processes of bone mineralization and the intensity of bone turnover processes and thus influences the mechanical strength of bones." [mobile phone]	**Bone mineralization altered**
(42)	**Singh, S., Mani, K. V., & Kapoor, N. (2015). Effect of occupational EMF exposure from radar at two different frequency bands on plasma melatonin and serotonin levels. *International Journal of Radiation Biology*, *91*(5), 426-34** http://www.ncbi.nlm.nih.gov/pubmed/25565559 "...Conclusion: The study showed the EMF ability to influence plasma melatonin and serotonin concentration in radar workers, significantly in 12.5-18 GHz range with service period greater than 10 years." [occupational exposure to radar]	**Melatonin and serotonin changes in radar workers**

(43)	**Sırav, B., & Seyhan, N. (2015). Effects of GSM modulated radio-frequency electromagnetic radiation on permeability of blood-brain barrier in male & female rats.** ***Journal of Chemical Neuroanatomy*** doi:**10.1016/j.jchemneu.2015.12.010** http://www.ncbi.nlm.nih.gov/pubmed/26723545 "... Results have shown that 20minutes pulse modulated radio-frequency radiation exposure of 900MHz and 1800MHz induces an effect and increases the permeability of blood-brain barrier of male rats...The results of this study suggest that mobile phone radation could lead to increase the permeability of blood-brain barrier under non-thermal exposure levels. More studies are needed to demonstrate the mechanisms of that breakdown." [0.02 W/Kg] [1.25 % of Safety Code 6]	**Blood-brain-barrier** **Non-thermal**
(44)	**Türedi, S., Hancı, H., Topal, Z., Ünal, D., Mercantepe, T., Bozkurt, İ., … Odacı, E. (2015). The effects of prenatal exposure to a 900-MHz electromagnetic field on the 21-day-old male rat heart.** ***Electromagnetic Biology and Medicine*****, *34*(4), 390–397** http://www.ncbi.nlm.nih.gov/pubmed/25166431 "...Electron microscopy revealed crista loss and swelling in the mitochondria, degeneration in myofibrils and structural impairments in Z bands. Our study results suggest that exposure to EMF in the prenatal period causes oxidative stress and histopathological changes in male rat pup heart tissue." [Power density: 0.50 W/m^2]	**Prenatal exposure: heart** **Oxidative and histopathological changes**
(45)	**Wang, X., Liu, C., Ma, Q., Feng, W., Yang, L., Lu, Y., … Zhang, L. (2015). 8-oxoG DNA glycosylase-1 inhibition sensitizes Neuro-2a cells to oxidative DNA base damage induced by 900 MHz radiofrequency electromagnetic radiation.** ***Cellular Physiology and Biochemistry: International Journal of Experimental Cellular Physiology, Biochemistry, and Pharmacology*****, *37*(3), 1075–1088** http://www.ncbi.nlm.nih.gov/pubmed/26401913 "... Exposure to 900 MHz RF-EMFs with insufficient energy could induce oxidative DNA base damage in Neuro-2a cells. These increases were concomitant with similar increases in the generation of reactive oxygen species (ROS)...RF-EMFs could cause DNA base damage in Neuro-2a cells as low as 1 W/kg." [1.0 W/Kg] [62.5 % of Safety Code 6]	**DNA damage**

2016 References and extracts		Effects
(46)	**Akdag, M. Z., Dasdag, S., Canturk, F., Karabulut, D., Caner, Y., & Adalier, N. (2016). Does prolonged radiofrequency radiation emitted from Wi-Fi devices induce DNA damage in various tissues of rats?** ***Journal of Chemical Neuroanatomy*** doi**. 10.1016/j.chemneu.2016.01.003** http://www.ncbi.nlm.nih.gov/pubmed/26775760 "... the increase of the DNA damage in rat testes tissue was significant ($p<0.01$)...The results of this study indicated that testes are more sensitive organ to RF radiation." [141.4 uW/Kg and 7127 uW/Kg (max)] [0.45 % of Safety Code 6]	**DNA damage**
(47)	**Calvente, I., Pérez-Lobato, R., Núñez, M.-I., Ramos, R., Guxens, M., Villalba, J., … Fernández, M. F. (2016). Does exposure to environmental radiofrequency electromagnetic fields cause cognitive and behavioral effects in 10-year-old boys?** ***Bioelectromagnetics*****, *37*(1), 25–36** http://www.ncbi.nlm.nih.gov/pubmed/26769168 "... children living in higher RF exposure areas (above median SRMS levels) had lower scores for verbal expression/comprehension and higher scores for internalizing and totl problems, and obsessive-compulsive and post-traumatic stress disorders, in comparison to those living in areas with lower exposure..." [Power density: 285.94 and 2759.68 µW/m2]	**Boys, behaviour**
(48)	**Dieudonné, M. (2016). Does electromagnetic hypersensitivity originate from nocebo responses? Indications from a qualitative study.** ***Bioelectromagnetics*****, *37*(1), 14–24** http://www.ncbi.nlm.nih.gov/pubmed/26369906 "... the hypothesis has been put forward that IEI-EMF [Idiopathic Environmental Intolerance attributed to Electromagnetic Fields] originates from psychological mechanisms, especially nocebo responses... Overall, symptoms appear before subjects start questioning effects of EMF on their health, which is not consistent with the hypothesis that IEI-EMF originates from nocebo responses to perceived EMF exposure." [environmental exposures]	**Electrosensitivity is not a nocebo effect**

(49)	**Dyka, L. D., Shakina, L. A., Strashnyuk, V. Y., & Shckorbatov, Y. G. (2016). Effects of 36.6 GHz and static magnetic field on degree of endoreduplication in Drosophila melanogaster polytene chromosomes. *International Journal of Radiation Biology*, *92*(4), 222–227** http://www.ncbi.nlm.nih.gov/pubmed/26882320 Conclusions: "Exposure to microwaves on the stage of embryogenesis has a stimulating effect on endoreduplication in Drosophila development..." [Power density: 1W/m^2]	**Insect - reproduction**
(50)	**Esmekaya, M. A., Tuysuz, M. Z., Tomruk, A., Canseven, A. G., Yücel, E., Aktuna, Z., … Seyhan, N. (2016). Effects of cell phone radiation on lipid peroxidation, glutathione and nitric oxide levels in mouse brain during epileptic seizure. *Journal of Chemical Neuroanatomy*** doi:**10.1016/j.jchemneu.2016.01.** http://www.ncbi.nlm.nih.gov/pubmed/26836107 "Overall, the experimental findings demonstrated that cellular phone radiation may increase the oxidative damage and NOx level during epileptic activity in mouse brain." [Cell phone]	**Oxidative damage**
(51)	**Gustavino, B., Carboni, G., Petrillo, R., Paoluzzi, G., Santovetti, E., & Rizzoni, M. (2016). Exposure to 915 MHz radiation induces micronuclei in Vicia faba root tips. *Mutagenesis*, *31*(2), 187–192** http://www.ncbi.nlm.nih.gov/pubmed/26476436 "These findings are in agreement with the limited number of data on cytogenetic effects detected in other plant systems exposed to mobile phone RF-EMF frequencies and clearly show the capability of radiofrequency exposure to induce DNA damage in this eukaryotic cell system." [0.4-1.5W/Kg] [93.75 % of Safety Code 6]	**Plants - DNA damage**
(52)	**Hidisoglu, E., Kantar Gok, D., Er, H., Akpinar, D., Uysal, F., Akkoyunlu, G., … Yargicoglu, P. (2016). 2100-MHz electromagnetic fields have different effects on visual evoked potentials and oxidant/antioxidant status depending on exposure duration. *Brain Research*, *1635*, 1–11** http://www.ncbi.nlm.nih.gov/pubmed/26776477 "... different effects of EMFs on VEPs depend on exposure duration. In addition, our results indicated that short-term EMF could provide protective effects, while long-term EMF could have an adverse effect on VEPs and oxidant/antioxidant status."	**Visual evoked potentials**

(53)	**Jiang, D.-P., Li, J.-H., Zhang, J., Xu, S.-L., Kuang, F., Lang, H.-Y., … Guo, G.-Z. (2016). Long-term electromagnetic pulse exposure induces Abeta deposition and cognitive dysfunction through oxidative stress and overexpression of APP and BACE1. *Brain Research*** doi:**10.1016/j.brainres.2016.02.053** http://www.ncbi.nlm.nih.gov/pubmed/26972535 "... the present results suggest that long-term EMP exposure is harmful to cognitive ability in rats and could induce AD[Alzheimer's Disease]-like pathological manifestation."	**Cognitive ability, behaviour**
(54)	**Jun S. (2016). The reciprocal longitudinal relationships between mobile phone addiction and depressive symptoms among Korean adolescents. *Comput. Hum. Behav. Computers in Human Behavior*, *58*, 179–186**. http://www.sciencedirect.com/science/article/pii/S0747563215303320 "... We analyzed three-year longitudinal data from the Korean Children and Youth Panel Survey conducted by the National Youth Policy Institute in Korea. A total of 1877 valid responses from 2011 to 2013 were analyzed using autoregressive cross-lagged modeling. We found that each mobile phone addiction and depressive symptom in earlier years was associated with increasing severity in these conditions consistently over the three years..." [mobile phone]	**Adolescents - addiction to mobile phone, depression**
(55)	**Kalakoti, P., Murray, R. D., Pettersson-Segerlind, J., Smeds, H., & Nanda, A. (2016). Cochlear implants in the etiopathogenesis of glioblastoma-an interesting observation or independent finding? *Acta Neurochirurgica*** doi:**10.1007/s00701-016-2718-3** http://www.ncbi.nlm.nih.gov/pubmed/26858207 ABSTRACT: "We hypothesize that the low-frequency RF-EMF emanating from the transcutaneous link of the CI [cochlear implants] prosthesis over a long period has potentially triggered tumor development in these patients." [cochlear implants]	**Cancer**
(56)	**Kuybulu, A. E., Öktem, F., Çiriş, İ. M., Sutcu, R., Örmeci, A. R., Çömlekçi, S., & Uz, E. (2016). Effects of long-term pre- and post-natal exposure to 2.45 GHz wireless devices on developing male rat kidney. *Renal Failure*, *38*(4), 571–580** http://www.ncbi.nlm.nih.gov/pubmed/26905323 "... chronic pre- and post-natal period exposure to wireless internet frequency of EMF may cause chronic kidney damages; staying away from EMF source in especially pregnancy and early childhood period may reduce negative effects of exposure on kidney." [0.1 W/Kg] [6.25 % of Safety Code 6]	**Chronic kidney damage**

(57)	**Lippi, G., Danese, E., Brocco, G., Benati, M., Salvagno, G. L., Montagnana, M., & Franchini, M. (2016). Thirty-minutes' exposure to smartphone call triggers neutrophil activation in vitro.** ***Clinical Chemistry and Laboratory Medicine*** doi:**10.1515/cclm-2015-1242** http://www.ncbi.nlm.nih.gov/pubmed/26872316 "The results of this study show that exposure to smartphone RF waves triggers activation of neutrophils in vitro..." [smartphones]	**Blood cells**
(58)	**Mina, D., Sagonas, K., Fragopoulou, A. F., Pafilis, P., Skouroliakou, A., Margaritis, L. H., … Valakos, E. D. (2016). Immune responses of a wall lizard to whole-body exposure to radiofrequency electromagnetic radiation.** ***International Journal of Radiation Biology*****,** ***92*****(3), 162–168** http://www.ncbi.nlm.nih.gov/pubmed/26853383 "Digital Enhanced Communication Telephony (DECT) base... Our results revealed a noticeable suppression (approximately 45%) of inflammatory responses in EMR-exposed lizards compared to sham-exposed animals. T cell-mediated responses were marginally affected. Conclusion Daily radiofrequency EMR exposure seems to affect, at least partially, the immunocompetence of the Aegean wall lizard." [3.2 V/m = 3200 mV/m = Power density: approximately 50 mW/m^2]	**Reptile - suppression of inflammatory response**
(59)	**Odacı, E., Hancı, H., Yuluğ, E., Türedi, S., Aliyazıcıoğlu, Y., Kaya, H., & Çolakoğlu, S. (2016). Effects of prenatal exposure to a 900 MHz electromagnetic field on 60-day-old rat testis and epididymal sperm quality.** ***Biotechnic & Histochemistry: Official Publication of the Biological Stain Commission*****,** ***91*****(1), 9–19** "Nuclear changes that indicated apoptosis were identified ... and large numbers of apoptotic cells were observed in most of the seminiferous tubule epithelium ... rat testes ... exhibited altered sperm quality and biochemical characteristics." [Electric field: 1-10V/m - Power density: 0.265 W/m^2 Specific absorption rate: 0.01 W/Kg] [0.63 % of Safety Code 6]	**Nuclear changes in testes, altered sperm**

(60)	**Ostrom, Q. T., Gittleman, H., de Blank, P. M., Finlay, J. L., Gurney, J. G., McKean-Cowdin, R., … Barnholtz-Sloan, J. S. (2016). American Brain Tumor Association Adolescent and Young Adult Primary Brain and Central Nervous System Tumors Diagnosed in the United States in 2008-2012. *Neuro-Oncology*, *18*(suppl 1), i1–i50.** No abstract. http://www.ncbi.nlm.nih.gov/pubmed/26705298 Press Release, American Brain Tumor Association, Chicago, Ill., Feb. 24, 2016 - A new report published in the journal *Neuro-Oncology* and funded by the American Brain Tumor Association (ABTA) finds that malignant brain tumors are the most common cause of cancer-related deaths in adolescents and young adults aged 15-39 and the most common cancer occurring among 15-19 year olds. The 50-page report, which utilized data from the Central Brain Tumor Registry of the United States (CBTRUS) from 2008-2012, is the first in-depth statistical analysis of brain and central nervous system (CNS) tumors in adolescents and young adults (AYA).	**This report does not state there is a causal link with brain tumours and mobile phone radiation exposure, but some brain cancer specialists are becoming convinced there is a causal link.** Canadian (Dr. Dr. Jacob Easaw, from the Tom Baker Cancer Centre in Calgary*), Australian (Dr. Charlie Meo** and USA *** brain surgeons believe there is likely a causal link to mobile phone exposure and brain tumours. * Prevent Cancer Now: http://www.preventcancernow.ca/brain-tumours-now-leading-form-of-cancer-in-adolescents ** https://www.youtube.com/watch?v=mMKwtjO73Y8 *** Environmental Health Trust: http://ehtrust.org/
(61)	**Redmayne, M., Smith, C. L., Benke, G., Croft, R. J., Dalecki, A., Dimitriadis, C., … Abramson, M. J. (2016). Use of mobile and cordless phones and cognition in Australian primary school children: a prospective cohort study. *Environmental Health*, *15* (1):26** http://www.ncbi.nlm.nih.gov/pubmed/26892106 "... Results for CP [cordless phone] use were broadly consistent with our earlier study of older children."	**Children, behaviour**
(62)	**Stalin, P., Abraham, S. B., Kanimozhy, K., Prasad, R. V., Singh, Z., & Purty, A. J. (2016). Mobile Phone Usage and its Health Effects Among Adults in a Semi-Urban Area of Southern India. *Journal of Clinical and Diagnostic Research: JCDR*, *10*(1), LC14–16** http://www.ncbi.nlm.nih.gov/pubmed/26894095 "Health problems like headache, earache, tinnitus, painful fingers and restlessness etc., were found to be positively associated with mobile phone usage."	**Headache, earache, tinnitus, painful fingers and restlessness**

(63)	**Zhang, G., Yan, H., Chen, Q., Liu, K., Ling, X., Sun, L., … Cao, J. (2016). Effects of cell phone use on semen parameters: Results from the MARHCS cohort study in Chongqing, China. *Environment International*, *91*, 116–121** http://www.ncbi.nlm.nih.gov/pubmed/26949865 "Our results showed that certain aspects of cell phone use may negatively affect sperm quality in men by decreasing the semen volume, sperm concentration, or sperm count, thus impairing male fertility."	**Human male sperm quality negatively affected**

Table 2. References of the 63 studies listed in Table 1. Listed by year published and then by first author.

2015

(1) Abu Khadra, K. M., Khalil, A. M., Abu Samak, M., & Aljaberi, A. (2015). Evaluation of selected biochemical parameters in the saliva of young males using mobile phones. *Electromagnetic Biology and Medicine*, *34*(1), 72–76. doi:10.3109/15368378.2014.881370

(2) Aydoğan, F., Aydın, E., Koca, G., Özgür, E., Atilla, P., Tüzüner, A., … Samim, E. E. (2015). The effects of 2100-MHz radiofrequency radiation on nasal mucosa and mucociliary clearance in rats. *International Forum of Allergy & Rhinology*. doi:10.1002/alr.21509

(3) Aydogan, F., Unlu, I., Aydin, E., Yumusak, N., Devrim, E., Samim, E. E., … Seyhan, N. (2015). The effect of 2100 MHz radiofrequency radiation of a 3G mobile phone on the parotid gland of rats. *American Journal of Otolaryngology*, *36*(1), 39–46. doi:10.1016/j.amjoto.2014.10.001

(4) Belpomme, D., Campagnac, C., & Irigaray, P. (2015). Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder. *Reviews on Environmental Health*, *30*(4), 251–271. doi:10.1515/reveh-2015-0027

(5) Belyaev, I., Dean, A., Eger, H., Hubmann, G., Jandrisovits, R., Johansson, O., … Thill, R. (2015). EUROPAEM EMF Guideline 2015 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses. *Reviews on Environmental Health*, *30*(4), 337–371. doi:10.1515/reveh-2015-0033

(6) Cao, H., Qin, F., Liu, X., Wang, J., Cao, Y., Tong, J., & Zhao, H. (2015). Circadian Rhythmicity of Antioxidant Markers in Rats Exposed to 1.8 GHz Radiofrequency Fields. *International Journal of Environmental Research and Public Health*, *12*(2), 2071–2087. doi:10.3390/ijerph120202071

(7) Carpenter, D. O. (2015). The microwave syndrome or electro-hypersensitivity: historical background. *Reviews on Environmental Health*, *30*(4), 217–222. doi:10.1515/reveh-2015-0016

(8) Dasdag, S., Akdag, M. Z., Erdal, M. E., Erdal, N., Ay, O. I., Ay, M. E., … Yegin, K. (2015a). Effects of 2.4 GHz radiofrequency radiation emitted from Wi-Fi equipment on microRNA expression in brain tissue. *International Journal of Radiation Biology*, *91*(7), 555–561. doi:10.3109/09553002.2015.1028599

(9) Dasdag, S., Akdag, M. Z., Erdal, M. E., Erdal, N., Ay, O. I., Ay, M. E., … Yegin, K. (2015b). Long term and excessive use of 900 MHz radiofrequency radiation alter microRNA expression in brain. *International Journal of Radiation Biology*, 1–6. doi:10.3109/09553002.2015.997896

(10) Dasdag, S., Taş, M., Akdag, M. Z., & Yegin, K. (2015). Effect of long-term exposure of 2.4 GHz radiofrequency radiation emitted from Wi-Fi equipment on testes functions. *Electromagnetic Biology and Medicine*, *34*(1), 37–42. doi:10.3109/15368378.2013.869752

(11) Deshmukh, P. S., Nasare, N., Megha, K., Banerjee, B. D., Ahmed, R. S., Singh, D., … Mediratta, P. K. (2015). Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation. *International Journal of Toxicology*, *34*(3), 284–290. doi:10.1177/1091581815574348

(12) Eris, A. H., Kiziltan, H. S., Meral, I., Genc, H., Trabzon, M., Seyithanoglu, H., … Uysal, O. (2015). Effect of Short-term 900 MHz low level electromagnetic radiation exposure on blood serotonin and glutamate levels. *Bratislavské Lekárske Listy*, *116*(2), 101–103.

(13) Furtado-Filho, O. V., Borba, J. B., Maraschin, T., Souza, L. M., Henriques, J. A. P., Moreira, J. C. F., & Saffi, J. (2015). Effects of chronic exposure to 950 MHz ultra-high-frequency electromagnetic radiation on reactive oxygen species metabolism in the right and left cerebral cortex of young rats of different ages. *International Journal of Radiation Biology*, *91*(11), 891–897. doi:10.3109/09553002.2015.1083629

(14) Gandhi, O. P. (2015). Yes the Children Are More Exposed to Radiofrequency Energy From Mobile Telephones Than Adults. *IEEE Access*, *3*, 985–988. doi:10.1109/ACCESS.2015.2438782

(15) Ghosn, R., Yahia-Cherif, L., Hugueville, L., Ducorps, A., Lemarechal, J.-D., Thuroczy, G., … Selmaoui, B. (2015). Radiofrequency signal affects alpha band in resting electroencephalogram. *Journal of Neurophysiology*, jn.00765.2014. doi:10.1152/jn.00765.2014

(16) Gulati, S., Yadav, A., Kumar, N., Kanupriya, null, Aggarwal, N. K., Kumar, R., & Gupta, R. (2015). Effect of GSTM1 and GSTT1 Polymorphisms on Genetic Damage in Humans Populations Exposed to Radiation From Mobile Towers. *Archives of Environmental Contamination and Toxicology*. doi:10.1007/s00244-015-0195-y

(17) Güler, G., Ozgur, E., Keles, H., Tomruk, A., Vural, S. A., & Seyhan, N. (2015). Neurodegenerative changes and

apoptosis induced by intrauterine and extrauterine exposure of radiofrequency radiation. *Journal of Chemical Neuroanatomy*. doi:10.1016/j.jchemneu.2015.10.006

(18) Hancı, H., Türedi, S., Topal, Z., Mercantepe, T., Bozkurt, I., Kaya, H., … Odacı, E. (2015). Can prenatal exposure to a 900 MHz electromagnetic field affect the morphology of the spleen and thymus, and alter biomarkers of oxidative damage in 21-day-old male rats? *Biotechnic & Histochemistry: Official Publication of the Biological Stain Commission*, *90*(7), 535–543. doi:10.3109/10520295.2015.1042051

(19) İkinci, A., Mercantepe, T., Unal, D., Erol, H. S., Şahin, A., Aslan, A., … Odacı, E. (2015). Morphological and antioxidant impairments in the spinal cord of male offspring rats following exposure to a continuous 900MHz electromagnetic field during early and mid-adolescence. *Journal of Chemical Neuroanatomy*. doi:10.1016/j.jchemneu.2015.11.006

(20) Lee, D., Lee, J., & Lee, I. (2015). Cell phone-generated radio frequency electromagnetic field effects on the locomotor behaviors of the fishes Poecilia reticulata and Danio rerio. *International Journal of Radiation Biology*, 1–8. doi:10.3109/09553002.2015.1062575

(21) Lerchl, A., Klose, M., Grote, K., Wilhelm, A. F. X., Spathmann, O., Fiedler, T., … Clemens, M. (2015). Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. *Biochemical and Biophysical Research Communications*, *459*(4), 585–590. doi:10.1016/j.bbrc.2015.02.151

(22) Liu, Q., Si, T., Xu, X., Liang, F., Wang, L., & Pan, S. (2015). Electromagnetic radiation at 900 MHz induces sperm apoptosis through bcl-2, bax and caspase-3 signaling pathways in rats. *Reproductive Health*, *12*, 65. doi:10.1186/s12978-015-0062-3

(23) Mahmoudabadi, F. S., Ziaei, S., Firoozabadi, M., & Kazemnejad, A. (2015). Use of mobile phone during pregnancy and the risk of spontaneous abortion. *Journal of Environmental Health Science and Engineering*, *13*. doi:10.1186/s40201-015-0193-z

(24) Marjanovic, A. M., Pavicic, I., & Trosic, I. (2015). Cell oxidation-reduction imbalance after modulated radiofrequency radiation. *Electromagnetic Biology and Medicine*, *34*(4), 381–386. doi:10.3109/15368378.2014.948184

(25) Megha, K., Deshmukh, P. S., Banerjee, B. D., Tripathi, A. K., Ahmed, R., & Abegaonkar, M. P. (2015). Low intensity microwave radiation induced oxidative stress, inflammatory response and DNA damage in rat brain. *Neurotoxicology*, *51*, 158–165. doi:10.1016/j.neuro.2015.10.009

(26) Megha, K., Deshmukh, P. S., Ravi, A. K., Tripathi, A. K., Abegaonkar, M. P., & Banerjee, B. D. (2015). Effect of Low-Intensity Microwave Radiation on Monoamine Neurotransmitters and Their Key Regulating Enzymes in Rat Brain. *Cell Biochemistry and Biophysics*. doi:10.1007/s12013-015-0576-x

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Table 3. Studies (30) published in 2015 and up to April 2016 showing potential harm at below Safety Code 6 Specific Absorption Rate (SAR) level (1.6 W/Kg). Listed in ascending order, as a % of SAR. Details in Table 1.

Authors	Year	SAR in study (W/Kg)	*% SC6 SAR (% of 1.60)*
Megha	2015b	0.0005953	*0.04*
Megha	2015a	0.00066	*0.04*
Deshmukh	2015	0.0006672	*0.04*
Dasdag	2015c	0.00242	*0.15*
Dasdag	2015a	0.007127	*0.45*
Akdag	2016	0.007127	*0.45*
İkinci	2015	0.01	*0.63*
Odacı	2015a	0.01	*0.63*
Odacı	2016	0.01	*0.63*
Shahin	2015	0.0146	*0.91*
Güler	2015	0.018	*1.13*
Sırav	2015	0.02	*1.25*
Odacı	2015c	0.024	*1.50*
Şahin	2015	0.024	*1.50*
Hancı	2015	0.025	*1.56*
Odacı	2015b	0.025	*1.56*
Dasdag	2015b	0.0369	*2.31*
Lerchl	2015	0.04	*2.50*
Cao	2015	0.056	*3.50*
Kuybulu	2016	0.10	*6.25*
Ohtani	2015	0.20	*12.50*
Aydoğan	2015	0.40	*25.00*
Aydogan	2015	0.40	*25.00*
Liu	2015	0.66	*41.25*
Ghosn	2015	0.93	*58.13*
Wang	2015	1.00	*62.50*
Abu Khadra	2015	1.09	*68.13*
Narayanan	2015	1.15	*71.88*
Furtado-Filho	2015	1.32	*82.50*
Gustavino	2016	1.50	*93.75*

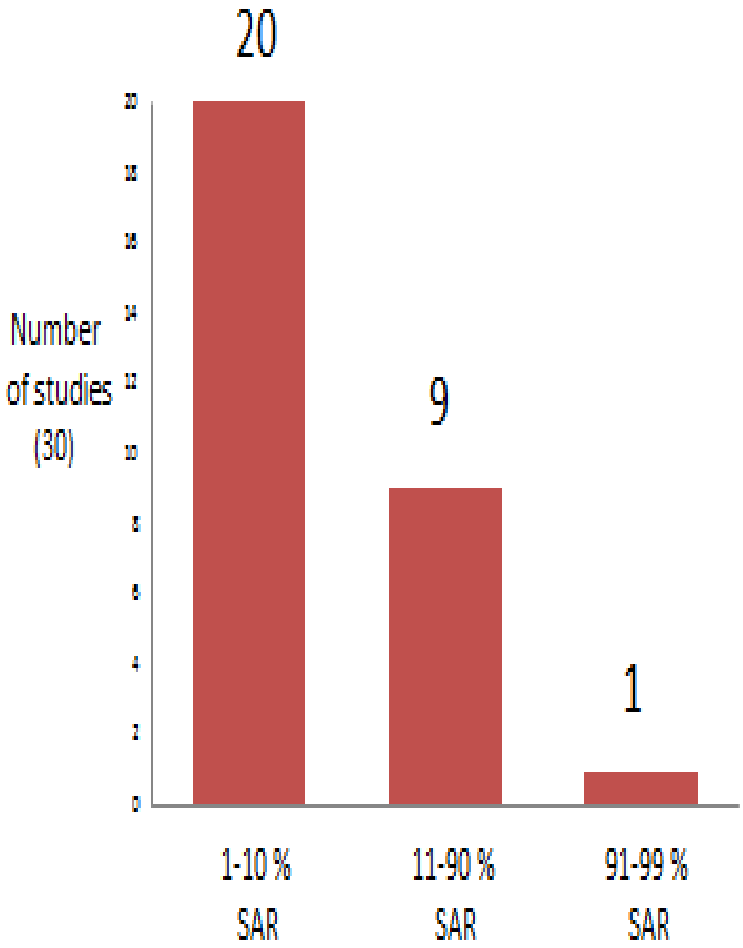

Figure 1. Studies listed in Table 3 graphed according to three categories: 0-10%, 11-90% and 91-99% of Health Canada's Safety Code 6 Specific Absorption Rate (SAR).

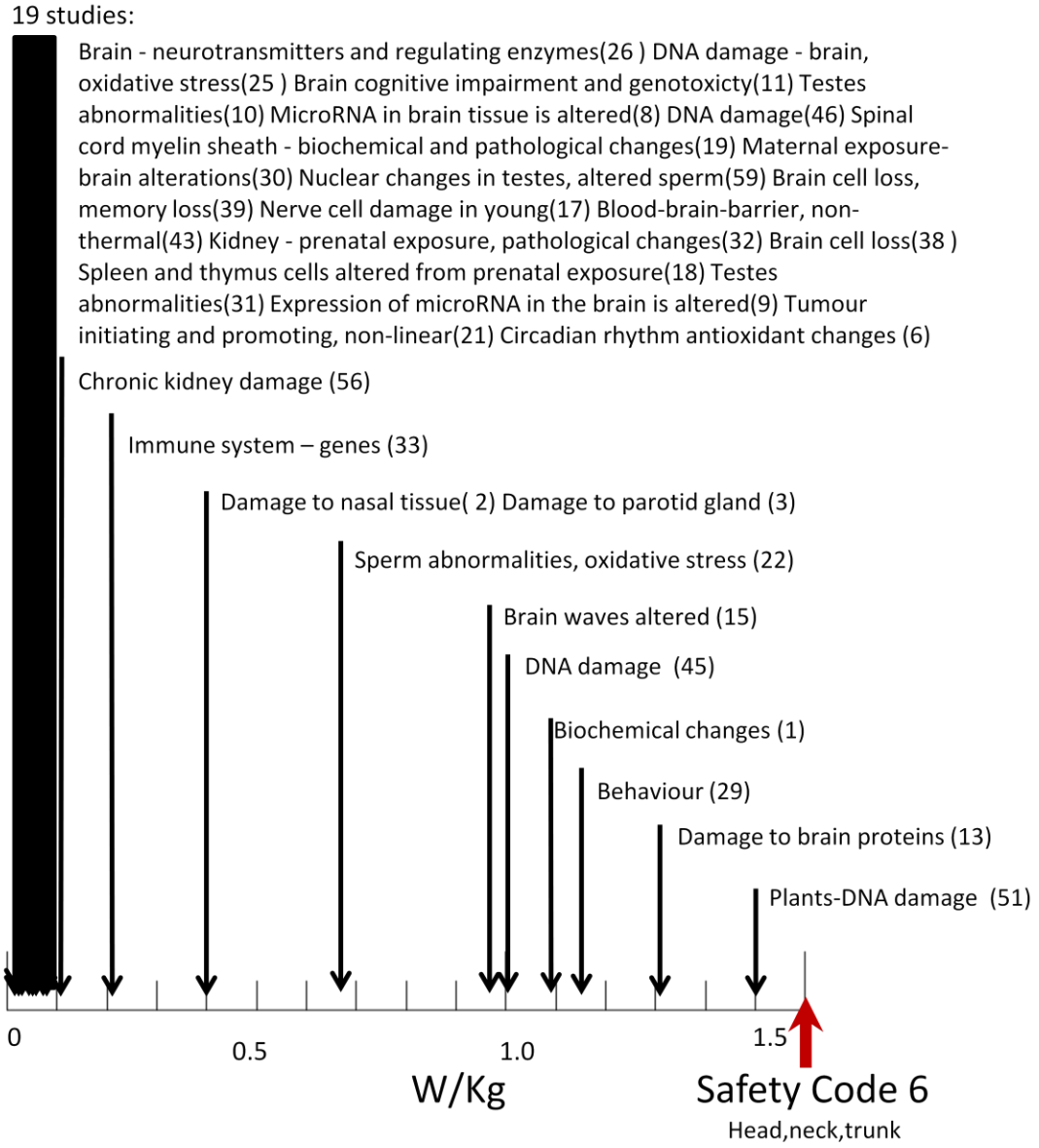

Figure 2. Thirty (30) relevant scientific studies published in 2015 and up to April 2016 reporting potential harm at or below Safety Code 6 (2015)*, Specific Absorption Rate (SAR). Health Canada's SAR for head, neck and trunk is 1.6 W/Kg. Graphed by level of SAR used in the study - human, animal and cell culture. Details on the studies, indicated by number in (round) brackets, are in Table 1.

* Health Canada's guidelines for safe human exposure to radiofrequency/microwave radiation.