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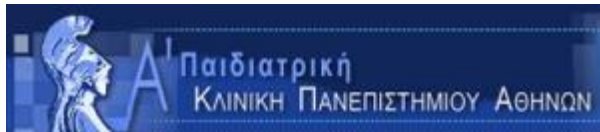




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Dear colleagues and friends,

We welcome you to the First International Symposium on “Electromagnetic Fields (EMFs) & Health”.

Electromagnetic radiation has been around since the birth of our universe. All living beings are exposed to varying EMFs, whose levels progressively increase as technology advances. EMFs of all frequencies are now one of the most common and fastest growing environmental influences on life on earth, which warrant research attention.

The Symposium is co-organized by the First Dpt. of Paediatrics, National and Kapodistrian University of Athens Medical School, Aghia Sophia Children’s Hospital, the University Research Institute of Maternal and Child Health & Precision Medicine, the Biomedical Research Foundation of the Academy of Athens, and the Hellenic College of Pediatrics.

This meeting addresses the entire electromagnetic spectrum, covering both natural and man-generated radiation.

The symposium includes invited speeches and e-poster sessions, provides a forum for productive discussion and aims to review robust experimental and population evidence in the area of EMFs and their effects on life functions.

Professor George P. Chrousos

Professor Christina Kanaka-Gantenbein

Dr Styliani Geronikolou

# Program

## FRIDAY SEPTEMBER 14TH 2018

### Medical radiation

**Chairs:** Anastasios Siountas, Anna Zygogianni, Alexander Georgakilas

11h30-12h00 Anastasios Siountas: *Ionizing radiation in medical exposure – benefits and/or risks*

12h00-12h30 Alexander Georgakilas: *Mechanisms of radiation response – The long road from radioresistance to radiosensitivity*

12h30-13h00 Antigoni Avramouli, Panagiotis Vlamos: *How protein misfolding mechanisms simulation influence therapeutic strategies*

13h00-13h30 Elena Vlastou, Panagiotis Spiliopoulos, Adam Kouvelis: *Radiation therapy for paediatric cancer*

13h00-14h00 Efstathios Efstathopoulos: *Radiation dosimetry in paediatric head CT examination*

14h00-14h30 Vassilis Kouloulis: *Clinical applications of hyperthermia as anticancer treatment*

14h30-15h00 e-poster session coffee break

### Natural radiation

**In memoriam:** Prof K. Poulakos, N. Vogglis, V. Petropoulos

**Chairs:** Mirella Harsoula, Flora Bacopoulou

15h00-15h30 George Chrousos: *Circadian CLOCK-mediated HPA axis and gene-specific regulation of peripheral glucocorticoid receptor transcriptional activity by acetylation*

15h30-16h00 Styliani Geronikolou: *A Chronome newly recognized: cyclic mortality variation follow solar and geomagnetic patterns*

16h00-16h30 Kostas Tsipiras: *Geomagnetism and construction: unhealthy buildings*

16h30-17h00 Manolis Georgoulis: *Solar radiation*

## SATURDAY SEPTEMBER 15<sup>TH</sup> 2018

### Telecommunications

**Chairs:** Christina Kanaka-Gantenbein, Eleni Petridou, Vassilis Protogerou

11h00-11h30 Nikolaos Sofikitis: *Cell phone effect on male fertility*

11h30-12h00 Eleni Petridou, Patricia Gerakopoulou: *Non-ionizing radiation and perception of health risks: the behavioral paradox*

12h00-12h30 George Drosatos, Olga Tsoumani, Styliani Geronikolou: *PhubMit- A new smart intervention for estimating and mitigating the cell phone induced ostracism (phubbing)*

12h30-13h00 Martin Roosli: *Radiofrequency exposure in the environment: how relevant are transmitters compared to other sources?*

13h00-13h30 Mary Redmayne: *International policy and advisory response regarding children's exposure to radio frequency electromagnetic fields (RF-EMF)*

13h30-14h00 Martin Roosli: *A Prospective cohort study of adolescents' memory performance and individual brain dose of microwave radiation from wireless communication*

14h00-14h30 Theodore Samaras: *Meeting the challenges in the assessment of exposure to continuously changing telecommunication systems*

14h30-15h00 Coffee break & e-poster session

**Chairs:** Elena Critselis, Katerina Katsibardi

15h00-15h30 Michael Kundi: *EMF and cancer – The evidence from epidemiology*

15h30-16h00 Hans Peter Hutter: *EMF and cancer-Public Health implications*

16h00-16h30 Christina Kanaka-Gantenbein: *RFs and health-A paediatrician point of view*

16h30-17h00 Styliani Geronikolou: *Mobile phone exposure impact on endocrine axes and autonomic nervous system- results and implicated mechanisms*

### Extremely Low Frequencies

**Chairs:** George Chrousos, Styliani Geronikolou

17h30-18h00 Lucas Christophorou: *Possible health effects from electricity transmission lines*

18h00-18h30 Igor Belyaev: *Key factors to be focused in assessing health risks from low density electromagnetic fields*

18h30-18h40 A Manta: *Oxidative stress as a possible non-thermal mode of telecommunication signal's exposure*

18h40-18h50 Katerina Skouroliahou: *Dosimetry during exposure to telecommunication signals*

18h50-19h20 Lukas Margaritis: *Telecommunication signals affect the function of cells and organisms: 20 years work*

## Contents

HOW PROTEIN MISFOLDING MECHANISMS SIMULATION INFLUENCE THERAPEUTIC STRATEGIES .....	10
MECHANISMS OF RADIATION RESPONSE – THE LONG ROAD FROM RADIORESISTANCE TO RADIOSENSITIVITY.....	11
RADIATION DOSIMETRY IN PAEDIATRIC HEAD CT EXAMINATIONS .....	12
RADIATION THERAPY FOR PEDIATRIC CANCER .....	13
CIRCADIAN CLOCK-MEDIATED HPA AXIS AND GENE-SPECIFIC REGULATION OF PERIPHERAL GLUCOCORTICOID RECEPTOR TRANSCRIPTIONAL ACTIVITY BY ACETYLATION .....	15
SOLAR RADIATION.....	16
CHRONOME NEWLY RECOGNIZED: CYCLIC MORTALITY VARIATIONS FOLLOW SOLAR AND GEOMAGNETIC PATTERNS.....	17
PHUBMIT- A NEW SMART INTERVENTION FOR ESTIMATING AND MITIGATING THE CELL PHONE INDUCED OSTRACISM (PHUBBING).....	19
A PROSPECTIVE COHORT STUDY OF ADOLESCENTS’ MEMORY PERFORMANCE AND INDIVIDUAL BRAIN DOSE OF MICROWAVE RADIATION FROM WIRELESS COMMUNICATION .....	20
NON-IONIZING RADIATION AND PERCEPTION OF HEALTH RISKS: THE BEHAVIORAL PARADOX .....	21
MOBILE PHONE EXPOSURE IMPACT ON ENDOCRINE AXES AND AUTONOMIC NERVOUS SYSTEM- RESULTS AND IMPLICATED MECHANISMS .....	22
EMF AND CANCER: PUBLIC HEALTH IMPLICATIONS.....	23
ELECTROMAGNETIC FIELDS EXPOSURE AND CHILD HEALTH: A PEDIATRICIAN’S PERSPECTIVE .....	24
EMF AND CANCER: EVIDENCE FROM EPIDEMIOLOGY .....	25
TELECOMMUNICATION SIGNALS CAN CAUSE BIOLOGICAL EFFECTS; OUR 20 YEARS’ STUDIES IN LIVING SYSTEMS..	27
INTERNATIONAL POLICY AND ADVICE REGARDING CHILDREN’S EVERYDAY RADIO-FREQUENCY EXPOSURES .....	28
RADIOFREQUENCY EXPOSURE IN THE ENVIRONMENT: HOW RELEVANT ARE TRANSMITTERS COMPARED TO OTHER SOURCES? .....	29
MEETING THE CHALLENGES IN THE ASSESSMENT OF EXPOSURE TO CONTINUOUSLY CHANGING TELECOMMUNICATION SYSTEMS .....	30
KEY FACTORS TO BE FOCUSED IN ASSESSING HEALTH RISKS FROM LOW INTENSITY ELECTROMAGNETIC FIELDS ....	32
POSSIBLE HEALTH EFFECTS FROM LOW-FREQUENCY, LOW-INTENSITY ELECTRIC AND MAGNETIC FIELDS FROM ELECTRICAL POWER TRANSMISSION AND DISTRIBUTION LINES .....	33
THE COMBINED EFFECTS OF MICROGRAVITY AND IONISING RADIATION IN GENE EXPRESSION: CHALLENGES IN SPACE FLIGHT AND <i>ORBIS NOVUM</i> COLONIALIZATION.....	35
THE EFFECTS OF RADIOFREQUENCY (RF) ELECTROMAGNETIC (EM) WAVES FROM MOBILE PHONES ON BIOLOGICAL ENTITIES .....	36
SPATIAL ESTIMATION OF ELECTRO-MAGNETIC INTERFERENCE FOR CELLULAR TELEPHONY .....	37
EVOLUTION IN ACTION; COULD EMR PROMOTE GENE EPISTASIS BY CAUSING HORMONAL IMBALANCES IN THE STRESS SYSTEM? .....	38



# **MEDICAL EXPOSURE**

# HOW PROTEIN MISFOLDING MECHANISMS SIMULATION INFLUENCE THERAPEUTIC STRATEGIES

**Antigoni Avramouli, Panagiotis Vlamos**

*Department of Informatics of Ionian University*

Failure of proteostasis leads to loss-of-function diseases, when too little native protein is produced, or gain-of-toxicity diseases, when too much aggregated protein is produced, thus leading to deleterious cell processes. Thus, the etiology of many diseases has been attributed to protein misfolding mechanisms. To gain insight into the processes that maintain a correctly folded and functional proteome, we should develop computational models that are able to generate assumptions to guide the design of new experiments. The approaches that enable mathematical modeling and computer simulation are relatively new in the medical sciences but their potential as a useful tool for the characterization of changes in protein dynamics and identification of rare molecular events is being increasingly recognized. Our study centers on our current knowledge about proteostasis and the discrimination of the molecular mechanisms underlying the pathogenesis of many diseases, with the use of high – throughput simulation technologies and sophisticated data mining algorithmic techniques.

## **Acknowledgements**

Authors have no competing interest to declare. This research is funded by the Hellenic Foundation for Research and Innovation (ELIDEK).

# **MECHANISMS OF RADIATION RESPONSE – THE LONG ROAD FROM RADIORESISTANCE TO RADIOSENSITIVITY**

**Alexandros Georgakilas**

*DNA Damage Laboratory, Physics Department, Applied Mathematical and Physical Sciences, National Technical University of Athens (NTUA), Zografou 15780, Greece*

Ionizing radiation (IR) is considered currently one of the most well-known and accepted carcinogens. Exposure of humans to IR from low (environmental) to high doses (radiotherapy) induces a variety of detrimental effects mainly due to the highly complex DNA, protein and lipid damage. Our work through the years has targeted the detection of complex DNA damage and also the mechanisms regulating response to IR and its biological effects. A major issue in this radiation response is the critical role of DNA damage response (DDR) network of mechanisms leading either to repair of DNA damage or cell death and the intermediate unfortunate state of misrepair and genomic instability. Of high importance, it is considered, the final outcome of exposure to IR i.e. the overall radiosensitivity or radioresistance of the human beings as well as the activation of the immune system. In this presentation, I will include the description of current knowledge on the mechanisms of radiosensitivity/radioresistance and the work from our group offering insights on the quite distinct mechanisms through experimental and bioinformatics approaches.

Author declares no conflict of interests. Dr. A.G. Georgakilas acknowledges funding from the DAAD Grant "DNA Damage and Repair and Their Relevance to Carcinogenesis" (No 57339330)

# **RADIATION DOSIMETRY IN PAEDIATRIC HEAD CT EXAMINATIONS**

**E. P. Efstathopoulos**

*School of Medicine, National and Kapodistrian University of Athens, Mikras Asias, 11527, Athens, Greece*

Objectives: Head CT examination is the most frequently performed pediatric CT examination. The objective of the current study was to estimate the radiation dose delivered during paediatric head CT examinations. Materials and Methods: The study included a cohort of 822 pediatric patients (0-15 years) who underwent head CT examinations in three hospitals (including 1 general and 2 children's hospitals). All CT protocols were age-based. Patients' characteristics, acquisition parameters and dosimetric quantities were extracted from DICOM metadata and recorded. Eye lens dose was estimated using thermoluminescent dosimeters (TLDs) placed on children's eye lens during the CT examinations. Results: The effective dose ranged from 1.2-3.9 mSv whereas the dose to the eye lens ranged from 10.5-34.2 mGy. Although CT protocols varied in terms of acquisition parameters and scanning mode, effective doses were comparable among the various hospitals for the same age group. Conclusion: Standardization and optimization of CT protocols, use and revision of Diagnostic Reference Levels (DRLs) as well as education and training on radiation protection issues are the most important parameters for the implementation of radiation protection in paediatric population.

The author declares no competing interests.

# **RADIATION THERAPY FOR PEDIATRIC CANCER**

**Elena Vlastou, Panagiotis Spiliopoulos, Adam Kouvelis**

*Athens General Children's Hospital "Pan. & Aglaia Kyriakou", Thivon str, 11527, Athens, Greece*

Childhood cancer remains the leading cause of death by disease among children worldwide. It is estimated that approximately 300.000 cases of cancer are diagnosed in children under the age of 19 every year. Among them, a percentage of 12% will not survive, whereas the 60% of the remaining will suffer long term side effects. The recent advances in chemotherapeutic agents and the huge process in radiotherapy techniques have contributed to a remarkable increase of the overall survival rate of pediatric cancer patients from 10% to 85% over the last 40 years.

One should keep in mind that radiation therapy treatment planning for children with cancer is much more challenging than for adults. Children's increased radiosensitivity and life expectancy compared to adults, address serious considerations about the late effects and the risk for radiation induced secondary malignancies. Both physicians and medical physicists face crucial dilemmas regarding the proper therapeutic approach that should be followed in each case. Our purpose is to report the difficulties lying in children's radiotherapy and some of the technical parameters that affect the outcome of a successful radiotherapeutic strategy.

We declare no competing interests.

## **NATURAL EXPOSURE**

# CIRCADIAN CLOCK-MEDIATED HPA AXIS AND GENE-SPECIFIC REGULATION OF PERIPHERAL GLUCOCORTICOID RECEPTOR TRANSCRIPTIONAL ACTIVITY BY ACETYLATION

**George P. Chrousos**

*First Department of Pediatrics, University of Athens Medical School, "Aghia Sophia" Children's Hospital, Athens, 11527, Greece*

All living organisms have to adjust their physical activities and behavior to day/night cycles, as well as to unforeseen, random environmental changes, the *stressors*. These biological responses are subserved by two highly complex mechanisms, the circadian biologic CLOCK and the stress system. The CLOCK consists of the heterodimer Clock/Bmal1, which, along with a set of other transcription factors, is responsible for the circadian oscillations of gene expression. The stress system is composed of the hypothalamic-pituitary-adrenal (HPA) axis and the locus caeruleus/norepinephrine (LC/NE)-autonomic nervous systems, which both restore our internal balance, or *homeostasis*. During the last decade, accumulating evidence suggests that there is a strong inter-relation between CLOCK and the HPA axis. Any dysregulation in or uncoupling of these systems could potentially cause several disorders. In this lecture, we provide an overview of the molecular interactions between CLOCK and the HPA axis and present the clinical implications of their dysregulation or uncoupling.

Circulating cortisol concentrations fluctuate diurnally under the control of the "master" circadian CLOCK system located in the hypothalamus, while we recently reported that the peripheral "slave" circadian CLOCK system regulates the transcriptional activity of the glucocorticoid receptor (GR) by acetylating it at local target tissues. To examine Clock-mediated GR acetylation and circadian changes in the sensitivity of peripheral target tissues to glucocorticoids (GCs) in humans, we examined the acetylation of the GR and the mRNA expression of the GR, Clock, Bmal1, and 8 known GC-responsive (4 transactivated and 4 transrepressed) genes in peripheral blood mononuclear cells (PBMCs) obtained from 10 healthy subjects at 8 am and at 8 pm. GR acetylation levels were higher in the morning than in the evening, in synchrony with fluctuations of Clock and Bmal1 mRNAs and the levels of circulating ACTH and cortisol. The mRNA expression of certain genes regulated positively (GILZ and tristetraprolin) or negatively (interferon gamma, IL-1alpha and IL-12 p40) by GCs demonstrated the expected concomitant diurnal fluctuations, while, surprisingly, those of other such genes (Annexin A1, dual phosphatase 1 and TNFalpha) did not fluctuate. To further examine details of the acetylation-mediated regulation of GC-responsive genes, we obtained PBMCs from 6 additional healthy subjects and cultured them for 24 h *ex vivo* in the absence or presence of added hydrocortisone, assuming continuing oscillation of the cellular CLOCK system. In these cells, hydrocortisone-induced mRNA expression of the GC-responsive genes previously found to not correlate with circulating cortisol *in vivo* demonstrated circadian fluctuation, mirroring the levels of GR acetylation and Clock mRNA expression, while that of the genes that correlated with circulating cortisol *in vivo* did not show fluctuation *ex vivo*. Knockdown of Clock by its siRNA in cultured PBMCs abolished this gene-specific fluctuation of GR transcriptional activity. These results suggest that the transcriptional activity of the human GR is moderated in a gene-specific fashion through circadian GR acetylation by the peripheral CLOCK, counteracting the transcriptional effect of circulating cortisol. Coordinated regulation of GC action at target tissues by circulating cortisol and peripheral CLOCK-mediated epigenetic modulation of the GR appears to be essential for the maintenance of GC homeostasis in man. Uncoupling of such coordination might lead to increased exposure of tissues to glucocorticoids and pathologies related to functional hypercortisolism.

There is no conflict of interest

# SOLAR RADIATION

## **Manolis Georgoulis**

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RCAAM of the Academy of Athens, 15527 Athens, Greece*

An overview of the solar electromagnetic and particulate radiation is presented, aiming to instigate discussion on potential effects to humans within and beyond the terrestrial atmosphere. The long-term total (bolometric) solar irradiance and its spectral distribution, along with the absorption exerted by the atmosphere all the way to sea level, are shown for the nominal solar activity cycle. Further on, we present the untypical, short-term emission patterns of eruptive solar activity that can affect astronauts and cosmonauts engaging in extravehicular activities around the International Space Station, *en route* to other solar system bodies, such as Moon and Mars, or in the surface of these bodies, in line with future space exploration scenarios. From the information provided, one may gather that besides the potential psychological effects of long-duration space travel, solar radiation is fully able to incur substantial effects, both cumulative and nearly instantaneous – in case of major solar eruptions – that could even turn life-threatening for human bodies protected only by nominal, contemporary space suits.

There are no competing interests to be declared.



# **CHRONOME NEWLY RECOGNIZED: CYCLIC MORTALITY VARIATIONS FOLLOW SOLAR AND GEOMAGNETIC PATTERNS**

**Geronikolou Styliani**

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The human biological clock, while not extensively understood, is an adaptive body mechanism to balance the stress caused by heliomagnetic disturbances. Mapping time-structures -called chronomes- is of scientific interest for extending the P4 medicine models with chronotherapy aspects. This presentation concentrates on one morbid condition (strokes) in one urban population of the Athenian riviera, the city of Piraeus, during 1985-1989. This time period involves minimum and maximum of solar cycles. The sunspot numbers and the incidence rate of stroke mortality, the daily and monthly events were evaluated with advanced statistics and chaotic methods for time series. The analysis clarified that violent variations over 35% of sunspot numbers inversely correlate with monthly mortality of strokes. It also showed that there is a newly recognized near-week common cycle of sunspot numbers and stroke mortality. The results suggest an intrinsic rhythm of nature to renew populations on the planet Earth.

The author declares no competing interests or funding source.

# **TELECOMMUNICATIONS**

# **PHUBMIT- A NEW SMART INTERVENTION FOR ESTIMATING AND MITIGATING THE CELL PHONE INDUCED OSTRACISM (PHUBBING)**

**Drosatos George<sup>1</sup>, Tsoumani Olga<sup>2</sup>, Geronikolou Styliani<sup>3,4</sup>**

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Phubbing or the cell phone-induced ostracism is defined as “snubbing someone by being busy oneself with one’s mobile phone and ignore social surroundings”. Thus, “phubber” is the subject, whereas, ‘phubbee’ is the target of phubbing. The phenomenon is common in all ages, affecting parental, marital, romantic, friendly and professional relations. It is known to be associated to other (phone and all visual) addictions and the so-called social micro-fragmentation. To this end, we propose a novel, unique and privacy-by-design platform, called, henceforth, PhubMit, consisting of (i) a mobile application for phubbers to self-regulate themselves and (ii) a platform for researchers to perform their research studies. PhubMit aims to empower users to combat the tendency to be focused on one’s own phone. It consists the first objective estimation tool of phubbing behavior as it attempts to reduce phubbing by personalized goals and messages, and further provides two more options (a) to the user’s social surroundings to be involved, and/or (b) profit from individual assistance by specialists. Finally, we designed a pilot study so as to estimate the efficacy of our tool.

All authors declare no competing interests.

# A PROSPECTIVE COHORT STUDY OF ADOLESCENTS' MEMORY PERFORMANCE AND INDIVIDUAL BRAIN DOSE OF MICROWAVE RADIATION FROM WIRELESS COMMUNICATION

Foerster Milena <sup>1,2</sup>, Thielens Arno <sup>3,4</sup>, Wout Joseph <sup>4,5</sup>, Eeftens Marloes <sup>1,2</sup>, Röösli Martin <sup>1,2</sup>

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The potential impact of microwave radiofrequency electromagnetic fields (RF-EMF) emitted by wireless communication devices on neurocognitive functions of adolescents is controversial. In a previous analysis, we found changes in figural memory scores associated with a higher cumulative RF-EMF brain dose in adolescents. We aimed to follow-up our previous results using a new study population, dose estimation, and approach to controlling for confounding from media usage itself. RF-EMF brain dose for each participant was modeled. Multivariable linear regression models were fitted on verbal and figural memory score changes over 1 y and on estimated cumulative brain dose and RF-EMF related and unrelated media usage (n=669–676). Because of the hemispheric lateralization of memory, we conducted a laterality analysis for phone call ear preference. To control for the confounding of media use behaviors, a stratified analysis for different media usage groups was also conducted. We found decreased figural memory scores in association with an interquartile range (IQR) increase in estimated cumulative RF-EMF brain dose scores:  $-0.22$  (95% CI:  $-0.47, 0.03$ ; IQR: 953 mJ/kg per day) in the whole sample,  $-0.39$  (95% CI:  $-0.67, -0.10$ ; IQR: 953 mJ/kg per day) in right-side users (n=532), and  $-0.26$  (95% CI:  $-0.42, -0.10$ ; IQR: 341 mJ/kg per day) when recorded network operator data were used for RF-EMF dose estimation (n=274). Media usage unrelated to RF-EMF did not show significant associations or consistent patterns, with the exception of consistent (nonsignificant) positive associations between data traffic duration and verbal memory. Our findings for a cohort of Swiss adolescents require confirmation in other populations but suggest a potential adverse effect of RF-EMF brain dose on cognitive functions that involve brain regions mostly exposed during mobile phone use.

We do not have any conflict of interests to declare.

Funding of the Hermes study:

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# NON-IONIZING RADIATION AND PERCEPTION OF HEALTH RISKS: THE BEHAVIORAL PARADOX

**Gerakopoulou Patricia<sup>1</sup>, Petridou Eleni<sup>2</sup>**

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<sup>2</sup> *Department of Hygiene, Epidemiology and Medical Statistics, Medical School, National and Kapodistrian University of Athens, Greece*

Several studies have explored the possible health effects of exposure to radiofrequency (RF) and extremely low frequency (ELF) electromagnetic fields (EMF) showing a high degree of scientific uncertainty and if anything, minimal risks. Most research has been conducted mainly in response of policy makers to serious concerns expressed by the public at large. Using an interdisciplinary approach and results of published and completed studies, methodological challenges along with socio-cognitive biases and how they interfere in the assessment of exposure of children and adolescents to electromagnetic fields generated by wireless telecommunication technologies when exploring their possible association with brain tumorigenesis will be discussed. Additionally, study design related and complexities linked to the implementation of international studies in a large number of countries as well as how cognitive procedures understood under the analytical models of the social thinker entail a fine-grained analysis of how people - health personnel in particular - perceive and interpret scientific evidence, as they are the ones to principally communicate their perceptions of current scientific knowledge and information on this issue to lay people. The focus is set on exploring systematically people's commonsense theories and leans heavily on the theory of social cognition.

The authors declare no conflict of interest.

# **MOBILE PHONE EXPOSURE IMPACT ON ENDOCRINE AXES AND AUTONOMIC NERVOUS SYSTEM- RESULTS AND IMPLICATED MECHANISMS**

**Geronikolou Styliani**

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*Biomedical Research Foundation of the Academy of Athens, Soranou Ephessiou 4, 11527, Athens*

The evidence-based data investigating the impact of the radiofrequency fields (RF) on the endocrine function and the autonomic nervous system are summarized and revisited in this work. Endocrine assessment is restrained to stress and reproductive hormones, awakening response, melatonin, thyroid hormones and growth factors. Their acute response and circadian disturbances have also been addressed. According to the reported findings it is evident that endocrine axes are influenced by the exposure to RF even at frequencies lower than the ones mentioned in the International Commission on Non -Ionizing Radiation Protection (ICNIRP) guidelines. Thyroid hormones paradoxically, moderate body's response, whereas, circadian disturbances gain interest. The autonomic nervous system (ANS) is supposed to preserve its balance and it does, as confirmed by many studies and meta-analyses. Yet, ANS components related to time domain as well as to the dynamic of the system are disturbed so as the body functions refrain from imbalance and disease. Finally, the newly described R1 interactome is proposed as explanatory mechanism of all suggested health effects, penetrating all endocrine axes, implicating with biological clock/ANS, carcinogenicity, integrating all previously suggested mechanisms and surpassing the thermal /non-thermal conflict in the scientific community.

The author declares no competing interests or funding source.

# EMF AND CANCER: PUBLIC HEALTH IMPLICATIONS

**Hutter Hans-Peter**

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Public health is defined as the science of protecting the safety and improving the health of communities through education, policy making and research for disease and injury prevention. In the case of electromagnetic fields, sources as well as possible health impacts of low as well as high frequency fields must be considered.

Research focusing on long-term risks from low frequency magnetic field exposure demonstrated a consistent pattern of an increase in childhood leukemia associated with average exposure to residential power-frequency magnetic field  $> 0.3-0.4 \mu\text{T}$ . Based on pooled analyses of epidemiological studies the International Agency for Research on Cancer (IARC) at the WHO classified extremely low magnetic fields as 2B "possibly carcinogenic to humans" in 2001. Later on several other epidemiological investigations were conducted that did not change the conclusions of an association between power frequency MF and childhood leukemia.

In 2011 radio frequency radiation (30 kHz–300 GHz) was assigned group 2B by IARC as well. This was based on an increased risk for glioma and acoustic neuroma in human epidemiological studies. This possibility of long-term health effects has relevance for the large and still growing number of mobile phone users, particularly for (very young) children.

Typically, if an agent is classified as a group 2B carcinogen, precautionary measures are taken at workplaces and special care is recommended if it is present in consumer products (e.g. lead, styrene, welding fumes). The consequences of such WHO evaluations are unambiguous for medical stateholders: Public health has to take such classifications seriously. Application of the precautionary principle and the ALARA (as low as reasonably achievable) principle for EMF exposure is urgently needed. Appropriate and suitable precautionary measures must be defined and implemented in order to reduce exposure of the population.

Conflict of Interest: My department got grants from the European Union, the Austrian Government and the Austrian Workers Compensation Board for research on EMF.

# **ELECTROMAGNETIC FIELDS EXPOSURE AND CHILD HEALTH: A PEDIATRICIAN'S PERSPECTIVE**

**Christina Kanaka-Gantenbein**

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During the last years there is an exponential use of electromagnetic fields (EMF) in everyday life. There are still sparse data on the potential harms of the exposure to such EMF on the developing organism of children and adolescents. EMF exposure may arise by the use of magnetic resonance imaging in medicine, exposure to high-voltage electric lines, mobile phones, telephone stations or even through the use of cordless phones.

There is a specific concern for children, given the greater susceptibility of their developing nervous system, the hyperconductivity of their brain tissue, the greater penetration of radiofrequency radiation relative to head size and their potential for a longer lifetime exposure. The main domains that may be affected are neurodevelopment, sleep quality and duration, endocrine function, reproductive capacity or even cancer risk.

Concerning neurodevelopment and cognition, studies report retarded memory, attention and behavioral problems related to increased use of wireless technology, while increased mobile phone use may lead to disordered sleep duration, parasomnias and night awakenings. These findings were not only attributed to EMF exposure but also to displacement of sleep due to prolonged media use and the effect of the blue screen light on melatonin suppression. However, disordered sleep could not be replicated in other studies.

Moreover, excessive exposure to mobile phone-frequencies over long periods of time has been reported to increase brain cancer risk. Specifically for children, several studies have investigated the role of EMF on leukemia, especially for those children living close to transmission lines. However, further studies need to be conducted to clarify this possible association, taking into consideration possible confounding factors.

In conclusion, since the long-term effects of EMF exposure on health over the lifespan are still inadequately studied and unraveled, the general concept of "Use in moderation" is advocated.

The author declares no conflict of interest or funding source for this research.



## **EMF AND CANCER: EVIDENCE FROM EPIDEMIOLOGY**

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Since the seminal publication of Wertheimer and Leeper in 1979 on the association between power frequency magnetic fields and childhood cancer the question whether or not EMFs contribute to cancer risk is under discussion. While animal experiments and in vitro studies are important to determine the mechanism of action, epidemiological evidence is indispensable to establish human health risks. Soon after the publication of Wertheimer and Leeper results of the Korean War veterans study indicated that maybe also RF EMFs are associated with an increased cancer risk. During the subsequent decades the discussion was fueled by apparently controversial findings, however, in 2000 two pooled analyses of the relationship between power frequency magnetic fields and childhood leukemia revealed an increased risk independent of the type of exposure assessment. It has been shown that this relationship could not be explained by single confounders although there remains the possibility of joint confounding that is, however, outweighed by the potential of exposure misclassification. Subsequent studies supported this relationship and currently there is little doubt that exposure to comparatively high levels of magnetic fields increases the risk of childhood leukemia and, to a lesser degree, also of adult leukemia. Epidemiological research of RF EMF and cancer was rare before the rise of digital telecommunication. The first studies were published end of the 1990s/early 2000s concentrating on tumors of the head and neck region but with insufficient duration of mobile phone use in studied individuals. Later studies had increasing proportions of individuals with meaningful latencies after onset of mobile phone use. Although these studies had their shortcomings the combined evidence points to an increased risk for glioma and acoustic neurinoma.

Conflict of Interest: I am expert witness in a court case in the USA concerning brain tumors, my department got grants from the European Union, the Austrian Government and the Austrian Workers Compensation Board for research on EMF

# **ILLUMINATING THE BIOCHEMICAL AND MOLECULAR EVENTS BEHIND THE OVARIAN PATHOPHYSIOLOGY AFTER EXPOSURE OF *DROSOPHILA MELANOGASTER* TO A TELECOMMUNICATION SIGNAL**

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The daily use by people of wireless communication devices has increased exponentially, rising concerns regarding its potential health hazards. *Drosophila melanogaster* was exposed to a telecommunication signal. Elevated ovarian ROS levels were identified after only 30 minutes of adults flies' exposure and were detected only at the pre-choriogenic stages. The role of p53 transcription factor was also assessed, using p53-null flies, where no alteration in redox status was observed.

Seeking the answer whether radiation is capable of altering the ovarian-gene expression transcriptional profiling; a genome-wide microarray analysis was conducted. 2h post-exposure alterations in the gene expression pattern of oogenesis were observed. Overall, 168 genes were found differentially expressed; 10 % of these genes are associated with stress and 6% with programmed cell death and especially apoptosis and autophagic self-eating. These observations may illuminate a novel mechanism of apoptosis that is specifically triggered upon non ionizing radiation. Finally, sporadically occurring egg chamber apoptosis was induced in both check points of oogenesis (germarium and stages 7 – 9, while p53-null flies showed increased number of apoptotic follicles only at stages 7 – 9, highlighting the differential, regulatory role of the transcription factor p53 in the externally mobile phone-induced apoptosis during oogenesis.

This research has been co-financed by the European Union (European Social Fund – ESF) and Greek national funds through the Operational Program Education and Lifelong Learning of the National Strategic Reference Framework (NSRF) - Research Funding Program: THALES. Investing in knowledge society through the European Social Fund. UoA- MIS 375784 – Biological effects of nonionizing electromagnetic radiation: a multidisciplinary approach coordinated by L.H.M.

## **TELECOMMUNICATION SIGNALS CAN CAUSE BIOLOGICAL EFFECTS; OUR 20 YEARS' STUDIES IN LIVING SYSTEMS**

**Margaritis L.H.**

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The big bang of telecommunication initiated a few decades ago has caused gradually an enormous increase of the electromagnetic pollution in the environment, work and home areas. Unlike ionizing radiation where the mechanisms with which it affects living matter has been explored adequately, and therefore dosimetrically based precautions are feasible, this is not the case with the non-ionizing telecommunication radiation. This is mainly due to a) the relatively short time passed since the initial applications, b) the fact that dosimetry is problematic, because unlike the other kinds of EMF they carry information i.e. modulated signals over time. As expected, one group of scientists (largely radiologists) are using phantom-based dosimetry and signal generators as exposure devices, whereas the other group, among them also our research team, is using real communication devices (cell phones, Wi-Fi) claiming that these represent the real conditions of human exposure. In addition, there is a debate whether non-thermal effects are possible during exposure of the living matter to this low energy telecommunication radiation. This notion is supported internationally by a large number of scientists that attribute it to the formation or increase of ROS. While ICNIRP's guidelines are base on thermal effects only. Our group has been using model biological systems in order to find out any plausible non-thermal effects.

# **INTERNATIONAL POLICY AND ADVICE REGARDING CHILDREN'S EVERYDAY RADIO-FREQUENCY EXPOSURES**

**Mary Redmayne**

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Environmental microwave exposures have become almost unavoidable. Use of transmitting devices by children and teenagers is now an everyday expectation even in schools in some countries. Millions of children are exposed 24/7. What international steps are being taken to protect our young people from the resulting bio-effects of these exposures at a home and at school? This presentation examines the varied policy approaches taken around the world to environmental and personal radio-frequency electromagnetic radiation, focusing particularly on young people. I examine whether environmental exposure Standards and policy advice on device-use need to be more stringent.

The author declares no competing interests.

# **RADIOFREQUENCY EXPOSURE IN THE ENVIRONMENT: HOW RELEVANT ARE TRANSMITTERS COMPARED TO OTHER SOURCES?**

## **Martin Rösli**

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Wireless phones and other devices that are used close to the body produce a near-field exposure situation, which is characterized by the specific absorption rate (SAR in W/kg tissue weight). Transmitters further away such as W-LAN (wireless local area networks), mobile and cordless phone base stations, broadcast transmitters and other people's mobile phone are far-field sources and the incident electric field (in V/m) is the most common exposure metric. To combine the two exposure measures to one single dose measure needs dosimetric calculations. To provide an overview about the contributions of various sources to total RF-EMF *exposure*. To use a recent personal measurement survey from Switzerland and a dosimetric model to estimate personal brain and whole body RF-EMF *dose* from various sources. A dosimetric model developed by Roser et al., 2015 combines near and far field dose contributions for the following exposure scenarios and usage pattern:

- cordless and mobile phone use: 5 min each per day
- active data transfer with mobile phone: 52 min per day
- stand-by data traffic with mobile phone on body: 1.2 min per day
- data traffic by laptop, tablet, computer close to body: 78 min per day
- Exposure levels from various far field sources as measured in a personal measurement study conducted with 42 pairs of one parent and adolescent (12-15 years) and 30 young adults (18-30 years) in 2015 in Switzerland.

The total daily whole body dose is 194 mJ per kilogram body weight. Near field sources contribute 90% and far field sources 10% to total dose. The most relevant near field sources are mobile phone calls (33%), cordless phone calls (8%), data traffic via mobile phone (19%) or via other devices (29%). Regarding far field sources, the most relevant contribution originate from mobile phone base stations (5%). The total brain dose is ca. 600 mJ/kg/day with 78% from mobile phone calls. The contribution from far field sources is very small (4%). Dosimetric calculations show that most of the absorbed RF-EMF dose originates from own device use even for whole body absorption. Minimizing the output power of devices operating close to the body is the most effective precautionary measure to reduce personal exposure to RF-EMF.

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I do not have any competing interest to declare.

# **MEETING THE CHALLENGES IN THE ASSESSMENT OF EXPOSURE TO CONTINUOUSLY CHANGING TELECOMMUNICATION SYSTEMS**

**Samaras Theodoros**

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The introduction of mobile telecommunication networks close to the end of the previous millennium is a huge milestone in the history of telecommunications. It has coined the idea of people's communication "anytime" and "anywhere", but has also changed the paradigm of human exposure to anthropogenic electromagnetic radiation with the introduction of transmitters close to the body. Since the deployment of the early, first generation systems, several changes have taken place in the technology of mobile telecommunications, not only with respect to signal characteristics and hardware but also in the intended use of mobile devices, which are now equipped with increased computational power. Assessment of exposure to telecommunications systems does not only serve the needs of compliance to safety standards. It is equally important for dosimetry of bioelectromagnetics experimentation and epidemiological studies. The continuous developments in sensorics and numerics have allowed to efficiently deal with all the challenges created by emerging telecommunications systems until now. The upcoming 5G networks are not expected to make an exception to the rule.

There are no competing interests to declare.

## **ELF EXPOSURE**

# KEY FACTORS TO BE FOCUSED IN ASSESSING HEALTH RISKS FROM LOW INTENSITY ELECTROMAGNETIC FIELDS

## Igor Belyaev

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Diverse biological responses to weak electromagnetic fields (EMF) of extremely low frequency (ELF) and non-thermal microwaves (MW) including adverse health effects related to electrohypersensitivity, have been reported. While some studies reported no effects (negative studies), these were found by others (positive studies). This presentation provides an overview of the complex dependence of the ELF/MW effects on various physical and biological variables. Among other variables, dependencies on carrier frequency, polarization, modulation, intermittence, electromagnetic stray fields, genotype, physiological traits, and cell density during exposure were reported [1]. Unfortunately, some reviews and panels do not include analysis of various biological and physical variables. As a result, misleading conclusion is made that weak ELF/MW produce no “reproducible” effects.

Significant body of studies shows that ELF/MW effects depend on concentration of divalent metals, ROS and antioxidants. These data provide a mechanistic background for treatment of electrohypersensitivity based on chelating divalent metals, reducing ROS, and balancing vitamins.

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Declaration of Interest: As expert, IB took part in the Cell Phone Litigation on the association between exposure to mobile phones and brain and provided expert opinion on association between exposure from base stations and health.

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# **POSSIBLE HEALTH EFFECTS FROM LOW-FREQUENCY, LOW-INTENSITY ELECTRIC AND MAGNETIC FIELDS FROM ELECTRICAL POWER TRANSMISSION AND DISTRIBUTION LINES**

**Loucas G. Christophorou**

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The problem is defined scientifically: electrical power transmission and distribution lines crisscross the space around us and consequently, we are exposed to the low-intensity, low-frequency electric and magnetic fields which they produce. Hence, the scientific question: what are the consequences of these fields for our health? Presently, there is no definite scientific answer to the question, although there have been several credible studies which indicate no adverse health effects under the existing regulations and legal directives. Nevertheless, the question can still be characterized as “trans-scientific”, that is, it cannot be fully answered by science at the present. However, the issue can become irrelevant by employing recent technologies where-by the high voltage-electrical cables are enclosed in pipes (buried underground) and insulated using high-dielectric strength gases at high pressure or cryogenic cables cooled by liquid nitrogen.

The author declares no conflict of interest.

# POSTERS

# THE COMBINED EFFECTS OF MICROGRAVITY AND IONISING RADIATION IN GENE EXPRESSION: CHALLENGES IN SPACE FLIGHT AND *ORBIS NOVUM* COLONILIZATION

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Space represents a rather hostile environment for the human body, with bone loss and immunosuppression being two of the most important consequences. Vertebrates have evolved with the presence (and maybe because of) of gravity and sunlight that is radiation. In recent years the human race is attempting to reenter the vast space (where we came from, in the first place), yet our knowledge on the challenges that such an endeavor includes is limited. In particular, one of the most obscure aspects in astrobiology is gene regulation in the microgravitational and zero-gravitational environments of outer space. The present work attempts to review experimental results of gene expression data and present some of the molecular functions of eukaryotes under microgravity and ionizing radiation (IR) exposure. Although, there not many studies concerning those effects, which is mainly due to the complicated nature of the phenomenon as well as the immense experimental cost, recent reports have highlighted that microgravity and radiation combined cause significant alteration in gene expression and gene regulatory pathways. Such approaches are extremely useful towards the understanding of gene regulation in outer space and thus they could assist mankind's endeavors for *orbis nova*.

All authors declare no competing interests or funding source.

# **THE EFFECTS OF RADIOFREQUENCY (RF) ELECTROMAGNETIC (EM) WAVES FROM MOBILE PHONES ON BIOLOGICAL ENTITIES**

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Knowledge on the effects of RF EM waves, is extremely important for the safe and efficient operation of mobile telephony as well as radio frequency or electromagnetic emission units, such as high-voltage stations. There have been many studies in this direction, but there has been no agreement between them, as both methodological and technical problems arise that influence the assessment of the effects of microwave irradiation. However, several studies converge to the conclusion that RF EM, causes tissue temperature raise, with a simultaneous penetration of the tissue. It is also interesting that RF EM tissue penetration is age dependent with children being more susceptible to it. The present work attempts to review the literature with respect to the effects and properties of RF EM on human tissues and furthermore, it has been attempted to repeat such simulations computationally. Our preliminary results showed that they were in agreement with those of previous studies. Therefore, it is apparent that in order to understand the effects of RF EM on human tissues more research is required and in addition, research should focus more on the molecular effects of RF EM in the eukaryotic cell.

All authors declare no competing interests

# SPATIAL ESTIMATION OF ELECTRO-MAGNETIC INTERFERENCE FOR CELLULAR TELEPHONY

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During the last decade the cellular phone communications systems are under rapid development. Telecommunications systems environmental effects' depend on their particular characteristics (like length of antenna, distance from antenna, power of magnetic field). To investigate these effects, simulation techniques must be introduced and calculation of the interfering electric field  $E_{EMI}$  is possible to be analyzed using specific mathematical formulas. Various parameters of these formulas considering appropriate measurements lead us to wide range of results. The final illustration of the magnetic field is possible to represent as a spatial point process and estimation of that spatial presentation could take place using specific spatial statistical techniques like kriging. This work is an extended work of Geronikolou et al. (2016).

## **Reference**

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The author declares that there is not any competing interest.

# EVOLUTION IN ACTION; COULD EMR PROMOTE GENE EPISTASIS BY CAUSING HORMONAL IMBALANCES IN THE STRESS SYSTEM?

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Electromagnetic radiation (EMR) may alter hormonal balance in mammalian organisms [1]. Namely, in rats, ACTH and adrenaline concentrations increase upon exposure to electromagnetic radiation at 12 Hz over 3 days. Interestingly, corticosterone and alpha a1-receptor concentrations decreased significantly over the same time period [2]. Therefore, it seems that the Hypothalamic-pituitary-adrenal (HPA) axis may be a major target of gene-environment interactions with EMR as the potential stressor. Indubitably, there is a major need for a thorough understanding of diseases caused by gene-environment interactions and of how genes influence other genes (epistasis) in the presence of environmental stimuli. Herein, we present a proposed mechanism via which EMR-related hormonal imbalance could influence DNA interactions with the CLOCK-BMAL1 heterodimer, the glucocorticoid receptor (GR) or the glucocorticoid ligand itself, thus, altering circadian rhythms and metabolism. As an example, we tested the ability of cortisol to affect CLOCK-BMAL1-DNA interactions. Our study suggests that there is a concentration-dependent ability of glucocorticoids to intercalate to the minor groove of the DNA of our genome. Thus, increased cortisol levels could increase the transcription factor-DNA interaction potential and thus alter circadian rhythmicity. This paradigm could be extended to other transcription factors in their interactions with their DNA response elements.

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# AUTHORS ALPHABETICAL INDEX

Avramouli Antigoni.....	7	Margaritis L.H. ....	23, 24
Belyaev Igor .....	29	Nicolaides Nicolas C.....	35
Christophorou Loucas G. ....	30	Papadopoulou D. ....	23
Chrousos George P. ....	12, 35	Petridou Eleni .....	18
Drosatos George.....	16	Polyzos A.P.....	23
Eeftens Marloes.....	17	Raftopoulou Sofia .....	35
Efstathopoulos E. P.....	9	Redmayne Mary.....	25
Eliopoulos Elias .....	35	Röösli Martin .....	17, 26
Foerster Milena .....	17	Samaras Theodoros .....	27
Georgakilas Alexandros .....	8	Skouroliakou A.S.....	23
Georgoulis Manolis.....	13	Spiliopoulos Panagiotis .....	10
Gerakopoulou Patricia.....	18	Stravopodis D.J. ....	23
Geronikolou Styliani .....	14, 16, 19	Thanos D. ....	23
Hutter Hans-Peter .....	20	Thielens Arno .....	17
Kanaka-Gantenbein Christina.....	21	Toumpaniaris Petros.....	32, 33
Kintzios Spyridon .....	35	Tsoumani Olga .....	16
Koutsouris Dimitrios .....	32, 33	Vlachakis Dimitrios .....	35
Kouvelis Adam .....	10	Vlamos Panagiotis.....	7
Kundi Michael.....	22	Vlastou Elena .....	10
Lambrou George I.....	32, 33	Wout Joseph .....	17
Manta A.K. ....	23	Zimeras Stylianos. ....	34

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