Biological and Health Effects of the Exposures to Non Ionizing Electromagnetic Fields (EMF)

The MUOS Case

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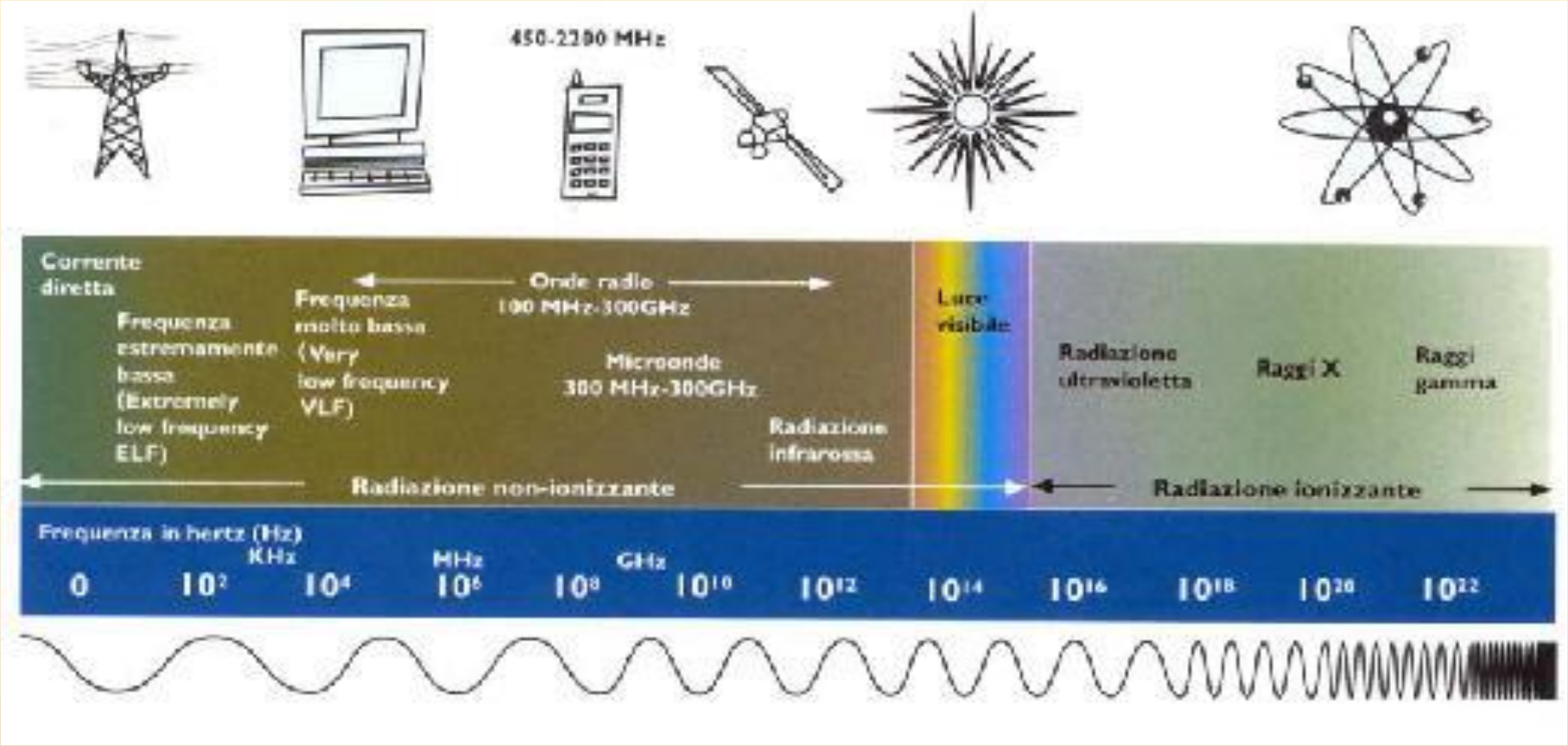
Introduction

- Recent and very recent scientific literature shows that both biological and sanitary effects of EMF radiations – from the extremely low frequency magnetic fields (ELF/EMF) to the high and very high radiofrequencies (RF/EMF) – are clearly established and occur even at very low exposure levels.

- Overall, there are now almost 4.000 experimental studies that report a variety of short and medium-term effects of EMF, which support the biological plausibility of the increased risks of their long-term genotoxic, carcinogenic and neurodegenerative consequences on exposed human populations.

Elecctromagnetic Waves



BASSE FREQUENZE

0 ——————————— 100 KHz

ELF

0 ———— 100 Hz

RF

——————————— 300 GHz

300 MHz ———— MO

Biological Effects

- EMF exposures of cultured mammaliant cells, of experimental animals and human subjects, may induce genetic and epigenetic effects, such as:

  – single and double strand DNA damages,
  – chromosomal aberrations,
  – sister-chromatid exchanges,
  – alteration or loss of the DNA damage repair processes
  – abnormal DNA transcription and protein functions, etc.;
  – stimulation of heat-shock protein synthesis;
  – inhibition of apoptosis (programmed cell death);

Biological Effects

(continued):

- damages to cellular macromolecules due to the impairment of the inactivation of free radicals and the consequent oxidative stress on account of the inhibition of melatonin syntesis and the stimulation of the Fenton's reaction;
- modification of the cell membrane permeability and the consequent alteration of the flow of biologically important ions such as Calcium;
- alteration of the function of the immune system;
- serious impacts on sperm morphology and functional with consequent effects on the offspring;
- alterations of the brain functions as a consequence of the interference of a EMF on cerebral frequencies, etc.

Health effects

- Many of these bioeffects can reasonably be presumed to result in adverse health effects if the exposures are prolonged or chronic.

- This is because they:
  - interfere with normal body processes (disrupt homeostasis)
  - prevent the body from healing damaged DNA
  - produce immune system imbalances, metabolic disruption and lower resilience to disease across multiple pathways.

Health effects and young ones

- Essential body processes can eventually be disabled by external stresses (from system-wide electrophysiological interference) and lead to pervasive impairment of behavioral metabolic and reproductive functions.

- There is good evidence that many toxic exposures to the fetus and very young child have enhanced detrimental consequences, depending on when they occur during critical phases of growth and development, or where such exposures may lay the seeds of health harm that develops even decades later.

Public Safety Limits

- Existing ICNIRP public safety limits are not sufficiently protective of public health, in particular:
  - for the young subjects - embryos, fetuses, neonates, very young children
  - for those which are exposed to extremely high ELF and RF/EMF levels.
- This is because European Union Directives and EU national legislations have – a should keep going even more to – more conservative limits

Public Safety Limits

- Sufficient evidence comes from epidemiological studies of an increased risk from exposure to EMF of adverse acute effects and even long-term carcinogenic effects that cannot be attributed to chance, bias or confounding.

- Therefore, according to the rules of IARC, such exposures can be classified at least as Group 2 “probable carcinogenic agents for humans”.

A resolution of the European Parliament was approved by a large majority in The Committee of Employment and Social Affairs, 06.12.2012, on "best protections for workers in the Eurozone exposed to electromagnetic fields", it was addressed to those workers exposed to high risk, p . eg . workers in heavy industry (metallurgy) and those workers who work for long periods in the radio and television stations, radar installations near or repeaters for mobile telephone network.

An update to the BioInitiative Report (BioInitiative 2012) was written by 29 scientists from 10 different countries , and it states that 1,800 new studies on the effects of EMFs report harmful to human health, in addition to the more than 2,000 studies until 2007.
According to the authors the epidemiological evidence indicates that the RF should be classified as probable carcinogenic to humans. Therefore the safety limits of exposure to RF established more than 20 years ago by ICNIRP, and endorsed by the EC, WHO, and other international agencies and adopted by the governments of many countries are inadequate to protect human health.

There are now much stronger evidence than 10 years ago that the risks from exposure to EMFs affect millions of people. Therefore, the status quo is no longer acceptable.

Reported Biological Effects from Radiofrequency Radiation at Low-Intensity Exposure
(Cell Tower, Wi-Fi, Wireless Laptop and 'Smart' Meter RF Intensities)

Power Density (Microwatts/centimeter2 - uW/cm2)		Reference
As low as (10^{-13}) or 100 femtowatts/cm2	Super-low intensity RFR effects at MW reasonant frequencies resulted in changes in genes; problems with chromatin conformation (DNA)	Belyaev, 1997
5 picowatts/cm2 (10^{-12})	Changed growth rates in yeast cells	Grundler, 1992
0.1 nanowatt/cm2 (10^{-10}) or 100 picowatts/cm2	Super-low intensity RFR effects at MW reasonant frequencies resulted in changes in genes; problems with chromatin condensation (DNA) intensities comparable to base stations	Belyaev, 1997
0.00034 uW/cm2	Chronic exposure to mobile phone pulsed RF significantly reduced sperm count,	Behari, 2006
0.0005 uW/cm2	RFR decreased cell proliferation at 960 MHz GSM 217 Hz for 30-min exposure	Velizarov, 1999
0.0006 - 0.0128 uW/cm2	Fatigue, depressive tendency, sleeping disorders, concentration difficulties, cardio- vascular problems reported with exposure to GSM 900/1800 MHz cell phone signal at base station level exposures.	Oberfeld, 2004
0.0009 uW/cm2	RFR induced 10%-40% increase in DNA synthesis in glioma cells (brain)	Stagg, 1997
0.003 - 0.02 uW/cm2	In children and adolescents (8-17 yrs) short-term exposure caused headache, irritation, concentration difficulties in school.	Heinrich, 2010
0.003 to 0.05 uW/cm2	In children and adolescents (8-17 yrs) short-term exposure caused conduct problems in school (behavioral problems)	Thomas, 2010
0.005 uW/cm2	In adults (30-60 yrs) chronic exposure caused sleep disturbances, (but not significantly increased across the entire population)	Mohler, 2010
0.005 - 0.04 uW/cm2	Adults exposed to short-term cell phone radiation reported headaches, concentration difficulties (differences not significant, but elevated)	Thomas, 2008
0.006 - 0.01 uW/cm2	Chronic exposure to base station RF (whole-body) in humans showed increased stress hormones; dopamine levels substantially decreased; higher levels of adrenaline and nor-adrenaline; dose-response seen; produced chronic physiological stress in cells even after 1.5 years.	Buchner, 2012
0.01 - 0.11 uW/cm2	RFR from cell towers caused fatigue, headaches, sleeping problems	Navarro, 2003

Stress proteins, HSP, disrupted immune function	Brain tumors and blood-brain barrier
Reproduction/fertility effeccts	Sleep, neuron firing rate, EEG, memory, learning, behavior
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0.01 - 0.05 uW/cm2	Adults (18-91 yrs) with short-term exposure to GSM cell phone radiation reported headache, neurological problems, sleep and concentration problems.	Hutter, 2006
0.005 - 0.04 uW/cm2	Adults exposed to short-term cell phone radiation reported headaches, concentration difficulties (differences not significant, but elevated)	Thomas, 2008
0.015 - 0.21 uW/cm2	Adults exposed to short-term GSM 900 radiation reported changes in mental state (e.g., calmness) but limitations of study on language descriptors prevented refined word choices (stupified, zoned-out)	Augner, 2009
0.05 - 0.1 uW/cm2	RFR linked to adverse neurological, cardio symptoms and cancer risk	Khurana, 2010
0.05 - 0.1 uW/cm2	RFR related to headache, concentration and sleeping problems, fatigue	Kundi, 2009
0.07 - 0.1 uW/cm2	Sperm head abnormalities in mice exposed for 6-months to base station level RF/MW. Sperm head abnormalities occurred in 39% to 46% exposed mice (only 2% in controls) abnormalities was also found to be dose dependent. The implications of the pin-head and banana-shaped sperm head. The occurrence of sperm head observed increase occurrence of sperm head abnormalities on the reproductive health of humans living in close proximity to GSM base stations were discussed."	Otitoloju, 2010
0.38 uW/cm2	RFR affected calcium metabolism in heart cells	Schwartz, 1990
0.8 - 10 uW/cm2	RFR caused emotional behavior changes, free-radical damage by super-weak MWs	Akoev, 2002
0.13 uW/cm2	RFR from 3G cell towers decreased cognition, well-being	Zwamborn, 2003
0.16 uW/cm2	Motor function, memory and attention of school children affected (Latvia)	Kolodynski, 1996
0.168 - 1.053 uW/cm2	Irreversible infertility in mice after 5 generations of exposure to RFR from an 'antenna park'	Magras & Zenos, 1997
0.2 - 8 uW/cm2	RFR caused a two-fold increase in leukemia in children	Hocking, 1996
0.2 - 8 uW/cm2	RFR decreased survival in children with leukemia	Hocking, 2000
0.21 - 1.28 uW/cm2	Adolescents and adults exposed only 45 min to UMTS cell phone radiation reported increases In headaches.	Riddervold, 2008

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0.5 uW/cm2	Significant degeneration of seminiferous epithelium in mice at 2.45 GHz, 30-40 min.	Saunders, 1981
0.5 - 1.0 uW/cm2	Wi-FI level laptop exposure for 4-hr resulted in decrease in sperm viability, DNA fragmentation with sperm samples placed in petri dishes under a laptop connected via WI-FI to the internet.	Avendano, 2012
1.0 uW/cm2	RFR induced pathological leakage of the blood-brain barrier	Persson, 1997
1.0 uW/cm2	RFR caused significant effect on immune function in mice	Fesenko, 1999
1.0 uW/cm2	RFR affected function of the immune system	Novoselova, 1999
1.0 uW/cm2	Short-term (50 min) exposure in electrosensitive patients, caused loss of well-being after GSM and especially UMTS cell phone radiation exposure	Eltiti, 2007
1.3 - 5.7 uW/cm2	RFR associated with a doubling of leukemia in adults	Dolk, 1997
1.25 uW/cm2	RFR exposure affected kidney development in rats (in-utero exposure)	Pyrpasopoulou, 2004
1.5 uW/cm2	RFR reduced memory function in rats	Nittby, 2007
2 uW/cm2	RFR induced double-strand DNA damage in rat brain cells	Kesari, 2008
2.5 uW/cm2	RFR affected calcium concentrations in heart muscle cells	Wolke, 1996
2 - 4 uW/cm2	Altered cell membranes; acetycholine-induced ion channel disruption	D'Inzeo, 1988
4 uW/cm2	RFR caused changes in hippocampus (brain memory and learning)	Tattersall, 2001
4 - 15 uW/cm2	Memory impairment, slowed motor skills and retarded learning in children	Chiang, 1989
5 uW/cm2	RFR caused drop in NK lymphocytes (immune function decreased)	Boscolo, 2001
5.25 uW/cm2	20 minutes of RFR at cell tower frequencies induced cell stress response	Kwee, 2001
5 - 10 uW/cm2	RFR caused impaired nervous system activity	Dumansky, 1974
6 uW/cm2	RFR induced DNA damage in cells	Phillips, 1998

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8.75 uW/cm2	RFR at 900 MHz for 2-12 hours caused DNA breaks in leukemia cells	Marinelli, 2004
10 uW/cm2	Changes in behavior (avoidance) after 0.5 hour exposure to pulsed RFR	Navakatikian, 1994
10 - 100 uW/cm2	Increased risk in radar operators of cancer; very short latency period; dose response to exposure level of RFR reported.	Richter, 2000
12.5 uW/cm2	RFR caused calcium efflux in cells - can affect many critical cell functions	Dutta, 1989
13.5 uW/cm2	RFR affected human lymphocytes - induced stress response in cells	Sarimov, 2004
14.75 uW/cm2	RFR increased biomarker for cell division in glioma brain tumor cells	Stagg, 1997
20 uW/cm2	Increase in serum cortisol (a stress hormone)	Mann, 1998
28.2 uW/cm2	RFR increased free radical production in rat cells	Yurekli, 2006
37.5 uW/cm2	Immune system effects - elevation of PFC count (antibody producing cells	Veyret, 1991
45 uW/cm2	Pulsed RFR affected serum testosterone levels in mice	Forgacs, 2006
50 uW/cm2	Cell phone RFR caused a pathological leakage of the blood-brain barrier in 1 hour	Salford, 2003
50 uW/cm2	An 18% reduction in REM sleep (important to memory and learning functions)	Mann, 1996
60 uW/cm2	RFR caused structural changes in cells of mouse embryos	Somozy, 1991
60 uW/cm2	Pulsed RFR affected immune function in white blood cells	Stankiewicz, 2006
60 uW/cm2	Cortex of the brain was activated by 15 minutes of 902 MHz cell phone	Lebedeva, 2000
65 uW/cm2	RFR affected genes related to cancer	Ivaschuk, 1999
92.5 uW/cm2	RFR caused genetic changes in human white blood cells	Belyaev, 2005
100 uW/cm2	Changes in immune function	Elekes, 1996
100 uW/cm2	A 24.3% drop in testosterone after 6 hours of CW RFR exposure	Navakatikian, 1994

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120 uW/cm2	A pathological leakage in the blood-brain barrier with 915 MHz cell RF	Salford, 1994
500 uW/cm2	Intestinal epithelial cells exposed to 2.45 GHz pulsed at 16 Hz showed changes in intercellular calcium.	Somozy, 1993
500 uW/cm2	A 24.6% drop in testosterone and 23.2% drop in insulin after 12 hrs of pulsed RFR exposure.	Navakatikian, 1994
STANDARDS		
530 - 600 uW/cm2	Limit for uncontrolled public exposure to 800-900 MHz	ANSI/IEEE and FCC
1000 uW/cm2	PCS STANDARD for public exposure (as of September 1,1997)	FCC, 1996
5000 uW/cm2	PCS STANDARD for occupational exposure (as of September 1, 1997)	FCC, 1996
BACKGROUND LEVELS		
0.003 uW/cm2	Background RF levels in US cities and suburbs in the 1990s	Mantiply, 1997
0.05 uW/cm2	Median ambient power density in cities in Sweden (30-2000 MHz)	Hamnierius, 2000
0.1 - 10 uW/cm2	Ambient power density within 100-200' of cell site in US (data from 2000)	Sage, 2000

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0.000064 - 0.000078 W/Kg	Well-being and cognitive function affected in humans exposed to GSM-UMTS cell phone frequencies; RF levels similar near cell sites	TNO Physics and
0.00015 - 0.003 W/Kg	Calcium ion movement in isolated frog heart tissue is increased 18% (P<.01) and by 21% (P<.05) by weak RF field modulated at 16 Hz	Schwartz, 1990
0.000021 - 0.0021 W/Kg	Changes in cell cycle; cell proliferation (960 MHz GSM mobile phone)	Kwee, 1997
0.0003 - 0.06 W/Kg	Neurobehavioral disorders in offspring of pregnant mice exposed in utero to cell phones - dose-response impaired glutamatergic synaptic transmission onto layer V pyramidal neurons of the prefrontal cortex. Hyperactivity and impaired memory function in offspring. Altered brain development.	Aldad, 2012
0.0009 W/Kg	Changes in brain glial cells with TDMA 836.55 MHz frequency	Stagg, 1997
0.0016 - 0.0044 W/Kg	Very low power 700 MHz CW affects excitability of hippocampus tissue, consistent with reported behavioral changes.	Tattersall, 2001
0.0021 W/Kg	Heat shock protein HSP 70 is activated by very low intensity microwave exposure in human epithelial amnion cells	Kwee, 2001
0.0024 - 0.024 W/Kg	Digital cell phone RFR at very low intensities causes DNA damage in human cells; both DNA damage and impairment of DNA is reported	Phillips, 1998
0.0027 W/Kg	Changes in active avoidance conditioned behavioral effect is seen after one-half hour of pulsed radiofrequency radiation	Navakatikian, 1994
0.0035 W/Kg	900 MHz cell phone signal induces DNA breaks and early activation of p53 gene; short exposure of 2-12 hours leads cells to acquire greater survival chance - linked to tumor agressiveness.	Marinelli, 2004
0.0095 W/Kg	MW modulated at 7 Hz produces more errors in short-term memory functioin on complex tasks (can affect cognitive processes such as attention and memory)	Lass, 2002
0.001 W/Kg	750 MHz continuous wave (CW) RFR exposure caused increase in heat shock protein (stress proteins). Equivalent to what would be induced by 3 degree C. heating of tissue (but no heating occurred)	De Pomerai, 2000

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0.001 W/Kg	Statistically significant change in intracellular calcium concentration in heart muscle cells exposed to RFR (900 MHz/50 Hz modulation)	Wolke, 1996
0.0021 W/Kg	A significant change in cell proliferation not attributable to thermal heating. RFR induces non-thermal stress proteins (960 MHz GSM)	Velizarov, 1999
0.004 - 0.008 W/Kg	915 MHz cell phone RFR caused pathological leakage of blood-brain barrier. Worst at lower SAR levels and worse with CW compared to Frequency of pathological changes was 35% in rats exposed to pulsed radiation at 50% to continuous wave RFR. Effects observed at a specific absorption (SA) of > 1.5 joules/Kg in human tissues	Persson, 1997
0.0059 W/Kg	Cell phone RFR induces glioma (brain cancer) cells to significantly increase thymidine uptake, which may be indication of more cell division	Stagg, 1997
0.014 W/Kg	Sperm damage from oxidative stress and lowered melatonin levels resulted from 2-hr per day/45 days exposure to 10 GHz.	Kumar, 2012
0.015 W/Kg	Immune system effects - elevation of PFC count (antibody-producing cells)	Veyret, 1991
0.02 W/Kg	A single, 2-hr exposure to GSM cell phone radiation results in serious neuron damage (brain cell damage) and death in cortex, hippocampus, and basal ganglia of brain- even 50+ days later blood-brain barrier is still leaking albumin (P<.002) following only one cell phone exposure	Salford, 2003
0.026 W/Kg	Activity of c-jun (oncogene or cancer gene) was altered in cells after 20 minutes exposure to cell phone digital TDMA signal	Ivaschuk, 1997
0.0317 W/Kg	Decrease in eating and drinking behavior	Ray, 1990
0.037 W/Kg	Hyperactivity caused by nitric oxide synthase inhibitor is countered by exposure to ultra-wide band pulses (600/sec) for 30 min	Seaman, 1999
0.037 - 0.040 W/Kg	A 1-hr cell phone exposure causes chromatin condensation; impaired DNA repair mechanisms; last 3 days (longer than stress response) the effect reaches saturation in only one hour of exposure; electro- sensitive (ES) people have different response in formation of DNA repair foci, compared to healthy individuals; effects depend on carrier frequency (915 MHz = 0.037 W/Kg but 1947 MHz = 0.040 W/Kg)	Belyaev, 2008

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0.05 W/Kg	Significant increase in firing rate of neurons (350%) with pulsed 900 MHz cell phone radiation exposure (but not with CW) in avian brain cells	Beason, 2002
0.09 W/Kg	900 MHz study of mice for 7 days, 12-hr per day (whole-body) resulted in significant effect on mitochondria and genome stability	Aitken, 2005
0.091 W/Kg	Wireless internet 2400 MHz, 24-hrs per day/20 weeks increased DNA damage and reduced DNA repair; levels below 802.11 g Authors say "findings raise questions about safety of radiofrequency exposure from Wi-Fi internet access devices for growing organisms of reproductive age, with a potential effect on fertility and integrity of germ cells" (male germ cells are the reproductive cells=sperm)	Atasoy, 2012
0.11 W/Kg	Increased cell death (apoptosis) and DNA fragmentation at 2.45 GHz for 35 days exposure (chronic exposure study)	Kesari, 2010
0.121 W/Kg	Cardiovascular system shows significant decrease in arterial blood pressure (hypotension) after exposure to ultra-wide band pulses	Lu, 1999
0.13 - 1.4 W/Kg	Lymphoma cancer rate doubled with two 1/2-hr exposures per day of cell phone radiation for 18 months (pulsed 900 MHz cell signal)	Repacholi, 1997
0.14 W/Kg	Elevation of immune response to RFR exposure	Elekes, 1996
0.141 W/Kg	Structural changes in testes - smaller diameter of seminiferous	Dasdag, 1999
0.15 - 0.4 W/Kg	Statistically significant increase in malignant tumors in rats chronically exposed to RFR	Chou, 1992
0.26 W/Kg	Harmful effects to the eye/certain drugs sensitize the eye to RFR	Kues, 1992
0.28 - 1.33 W/Kg	Significant increase in reported headaches with increasing use of hand-held cell phone use (maximum tested was 60 min per day)	Chia, 2000
0.3 - 0.44 W/Kg	Cell phone use results in changes in cognitive thinking/mental tasks related to memory retrieval	Krause, 2000
0.3 - 0.44 W/Kg	Attention function of brain and brain responses are speeded up	Preece, 1999
0.3 - 0.46 W/Kg	Cell phone RFR doubles pathological leakage of blood-brain barrier permeability at two days (P=.002) and triples permeability at four days (P=.001) at 1800 MHz GSM cell phone radiation	Schirmacher, 2000

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SAR (Watts/Kilogram)		Reference
0.43 W/Kg	Significant decrease in sperm mobility; drop in sperm concentration; and decrease in seminiferous tubules at 800 MHz, 8-hr/day, 12 weeks, with mobile phone radiation level on STANDBY ONLY (in rabbits)	Salama, 2008
0.5 W/Kg	900 MHz pulsed RF affects firing rate of neurons (Lymnea stagnalis) but continuous wave had no effect	Bolshakov, 1992
0.58 - 0.75 W/Kg	Decrease in brain tumors after chronic exposure to RFR at 836 MHz	Adey, 1999
0.6 - 0.9 W/Kg	Mouse embryos develop fragile cranial bones from in utero 900 MHz The authors say "(O)ur results clearly show that even modest exposure (e.g., 6 min daily for 21 days" is sufficient to interfere with the normal mouse developmental process"	Fragopoulou, 2009
0.6 and 1.2 W/Kg	Increase in DNA single and double-strand DNA breaks in rat brain cells with exposure to 2450 MHz RFR	Lai & Singh, 1996
0.795 W/Kg	GSM 900 MHz, 217 Hz significantly decreases ovarian development and size of ovaries, due to DNA damage and premature cell death of nurse cells and follicles in ovaries (that nourish egg cells)	Panagopoulous, 2012
0.87 W/Kg	Altered human mental performance after exposure to GSM cell phone radiation (900 MHz TDMA digital cell phone signal)	Hamblin, 2004
0.87 W/Kg	Change in human brainwaves; decrease in EEG potential and statistically significant change in alpha (8-13 Hz) and beta (13-22 Hz) brainwave activity in humans at 900 MHz; exposures 6/min per day for 21 days (chronic exposure)	D'Costa, 2003
0.9 W/Kg	Decreased sperm count and more sperm cell death (apoptosis) after 35 days exposure, 2-hr per day	Kesari, 2012
< 1.0 W/Kg	Rats exposed to mobile phone radiation on STANDBY ONLY for 11-hr 45-min plus 15-min TRANSMIT mode; 2 times per day for 21 days showed decreased number of ovarian follicles in pups born to these pregnant rats. The authors conclude "the decreased number of follicles in pups exposed to mobile phone microwaves suggest that intrauterine exposure has toxic effects on ovaries."	Gul, 2009
0.4 - 1.0 W/Kg	One 6-hr exposure to 1800 MHz cell phone radiation in human sperm cells caused a significant dose response and reduced sperm motility and viability; reactive oxygen species levels were significantly increased after exposure to 1.0 W/Kg; study confirms detrimental effects of RF/MW to human sperm. The authors conclude "(T)hese findings have clear implicatiions for the safety of extensive mobile phone use by males of reproductive age, potentially affecting both their fertility and the health and wellbeing of their offspring."	De Iuliis, 2009

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1.0 W/Kg	Human semen degraded by exposure to cell phone frequency RF increased free-radical damage.	De Iuliis, 2009
1.0 W/Kg	Motility, sperm count, sperm morphology, and viability reduced in active cell phone users (human males) in dose-dependent manner.	Agarwal, 2008
1.0 W/Kg	GSM cell phone use modulates brain wave oscillations and sleep EEG	Huber, 2002
1.0 W/Kg	Cell phone RFR during waking hours affects brain wave activity. (EEG patterns) during subsequent sleep	Achermann, 2000
1.0 W/Kg	Cell phone use causes nitric oxide (NO) nasal vasodilation (swelling inside nasal passage) on side of head phone use	Paredi, 2001
1.0 W/Kg	Four-fold increase in eye cancer (uveal melanoma) in cell phone users	Stang, 2001
1.0 W/Kg	Increase in headache, fatigue and heating behind ear in cell phone users	Sandstrom, 2001
1.0 W/Kg	Significant increase in concentration difficulties using 1800 MHz cell phone compared to 900 MHz cell phone	Santini, 2001
1.0 W/Kg	Sleep patterns and brain wave activity are changed with 900 MHz cell phone radiation exposure during sleep	Borbely, 1999
1.4 W/Kg	GSM cell phone exposure induced heat shock protein HSP 70 by 360% (stress response) and phosphorylation of ELK-1 by 390%	Weisbrot, 2003
1.46 W/Kg	850 MHz cell phone radiation decreases sperm motility, viability is significantly decreased; increased oxidative damage (free-radicals) significantly decreased; increased oxidative damage (free-radicals)	Agarwal, 2009
1.48 W/Kg	A significant decrease in protein kinase C activity at 112 MHz with 2-hr per day for 35 days; hippocampus is site, consistent with reports that RFR negatively affects learning and memory functions	Paulraj, 2004
1.0 - 2.0 W/Kg	Significant elevation in micronuclei in peripheral blood cells at 2450 MHz (8 treatments of 2-hr each)	Trosic, 2002
1.5 W/Kg	GSM cell phone exposure affected gene expression levels in tumor suppressor p53-deficient embryonic stem cells; and significantly increased HSP 70 heat shock protein production	Czyz, 2004

Stress proteins, HSP, disrupted immune function	Brain tumors and blood-brain barrier
Reproduction/fertility effeccts	Sleep, neuron firing rate, EEG, memory, learning, behavior
Oxidative damage/ROS/DNA damage/DNA repair failure	Cancer (other than brain), cell proliferation
Disrupted calcium metabolism	Cardiac, heart muscle, blood-pressure, vascular effects

Reported Biological Effects from Radiofrequency Radiation at Low-Intensity Exposure
(Cell Tower, Wi-Fi, Wireless Laptop and 'Smart' Meter RF Intensities)

SAR (Watts/Kilogram)		Reference
1.8 W/Kg	Whole-body exposure to RF cell phone radiation of 900-1800 MHz 1 cm from head of rats caused high incidence of sperm cell death; deformation of sperm cells; prominent clumping together of sperm cells into "grass bundle shapes" that are unable to separate/swim. Sperm cells unable to swim and fertilize in normal manner.	Yan, 2007
2.0 W/Kg	GSM cell phone exposure of 1-hr activated heat shock protein HSP 27 (stress response) and P38 MAPK (mutagen-activated protein kinase) that authors say facilitates brain cancer and increased blood-brain barrier permeability, allowing toxins to cross BBB into brain	Leszczynski, 2002
2 W/Kg	900 MHz cell phone exposure caused brain cell oxidative damage by increasing levels of NO, MDA, XO and ADA in brain cells; caused statistically significant increase in 'dark neurons' or damaged brain cells in cortex, hippocampus and basal ganglia with a 1-hr exposure for 7 consecutive days	Ilhan, 2004
2.6 W/Kg	900 MHz cell phone exposure for 1-hr significantly altered protein expression levels in 38 proteins following irradiation; activates P38 MAP kinase stress signalling pathway and leads to changes in cell sie and shape (shrinking and rounding up) and to activation of HSP 27, a stress protein (heat shock protein)	Leszczynski, 2004
2.0 - 3.0 W/Kg	RFR accelerated development of both skin and breast tumors	Szmigielski, 1982
2 W/Kg	Pulse-modulated RFR and MF affect brain physiology (sleep study)	Schmidt, 2012

STANDARDS		
0.08 W/Kg	IEEE Standard uncontrolled public environment (whole body)	IEEE
0.4 W/Kg	IEEE Standard controlled occupational environment (whole body)	IEEE
1.6 W/Kg	FCC (IEEE) SAR limit for 1 gram of tissue in a partial body exposure	FCC, 1996
2 W/Kg	ICNIRP SAR limit for 10 grams of tissue	ICNIRP, 1996

Stress proteins, HSP, disrupted immune function	Brain tumors and blood-brain barrier
Reproduction/fertility effeccts	Sleep, neuron firing rate, EEG, memory, learning, behavior
Oxidative damage/ROS/DNA damage/DNA repair failure	Cancer (other than brain), cell proliferation
Disrupted calcium metabolism	Cardiac, heart muscle, blood-pressure, vascular effects

The MUOS Case

- The MUOS (Mobile User Objective System) is a military radio-transmission system that is proposed for installation close to the small town of Niscemi (Sicily, Italy).

- Our study presents the results of electromagnetic radiation models in that area and documents the scientific reasons why the MUOS system should not be installed in Niscemi for safety reasons.

The MUOS Case

- The MUOS (Mobile User Objective System) station in Niscemi (Sicily, Italy) is part of a worldwide network of telecommunications of the U.S. Army

- The network consists of three other similar stations (two in the U.S. and one in Australia) and a fleet of satellites.

- The MUOS in Niscemi should become the most important telecommunications hub of the U.S. military forces in Europe, Africa and the Middle East. It could be located however elsewhere in those continents.

The MUOS Case

- Initially, its implementation was planned within the perimeter of the military airport of Sigonella;
- However, the project was eventually moved to the military telecommunications facility NRTF of the U.S. Navy (Naval Radio Transmitter Facility) in Niscemi.
- A study of 2006 , in fact, commissioned by the U.S. Army, showed that the strong electromagnetic emissions implied interference risks and accidents for military flights.

- Recent studies show that the same problems would occur for civilian flights, since 4 airports are located within 70 km from the MUOS site in Sicily. A large portion of that Region should become a no-fly zone.


Fiber-optic cable
Northwest
Virginia
Niscemi
Sicily
Wahiawa
Hawaii
Fiber-optic cable
Geraldton
Australia

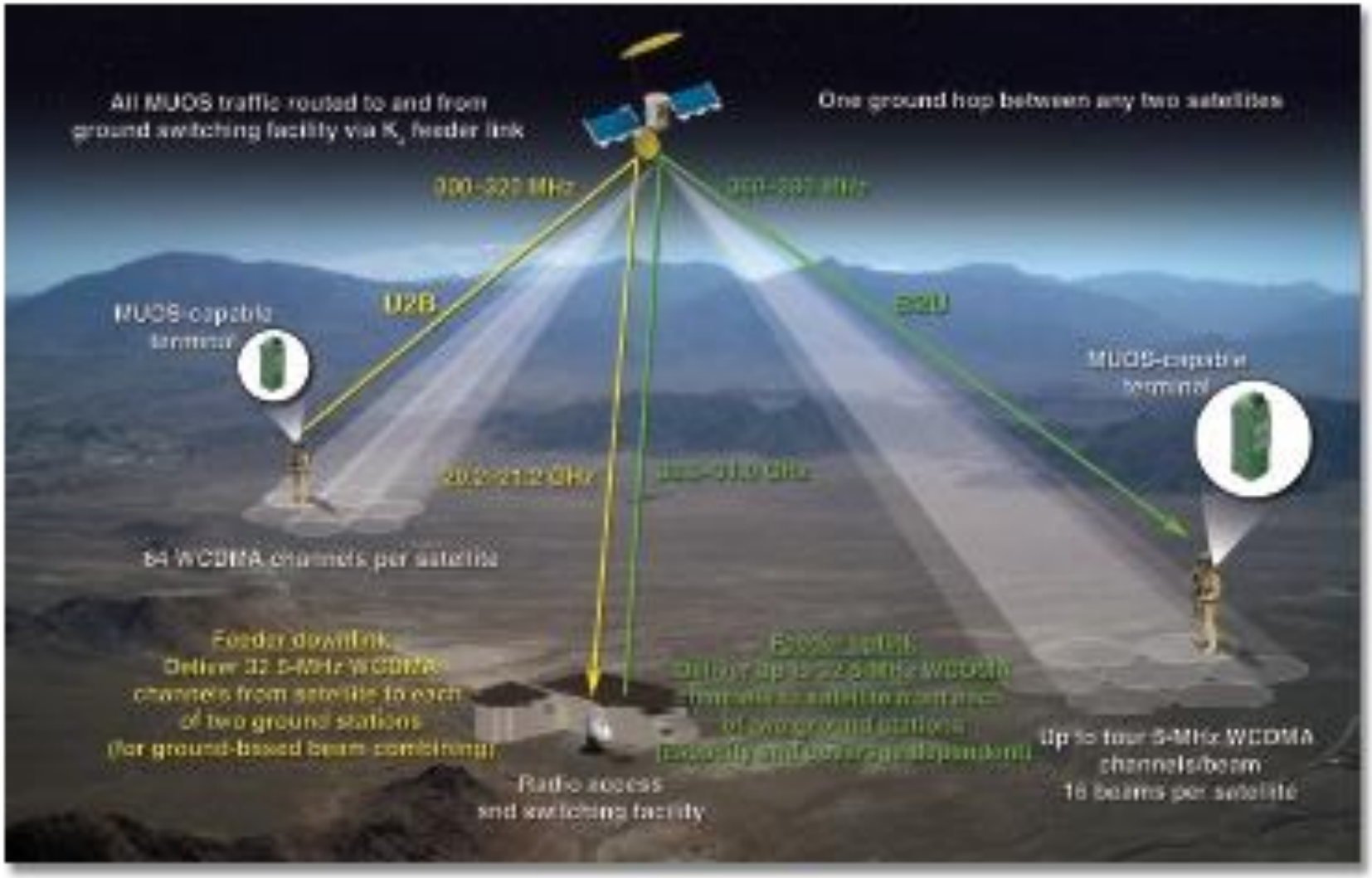

Figure 2. MUOS signal flow.

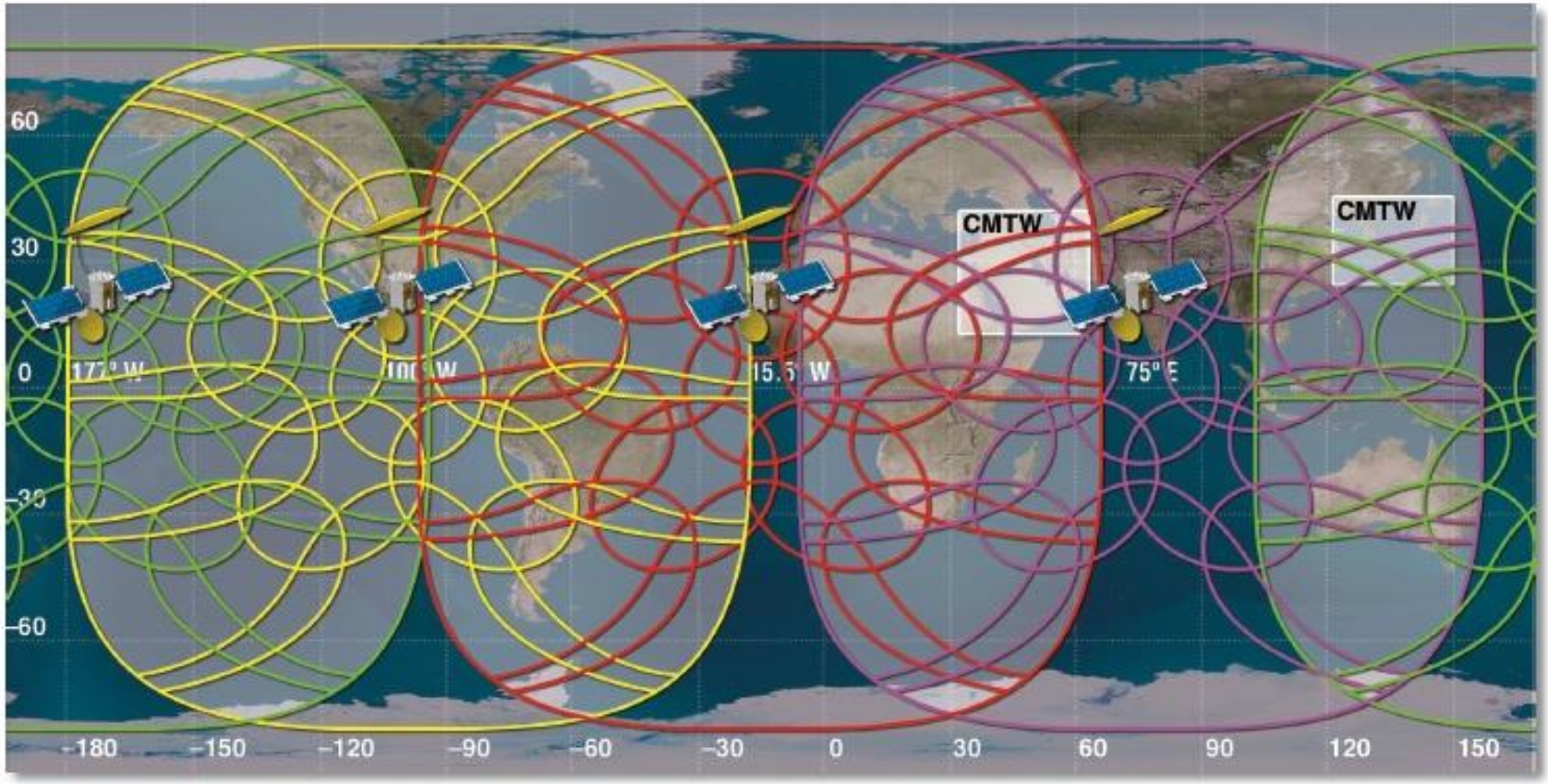

Figure 3. MUOS global coverage. The MUOS terminals within the gray shaded areas are in view of two MUOS satellites. CMTW, combined major theaters of war.

Figure 6. MUOS RAF in Geraldton, Australia.

From a presentation given by US in the MUOS site
to a M5S delegation, may 2013

Stazioni Terrestri MUOS

Wahiawa, HI operativa, sicurezza verificata

Chesapeake, VA operativa, sicurezza verificata

Australia operativa, sicurezza verificata

Niscemi, Italia non ancora operativa

RESULTS OF THE STUDY

Many risks due to MUOS installation were evaluated from our assessment, such as:

- direct exposure to the beam emitted by MUOS in case of pointing error,
- due to plane crash,
- accidental irradiation of aircraft during normal operation,
- harmful effectss on the surrounding environment.
- long-term exposure to diffuse EMF radiation

The application of the Precautionary Principle (PP) in relation to the state of scientific knowledge has recently been widely debated in several monographs included in the important publication of the European Environmental Agency 2013.

In particular, a survey was made of cases in which the PP was applied by governments, with measures intended to limit or exclude the use of particular products or to avoid exposure that later proved to be unnecessary, in case of a likely risk for public health.

The application of the PP is adequate in the case of MUOS, however not strictly necessary, because there is evidence of radiation environmental levels that are beyond the limits recommended by Italian Legislation, already with the existing antennas of the NRTF facility.

The telecommunications station NRTF-Niscemi, in fact, operates since 1991, just 4 Km from the center of the small town of the same name.

Within NRTF-Niscemi, 46 large antennas are present: as stated by the U.S. military, only 27 of them are actually operational, 26 of them emitting in HF (High Frequency) band, at frequencies between 3 and 30 MHz, and one in the LF (Low Frequency) band, at 46 KHz .
The emissions of MUOS should therefore be added to those generated by the existing antennas.

At the time when the base-NRTF Niscemi was built in 1991, the Italian legislation for radiation protection against electromagnetic emissions of radio frequency was lacking, and therefore no preliminary environmental assessment was carried out.

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At the time when the base-NRTF Niscemi was built in 1991, the Italian legislation for radiation protection against electromagnetic emissions of radio frequency was lacking, and therefore no preliminary environmental assessment was carried out.

Currently, the situation is very different: in fact, we have shown in the previous sections that the scientific evidence about the harmful effects of exposure to electromagnetic waves of radio frequency (RF) and microwave (MW) have continued to accumulate, even in recent years, so as to lead to their recognition as possible carcinogens to humans by the World Health Organization (IARC, 2011)

TABLE 1 – Italian law safety thresholds (DPCM July 8, 2003)

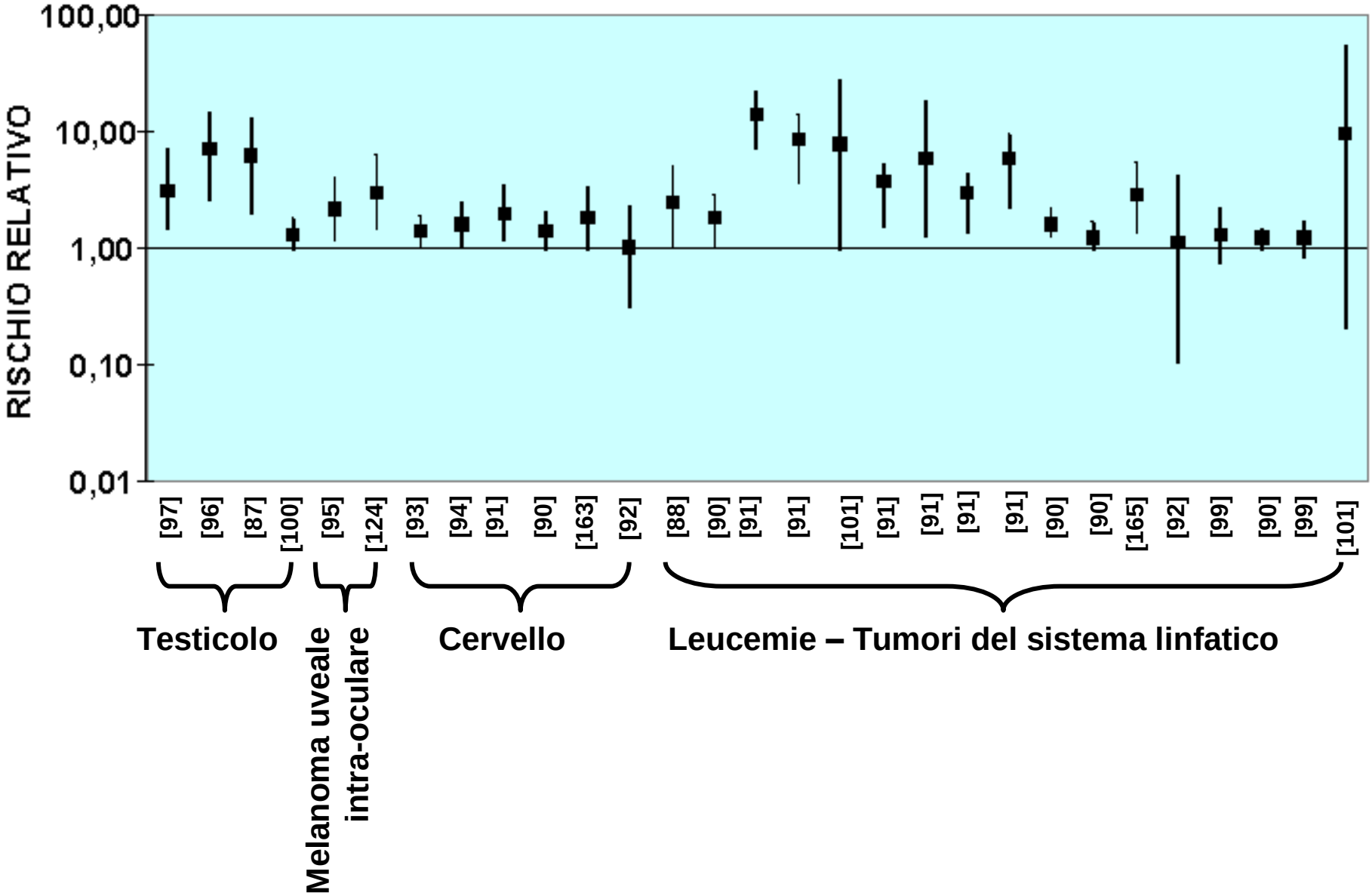
Safety thresholds for acute effects ("Limiti di esposizione")			
Frequency	Electric field	Magnetic field	Power flux
100 Khz - 3 MHz	60 V/m	0,2 A/m	-
3 MHz - 3 GHz	20 V/m	-	1 W/m^2
3 GHz - 300 GHz	40 V/m	-	4 W/m^2
Safety thresholds for long time exposure effects ("Valori di attenzione")			
Frequency	Electric field	Magnetic field	Power flux
100 Khz - 300 GHz	6 V/m	0,016 A/m	0,1 W/m^2

CONCLUSIONS

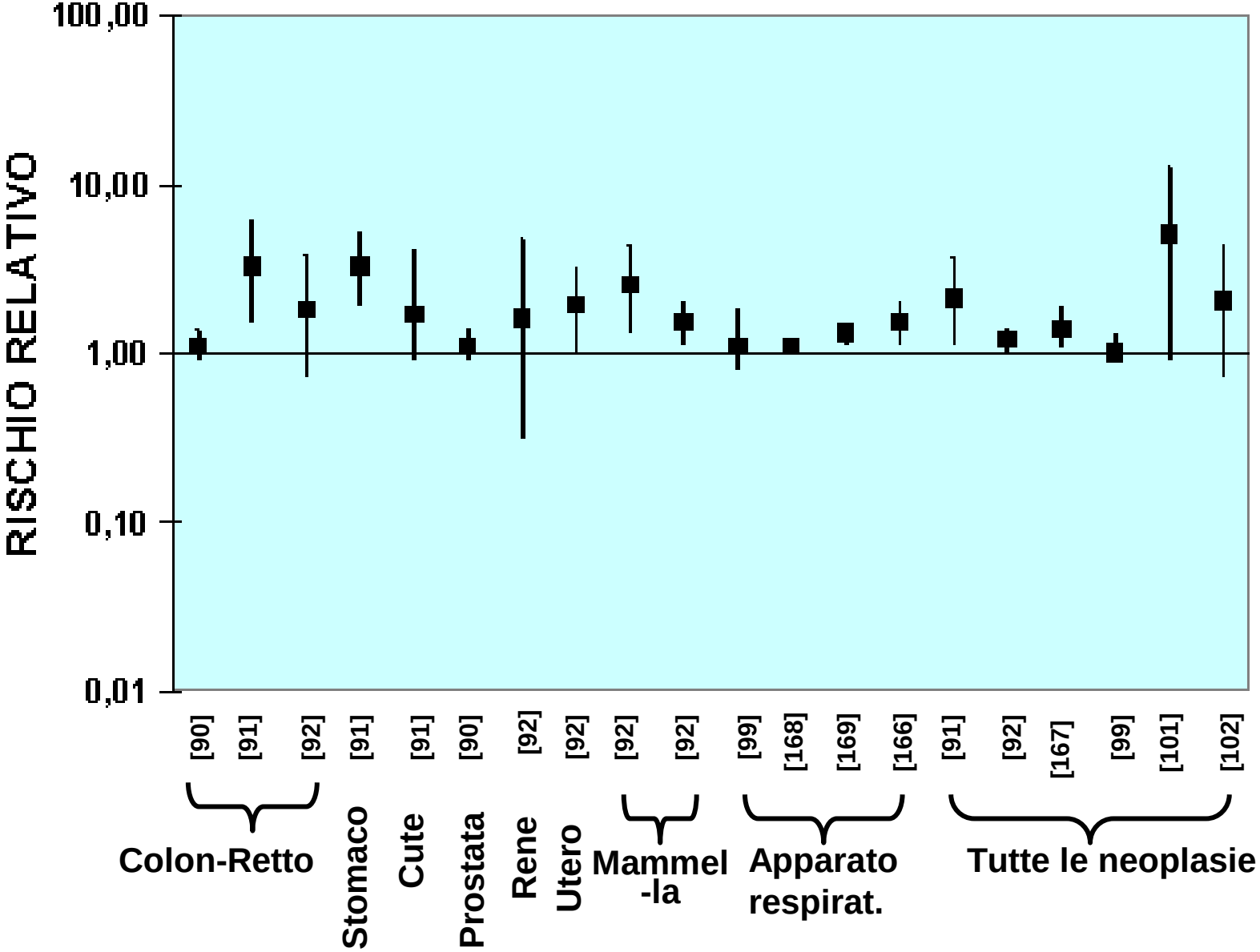
- On the basis of the elements above exposed it may be concluded that, in order to safeguarding the health of the population and the environment, it should not be allowed any further installation of electromagnetic field sources at the station NRTF Niscemi, and indeed is necessary to plan a rapid reduction of current emissions, according to the procedure " reduction in conformity "under Italian law in force

- Emission from the MUOS system may cause serious accidents and damage to health of the population and the environment, due to the realization at a distance of just a few Km from densely populated areas, such as the town of Niscemi.

STUDI OCCUPAZIONALI - I



STUDI OCCUPAZIONALI - II



American Journal of Epidemiology

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Printed in U.S.A.
810-818

Cancer in Korean War Navy Technicians: Mortality Survey after 40 Years

Frank D. Groves,[1] William F. Page,[2] Gloria Gridley,[1] Laure Lisimaque,[1] Patricia A. Stewart,[1] Robert E. Tarone,[1] Mitchell H. Gail,[1] John D. Boice, Jr.,[3] and Gilbert W. Beebe[1]

Abbreviations: BIRLS, Beneficiary Identification and Records Locator System; CI, confidence interval; ICD-8, *International Classification of Diseases*, Eighth Revision; ICD-9, *International Classification of Diseases*, Ninth Revision; ICDA-8, *International Classification of Diseases Adapted for Use in the United States*, Eighth Revision; SIR, standardized incidence ratio; SMR, standardized mortality ratio.

[1] Division of Cancer Epidemiology and Genetics, National Cancer Institute, Bethesda, MD.

[2] Medical Follow-up Agency, National Academy of Sciences, National Research Council, Washington, DC.

[3] International Epidemiology Institute, Rockville, MD, and Vanderbilt-Ingram Cancer Center, Vanderbilt University, Nashville, TN.

Int. J. Cancer: **124**, 945–951 (2009)

Causes of death among Belgian professional military radar operators: A 37-year retrospective cohort study

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Exp Oncol 2011
33, 2, 62–70

REVIEW

Experimental ONCOLOGY

LONG-TERM EXPOSURE TO MICROWAVE RADIATION PROVOKES CANCER GROWTH: EVIDENCES FROM RADARS AND MOBILE COMMUNICATION SYSTEMS

I. Yakymenko[1,2], E. Sidorik[1], S. Kyrylenko[3], V. Chekhun[1]*

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[3]*Masaryk University, Kamenice 5, A6, Brno 625 00, Czech Republic*

Bioelectromagnetics 29:345–352 (2008)

Is Fertility Reduced Among Men Exposed to Radiofrequency Fields in the Norwegian Navy?

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Electromagnetic Biology and Medicine, 26: 235–238, 2007

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DOI: 10.1080/15368370701357841

informa
healthcare

Influence of Radar Radiation on Breeding Biology of Tits (*Parus sp.*)

L. REJT[1], T. MAZGAJSKI[1], R. KUBACKI[2], J. KIELISZEK[2], E. SOBICZEWSKA[2], AND S. SZMIGIELSKI[2]

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Table 1

Estimated prevalence of electrosensitive people in different years and countries

Measured year	% El sensitive	Country, reported year	Ref. No.
1985	0.06	Sweden 1991 (0.025–0.125%)	National Encyclopedia Sw., 1991
1994	0.63	Sweden 1995	Anonymous est., 1994
1995	1.50	Austria 1995	Leitgeb N. et al., 1995, 2005
1996	1.50	Sweden 1998	SNBHW, Env. report, 1998
1997	2.00	Austria 1998	Leitgeb N. et al., 1998, 2005
1997	1.50	Sweden 1999	Hillert L. et al., 2002
1998	3.20	California 2002	Levallois P., 2002
1999	3.10	Sweden 2001	SNBHW, Env. report, 2001
2000	3.20	Sweden 2003	Sw Labour Union Sif, 2003
2001	6.00	Germany 2002	Schroeder E., 2002
2002	13.30	Austria 2003 (7.6–19%)	Spiß B., 2003
2003	8.00	Germany 2003	Infas, 2003
2003	9.00	Sweden 2004	Elöverkänsligas Riksförbund, 2005
2003	5.00	Schweiz 2005	Bern, Medicine Social, 2005
2003	5.00	Ireland 2005	This is London, 2005
2004	11.00	England 2004	Fox E., 2004
2004	9.00	Germany 2005	Infas, 2004
2017	50.00	Extrapolated to 50%	

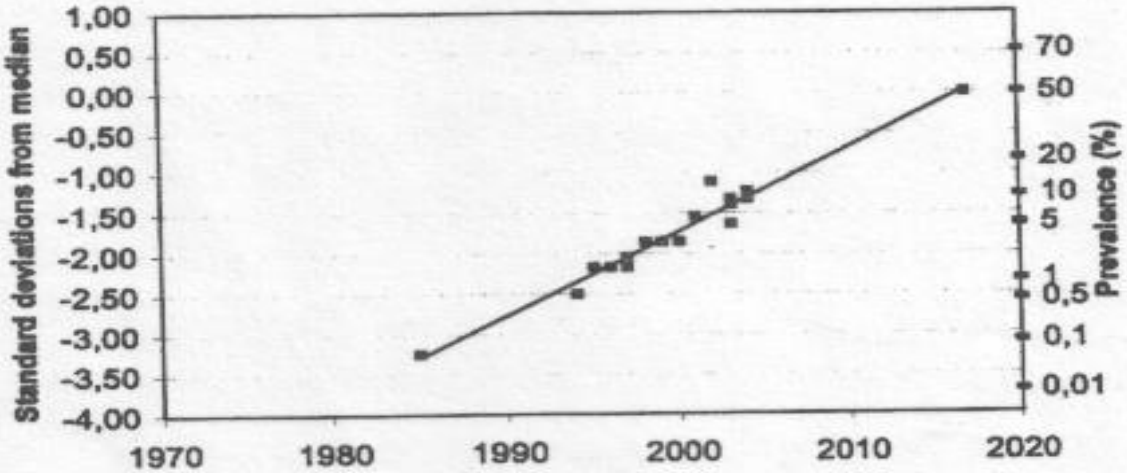

Figure 1. The prevalence (%) of people around the world who consider themselves to be electrosensitive, plotted over time in a normal distribution graph. The endpoint at 50% is an extrapolated value. Variation explained is 91%, the endpoint not included.

Parliamentary Assembly
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http://assembly.coe.int

COUNCIL OF EUROPE CONSEIL DE L'EUROPE

- **Doc. 12608**
- 6 May 2011
- **The potential dangers of electromagnetic fields and their effect**
- **on the environment**
- Report1
- Committee on the Environment, Agriculture and Local and Regional Affairs
- Rapporteur: Mr Jean HUSS, Luxembourg, Socialist Group

BioInitiative 2012

A Rationale for Biologically-based Exposure Standards for Low-Intensity Electromagnetic Radiation

You are here: Home / Research Summaries

Home
Editors' Notes
BioInitiative Report
Research Summaries
RF Color Charts
Participants
Media
Contact

Research Summaries

Henry Lai's Research Summaries

These are invaluable sets of abstracts (data-based to be searchable) covering the RFR scientific literature, as well as collections of scientific abstracts on free radical damage (from both RFR and ELF) and a set specific to electrosensitivity. They cover the research published between 1990-2012.

1. RFR Research Summary (2012)
2. RFR Free Radical Abstracts (2012)
3. ELF Free Radical Abstracts (2012)
4. Electrohypersensitivity Abstracts (2012)

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