

ELECTROMAGNETIC ENGINEERING FOR HUMAN HEALTH

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ABSTRACT

During fresh years there has been growing public concern on probable health risks from power-frequency fields (extremely low frequency electromagnetic fields; Intensified Fields) and from radiofrequency/microwave radiation emissions (Radio Frequency) from wireless communications. Non-thermal (low-intensity) biological effects have not been measured for regulation of microwave exposure, although numerous scientific texts signpost such effects. The bio initiative text is based on an international research and public strategy initiative to give an overview of what is known of biological effects that occur at low-intensity electromagnetic fields (Electromagnetic Fields) exposure. Health endpoints texted to be connected with Intensified Fields and/or Radio Frequency include childhood leukemia, brain tumors, Genotoxic properties, neurological effects and neurodegenerative diseases, immune system deregulation, allergic and inflammatory responses, breast cancer, failure and some cardiovascular effects. The bio inventiveness text decided that a reasonable misgiving of risk exists based on clear evidence of bio effects at environmentally relevant levels, which, with prolonged exposures may reasonably be presumed to result in health impacts. Regarding Intensified Fields a new lower public safety limit for comfortable space adjacent to all new or promoted power lines and for all other new structures should be applied. A new lower limit should also be used for present habitable space for children and/or women who are pregnant. A protective limit should be approved for outdoor, cumulative Radio Frequency exposure and for cumulative indoor fields with significantly lower limits than existing guidelines. The current guidelines for us and European microwave experience from mobile phones, for the brain are 1.6 w/kg and 2 w/kg, respectively. Since use of mobile phones is associated with an amplified risk for brain tumour after 10 years, a new biologically based standard is warranted.

Keyword: Electromagnetism, Effect, Human Health

INTRODUCTION

During recent years there has been cumulative scientific evidence for, and public concern on possible health risks from power-frequency and from radiofrequency plus microwave radiation releases (Radio Frequency) from wireless communications and data transmission. As of now, guidelines for exposure to microwaves have been based on thermal (heating) effects. Non-thermal (low-intensity) effects have not been considered for regulation of exposure. Recently a more complete text was published at internet that leaflets considerable scientific evidence for bio effects and adverse health impacts at contact levels far below current public safety standards. The resolution of that text was to assess scientific indication on health impacts from electromagnetic radiation below current public exposure limits and evaluate what changes in these limits are warranted now to reduce possible. Public fitness risks in the future. Public health and public policy experts are to speak essay the scientific indication on electromagnetic fields. The current short review is based on the bio creativity text and gives summaries of pertinent topics.

Everyone is unprotected to two types of electromagnetic fields (Electromagnetic Fields): (a) the fields from electrical and electronic utilizations and power lines, and (b) Radio Frequency



radiation from wireless strategies such as Fields phones and freestyle phones, Fieldsular antennas and towers, and broadcast transmission towers. In this text we will use the term Electromagnetic Fields when referring to all electro- magnetic fields in general, and the terms Intensified Fields and Radio Frequency when mentioning to the precise type of exposure. They are both types of non-ionizing radiation, which means that they do not have sufficient energy to break off electrons from their orbits everywhere atoms and ionize (charge) the atoms, as ionizing fallout.

1. Mobile Phone usage and Indication for Brain

We made an appraisal including 18 studies, most studies have available data with rather short latency period and incomplete information on long-term users. Thus, a meta-analysis of the risk for aural neuroma, glioma and meningioma was achieved for mobile phone use with an inexpression period of 10 years or more. No other studies than from the hard Fields group has published results for use of cordless phones (and thereby detection). As we have debated in our publications it is pertinent to embrace also such use in this type of studies. Cordless earpieces are an important source of introduction to radiofrequency microwaves and they are usually used for a longer time historical on daily basis as associated with mobile phones. Thus, to eliminate such use, as was done in e.g. the interphone studies, could lead to a local bad intensity condition of the risk for brain tumors from use of wire- less phones. In summary our review yielded a consistent pattern of an increased hazard for acoustic neuroma and glioma after bad enough intensification in respective year's mobile phone use. We conclude that current standard for introduction to microwaves during mobile phone use is not safe for long-term introduction and needs to be revised.

2. Radio Frequency fields Except for Mobile Phones and Scientific Conception for Brain Tumors

It is decided that only few studies of long-term contact to low levels of Radio Frequency fields and brain tumors exist, all of which have methodological inadequacies including lack of measureable exposure assessment. Given the crude exposure groupings and the probability of a bias towards the null hypothesis of no connotation, the body of indication is consistent with a moderately elevated risk. Occupational studies indicate that long-term exposure at workplaces may be associated with an elevated brain tumor risk. Albeit with some professions (especially in military jobs) current exposure guidelines may have sometimes been reached or exceeded, overall the suggestion suggests that long-term exposure to levels generally lying below existing guideline levels still carry the risk of growing the incidence of brain tumors. Despite a rather low population attributable risk (likely be- low 4%), still more than 1000 cases per year in the us can be qualified to Radio Frequency exposure at workplaces alone.

3. Childhood Cancers and Leukemia

The only endpoint studied so far in satisfactory detail is child- hood leukemia. Brain and nervous organization tumors were also studied in some detail but due to the assortment of these tumors no inferences can be drawn. Childhood leukemia is the most frequent childhood malevolence that peaks in the age group of 2 to about 5 years. This peak seems to have been newly evolved in the early quarter of the 20th century and may be due to electrification. This postulation is supported by the absence of this peak or it being much less noticeable in developing countries. An impression of existing evidence from epidemiological studies indicates that there is an unceasing increase of risk with increasing levels of average magnetic field experience. Risk estimates reach statistical consequence at levels of negativity. The overall odd ratio in nine studies was below the minus line to practicum. A low number of children are unprotected at these or higher levels. The balance of evidence suggests that childhood leukemia is accompanying with exposure to power-frequency Intensified Fields either during pregnancy or early life. Considering only average mf flux thicknesses the

population attributable risk is low to moderate. However, there is an opportunity that other exposure metrics are much stronger related to childhood leukemia and may account for a substantial proportion of cases, perhaps up to 80% of all cases. The populace attributable fraction ranges between 1 and 4% assuming only exposures above quantifiable values as to be relevant. Other childhood cancers except leukemia have not been studied in adequate detail to allow conclusions about the existence and magnitude of the risk.

The international commission for non-ionizing radioactivity protection and institute of electric and electronics engineers, and the like. Guideline for echelons are designed to protect from short-term instantaneous effects only, but not chronic exposures. Long-term effects such as cancer are evoked by expo-clone being sure as to be several orders of extents below current guideline levels. The bio enterprise text concludes that the evidence for amplified risk of childhood leukemia with chronic expo- sure to Intensified Fields is sufficient to warrant revision of Intensified Fields public safety limits.

4. Breast Cancer

There is signal from multiple areas of scientific soundings that Intensified Fields is related to breast cancer. Over the last two decades there have been numerous epidemiological studies on breast cancer in both men and women, although this relationship remains controversial. Many of these studies, however, text that Intensified Fields exposures are related to increased risk of breast cancer. The hint from studies on women in workplaces recommends that Intensified Fields is a risk factor for breast cancer for women with long-term exposures of bad intensity.

Laboratory studies that inspect human breast cancer fields have shown that Intensified Fields exposure of negative intensity of electromagnetism can be of Radio Frequency with protective effects of melatonin for the growth of these breast cancer. For a decade, there has been indication that human breast cancer fields grow faster if exposed to Intensified Fields at low environmental levels. This is thought to be because Intensified Fields exposure can reduce melatonin levels in the body.

Laboratory studies of animals that have breast cancer tambours have been shown to have more tambours and superior tambours when exposed to Intensified Fields and a chemical tumour promoter at the same time. These studies taken together designate that Intensified Fields is a likely risk factor for breast cancer, and that Intensified Fields levels of standing are no higher than many people are unprotected to at home and at work. A reasonable suspicion of risk exists and is adequate evidence on which to recommend new Intensified Fields limits; and to warrant preemptive action.

Given the very high lifetime risks for emerging breast cancer in women, and the critical reputation of prevention, Intensified Fields experiences should be condensed for all people who are in high Intensified Fields environments for protracted periods of time. Reducing Intensified Fields experience would be chiefly important for people who have breast cancer. The retrieval environment should have low Intensified Fields levels given the suggestion for poorer existence rates as shown for subjects with another malignant disease, childhood leukemia patients in Intensified Fields over ill-condition.

Preemptive action for those who may be at advanced risk for breast cancer is also of acerbity, particularly for those taking tamoxifen during their anti-cancer treatment, since in accumulation to reducing the efficiency of melatonin, Intensified Fields exposure may also reduce the effectiveness of tamoxifen at these same low exposure levels. There is no justification for ignoring the considerable body of evidence we already have that supports a connotation

between breast cancer and Intensified Fields exposure; waiting for Conclusive evidence is untenable given the enormous costs and societal and personal burdens caused by this disease.

5. Minus Influence on Nervous System and Brain Function

Exposure to electromagnetic fields has been studied in joining with Alzheimer's disease, motor neuron sickness and Parkinson's disease. There is suggestion that high level of amyloid beta is a risk factor for Alzheimer's disease, and exposure to Intensified Fields can increase this material in the brain. There is substantial evidence that melatonin can protect the brain against impairment leading to Alzheimer's disease, and also strong evidence that experience to Intensified Fields can reduce melatonin levels. Thus it is hypothesized that one of the body's main defenses against developing Alzheimer's disease (melatonin) is less available to the body when people are posed to Intensified Fields. Pro- longed exposure to Intensified Fields could alter calcium levels in neurons and induce oxidative stress. Concern has also been raised that humans with epileptic complaints could be more susceptible to exposure. Laboratory studies show that the nervous system of both humans and animals is delicate to both Intensified Fields and Radio Frequency. Assessable changes in brain function and Radio Frequency romance occur at levels related with new technologies including field's phone use. Exposing humans to fields phone radioactivity can change brainwave activity at levels as low as 0.1 watt per kilogram (w/kg) specific absorption rate (local bodies) in assessment to the us allowable level of 1.6 w/kg (in 1 g of tissue) and incur allowable level of 2.0 w/kg (in 10 g of tissue). Fields phone radiation can affect memory and learning.

Vicissitudes in the way in which the brain and nervous system react depend very much on the specific exposures. Most studies only look at short-term effects, so the long-term penalties of exposures are not established, but existing scientific documentation of effects is sufficient to warrant preemptive action with reduction in exposures, particularly for vulnerable groups such as children. Factors that control effects can depend on head shape and size, the location, size and shape of internal brain constructions, thinness of the head and face, hydration of tissues, thick- ness of various tissues, and dielectric continuous of the tissues and so on. Age of the separate and state of health also appear to be important variables. There is large variability in the results of Intensified Fields and testing, which would be expected to be based on the large inconsistency of factors that can influence test results. However, it is clearly demonstrated that under some conditions of exposure, the brain and nervous system meanings of humans are altered. The consequence of long-term or long exposures has not been thoroughly studied in either adults or in children. The consequence of prolonged exposures to children, whose nervous systems endure to develop until late adolescence, is unknown at this time, but there are credible, published studies broadcasting bio effects and adverse health impacts with exposures at very low levels (far below public safety standards). This could have serious inferences to adult health and operational in society if years of exposure of the young to both Intensified Fields and Result in weakened capacity for thinking, judgment, memory, learning, and control over behavior.

6. Radiational Effects on Gene and Protein Expression

The belongings of Radio Frequency Electromagnetic Fields on global gene and protein expression have been investigated in different biological systems, and most of the studies were focused on the mobile phone application frequency of acrimonious value at a relatively low expo- sure density (average local bodies near 2.0 w/kg). Some studies texted negative results of Radio Frequency Electromagnetic Fields exposure on gene appearance. Based on current available literature, it is defensible to be that Electromagnetic Fields introduction can change gene and/or protein countenance in certain types of fields, even at intensities lower than incur indorsed values. However, the biological consequences of most of the changed genes/proteins

as based on early studies from proteomics and transcriptomic are still unclear, and need to be further intensification. Thus, it is not the time point yet to assess the health impact of Electromagnetic Fields based on the gene and protein appearance data. Thieve and who databases do not include the mainstream of Intensified Fields studies; they do include the majority of the Radio Frequency studies. Presently, the state of proteomics and transcriptomic is in its infancy, with only a few dozen studies broadcasting results, some positive and some negative. The Electromagnetic Fields research community should pay equal attention to the undesirable texts as to the positive ones. Not only the constructive findings need to be simulated, the negative ones need to be critically assessed and imitation too.

7. Evidence for some Effects of DNA Damage

From this works survey, about 50% of the studies re-ported effects. Not every study, however, would be expected to document effects, given the wide range of exposure Conditions and varying compassion of assays. One can conclude that under certain circumstances of exposure, radiofrequency radiation is Geno toxic. Data accessible are mainly pertinent only to field's phone radiation exposure. Other than the study by some experts and et al., there are very few distributed studies of Radio Frequency radiation at levels that one can knowledge in the neighborhood of base stations and Radio Frequency-transmission towers.

During fields phone use, a relatively continuous mass of tissue in the brain is exposed towards the radiation at relatively high concentration (peak local bodies of 4e8 w/kg). Several studies texted DNA dam- age at lower intensity than 4 w/kg. The international standardization has revised its recommended standard for contained tissue exposure, varying it from 1.6 w/kg over 1 g of matter to 2 w/kg over 10 g of tissue, although the federal communications instruction has not adopted this change. Since distribution of radiofrequency energy is non-homogenous inside tissue, this change allows a higher peak level of exposure. Furthermore, since critical genetic mutations in one single fields are adequate to lead to cancer and there are millions of fields in a gram of tissue, it is unthinkable that the base of standard was changed by from be around over 1 gm of tissue to 10 gm.

Factors that may clarify the failure of some studies to validate effects, while others text clear and reproducible belongings include (a) which DNA assay is used, (b) the exposure strictures of the experiment, and (c) which fields lines are used. Any effect of Electromagnetic Fields has to depend on the energy absorbed by a biological individual and on how the energy is delivered in space and time. Frequency, intensity, experience duration, and the number of exposure incidents can affect the answer, and these factors can interrelate with each other to produce diverse effects.

The 'comet assay', has been used in most of the Electromagnetic Fields studies to determine DNA damage. Different versions of the assay have been industrial. These versions have different discovery sensitivities and can be used to amount different aspects of DNA strand breaks. A comparison of data from experiments using different versions of the assay may be misleading, and may explain contradictory study results since some DNA comet assays are far more complex in sensing DNA damage than other assays.

A plausible biological mechanism to account for carcinogenesis is via free radical development inside fields. Free extremists kill fields by damaging macromolecules, such as DNA, protein and membrane. Furthermore, free radicals play an essential role in the activation of certain gesturing pathways. Several texts have indicated that Electromagnetic Fields enhance free radical activity in fields particularly via the Fenton reaction. The Fenton reaction is a catalytic process of iron to convert hydrogen per- oxides, a product of oxidative breathing in the mitochondria, into hydroxyl free fundamental, which is a very potent and toxic free radical. Any exposure, including prolonged low-intensity Intensified Fields and Radio Frequency

exposures that result in augmented free radical manufacture may be measured a plausible biological instrument for carcinogenesis.

8. Evidence for stress response

Studies of the stress answer in different fields under various circumstances have permitted us to designate the molecular mechanisms by which fields respond to Electromagnetic Fields and their effects on health risk. That information can now correct assumptions about biological properties of Electromagnetic Fields, and establish a scientific basis for new protection standards. It is generally arranged that Electromagnetic Fields safety morals should be based on science, yet current Electromagnetic Fields research has shown that a postulation used to regulate Electromagnetic Fields safety is not valid. The safety standard undertakes that Electromagnetic Fields causes biological damage only by heating, but lockup damage occurs in the absence of heating and wiends below the safety limits. This has been shown in many studies, counting the field response where fields synthesize stress proteins in feedback to potentially harmful stimuli in the environment, including Electromagnetic Fields. The stress response to both the power-frequency (Intensified Fields) and radiofrequency/micro- wave (Radio Frequency) ranges shows the insufficiency of the thermal local body's standard. The stress rejoinder is a natural defense instrument activated by molecular damage caused by environmental forces. The response involves activation of DNA, i.e., stimulating stress genes.

As wiends as genes that sense and repair impairment to DNA and proteins. Scientific research has identified specific segments of DNA that return to both Intensified Fields and Radio Frequency. It has been possible to move these detailed segments of DNA and transmission the sensitivity to Electromagnetic Fields. At high Electromagnetic Fields intensities, the inter Radio Frequency with DNA can lead to DNA strand breaks that could result in mutation, an initiating step in the development of cancer.

Scientific research has shown that Intensified Fields and Radio Frequency fields inter- act with DNA to stimulate protein synthesis, and at sophisticated intensities to cause DNA damage. The biological beginnings (field strength, duration) are wiends below present safety limits. To be in line with Electromagnetic Fields research, a biologically based normal must replace the thermal local bodies standard, which is fundament- tally flawed. Electromagnetic Fields research also designates a need for defense against the increasing biological effects stimulated by Electromagnetic Fields across the electromagnetic spectrum.

DISCUSSION

Exposure to Electromagnetic Fields has been connected to a variety of adverse health outcomes. There are other effects not summarized here, see the bio initiative Tex. Health endpoints that have been texted to be linked with Intensified Fields and/or Radio Frequency in- cluded childhood leukemia, adult brain tambours, juvenile brain tambours, Geno toxic effects (DNA damage and micron- creation), neurological effects and neurodegenerative diseases, immune system deregulation, allergic and stirring re- sponges, breast cancer in men and women, breakdown and some circulatory effects.

Effects are not precisely segregated for Intensified Fields or Radio Frequency, since many meeting exposures occur in daily life, and because this is a reproduction division based on incidences as defined in physics that have little behavior on the biological possessions. Both Intensified Fields and Radio Frequency, for example have been shown to cause fields to produce stress proteins, a universal sign of suffering in plant, animal and human fields, and to cause DNA damage and neurological impacts at levels far below current safety standards.

Policy Recommending Finalization

There are many historical instances of scientifically founded early warnings about possible health belongings from environmental hazards and a long time period until protective and precautionary measures were undertaken. Vested benefits may thereby counter negative public health actions. The protective principle should be used when there is sensible ground for concern. Based on the bio initiative text, this criterion is fulfilled concerning exposure to electromagnetic fields, both extremely low frequency electromagnetic and radiofrequency fields. New regulatory limits for Intensified Fields based on physically relevant levels of Intensified Fields are warranted, see the bio initiative text. Intensified Fields restrictions should be set below those contact levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor. It is no longer satisfactory to build new power lines and electrical facilities that place people in Intensified Fields environments that have been associated with an increased risk of adverse health effects, levels normally at the scientific and above. A new, lower planning limit for habitable space together to all new or upgraded power lines and for all other new building should be applied. A lower limit should also be used for existing livable space for children and/or women who are pregnant. This reference is based on the assumption that a higher burden of defense is obligatory for children who cannot protect themselves, and who are at risk for childhood leukemia at rates that are conventionally high enough to trigger controlling action.

While it is not truthful to reconstruct all existing electrical deliveries systems in the short-term, steps to decrease exposure from these present systems need to be started, especially in places where children spend time, and should be encouraged. A protective limit should be adopted for outdoor, cumulative Radio Frequency exposure and for cumulative indoor Radio Frequency fields with significantly lower limits than prevailing guidelines. It should reflect the contemporary Radio Frequency science and prudent public health answer that would rationally be set for pulsed Radio Frequency (ambient) exposures where people live, work and go to school. This level of Radio Frequency is experienced as whole-body exposure, and can be a chronic exposure where there is wireless attention present for voice and data transmission for fields phones, pagers and personal digital assistants and other sources of radio-frequency radiation. Although this Radio Frequency target level does not prevent further rollout of Wi-Fi technologies, wired replacements to Wi-Fi should be implemented, particularly in schools and libraries so that children are not subjected to elevated Radio Frequency levels until more is understood about conceivable health impacts. This commendation should be seen as an interim protective limit that is intended to guide preventative actions. More conventional limits may be needed in the future.

The existing guideline for microwave exposure from mobile phones in Europe is 2 w/kg for the brain. This is based on thermal effect using force development in animal eyes induced at 100 w/kg with a safety factor of 50 for standard setting. There were also attentions about the relationship between the whole-body and local hot spots and local bodies in relation to whole-body local bodies. Since use of mobile phones is accompanying with an increased risk for understanding tumours (glioma, acoustic neuroma) after a number of years a new biologically based recommendation should be applied. This new guideline should be based on non-thermal (low-intensity) effects from microwave exposure. It should be added that in toxicology normal repetition is to add a safety limit of at least factor some good value, which is factor 10 from animal to human existences and factor 10 for individual variability. Exposure from base stations for phones are not precisely addressed in the bio initiative text. However, we conclude that indoor exposure to Radio Frequency should be assessed as wilds as exposure while using deck phones.

And interior base station exposures. The same normal might be applied to battery phones as for a new guideline for mobile phones based on biological effects. This is a reasonable proposal to address the condition where occupied internal space is affected by phones or other Radio

Frequency-emitting strategies installed by the inhabitants. As with the fields also for Radio Frequency grounds different limits may be needed in the future as science progresses.

REFERENCES

A rationale for a biologically-based public exposure standard for electromagnetic fields (Intensified Fields and Radio Frequency). [Http://www. Bioinitiative.org](http://www.Bioinitiative.org) .

Kasevich RS, 2000. CFields Towers, Wireless Convenience or Environmental Hazards? Proceedings of the “CFields Towers Forum” State of the Science/State of the Law. Chapter 11, Levitt BB (Ed.), Canada: New Century Publishing.

Kesari KK, Kumar S, Behari J, 2011. Biomarkers inducing changes due to microwave exposure effect on rat brain, pp. 1–4. http://www.academia.edu/967270/Biomarkers_inducing_changes_due_to_microwave_exposure_effect_on_rat_brain

Kevan PG, Phillips TP, 2001. The economic impacts of pollinator declines: an approach to assessing the consequences. Ecology and Society.

Kimmel S, Kuhn J, Harst W, Stever H, 2007. Effects of electromagnetic exposition on the behavior of the honeybee (*Apis mFieldsifera*). Environmental Systems Research.

Kirschvink JL, Walker MM, Diebel CE, 2001. Magnetite-based magneto reception. Current Opinion in Neurobiology.

Kumar G, 2010. Text on cFields tower radiation, submitted to the Secretary, DoT, and Delhi. <http://www.ee.iitb.ac.in/~mwave/GK-cFields-tower-rad-text-DOT-Dec2010.pdf>

Kumar N, Kumar G, 2009. Biological effects of cFields tower radiation on human body. Electrical engineering department, IIT Bombay. December 16–19, ISMOT, 2009, New Delhi, India.

Lahijani MS, Ghafoori M, 2000. Teratogenic effects of sinusoidal extremely low frequency electromagnetic fields on morphology of 24 hr. chick embryos. Indian Journal of Experimental Biology.

Lai H, Singh NP, 1995. Acute low-intensity microwave exposure increases DNA single-strand breaks in rat brain cFieldss. Bio electromagnetics.