

CHRONIC FATIGUE SYNDROME (CFS) AND SLEEP DISORDERS: EVIDENCE THAT EXTREMELY LOW FREQUENCY MAGNETIC FIELDS AND RADIOFREQUENCY ELECTROMAGNETIC FIELDS ARE FACTORS TO INVESTIGATE IN TREATMENT

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Overview

A 2019 report to the Australian NHMRC found that 66% of research on Chronic Fatigue Syndrome (CFS), also referred to as Myalgic Encephalomyelitis (ME) was on managing the condition, 17% was on finding the cause for the condition, 10% on prevention and 7% on multiple areas. Besides a number of recommendations, the committee recommended “building research quantity and capacity, improving health services research and developing health advice.” (1)

It is estimated that 50 -70 million Americans chronically suffer from a sleep and wakefulness disorder which hinders their daily functioning and adversely affects health and longevity (2). In Australia, a 2016 sleep health survey found that inadequate sleep affects 33-45% of adults, across all age groups.(3)

As one of the symptoms of CFS is insomnia and other sleep disorders, any common factor in these conditions should be of research interest. Australia is in an excellent position for such research. For example, the *National Centre for Neuroimmunology and Emerging Diseases*, based at Griffith University, Qld. and part of the *Menzies Health Institute Queensland*, has a research focus on the causes and mechanisms of ME/CFS, identifying biomarkers of the condition and improving patient outcomes in the area of preventative medicine, social and clinical care and public health. (4)

According to a literature review by Henry Lai, bioengineering Professor Emeritus at the University of Washington and Editor-in-chief of *Electromagnetic Biology and Medicine*, the biological effects of extremely low frequency (ELF) electromagnetic fields (which range from 0 - 300 Hz) (5) and radiofrequency electromagnetic fields (RF-EMF) (from 30 kHz to 300 GHz) (6) are very similar, with both including sleep problems (7). Lai concludes that there is a basic mechanism of interaction between biological tissues and artificial electromagnetic fields that

is independent of frequency (8). This finding brings into question the assurances of safety claimed by various national and international exposure standards.

In a paper published in *Molecular Medicine* in 2010, researchers led by Swedish oncologist Lennart Hardell, found evidence that an enzyme (β -trace protein), essential in the formation of a sleep-promoting neurohormone in the brain may be down-regulated by RF fields. The authors suggest that this effect may be a factor in sleep disturbances reported in people exposed to RF fields (9).

LIMITATIONS OF THE OFFICIAL EXPOSURE STANDARDS

1) MAINS POWER FREQUENCY 50 HERTZ MAGNETIC FIELDS (ALSO CALLED EXTREMELY LOW FREQUENCY FIELDS-ELF)

Australia currently does not have a national exposure standard for exposure to mains power frequency magnetic fields but follows the limits recommended by the NGO professional body, the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Following the advice from ICNIRP, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) states in part, *there is no established evidence that the exposure to magnetic fields from powerlines, substations, transformers or other electrical sources, regardless of the proximity, causes any health effects* (10). However this claim is brought into question by the International Agency for Research on Cancer (IARC) who in 2001 evaluated the evidence linking ELF-EMF to cancer and classified it as a Group B possible human carcinogen (11)

2) RADIOFREQUENCY FIELDS

Relying on the ICNIRP guidelines for RF, ARPANSA has established a standard for exposure to radiofrequency fields, including the microwave range. These limits are designed to avoid proven harmful biological effects from exposure to RF fields. This is meant to provide protection against internal tissue heating from short-term exposure to high levels of RF. Other possible biological effects, not related to heating, are not taken into consideration in setting guideline recommendations. According to ARPANSA; *there is no established scientific evidence to support any adverse health effects from very low RF EME [Electromagnetic Energy] exposures to populations or individuals... no health effects are expected from radio frequency exposures below the limits set in the ARPANSA standard* (12).

This claim is also questioned in light of the IARC in 2011 evaluating RF fields (at levels far below the ICNIRP limits), as a class 2B possible human carcinogen (13).

The problem for the above guidelines/standards for ELF and RF fields is that they were designed to protect against immediate adverse health effects and are not intended to provide protection against possible cancer induction and other biological effects from prolonged exposure at levels below ICNIRP's limits (14).

WHERE THE STANDARDS DO NOT GO

1) HEALTH EFFECTS OF ELF MAGNETIC FIELDS

In 1994, Australian Democrat Senator Robert Bell (Tasmania) tabled a report in the Australian Senate examining the evidence that the national and international exposure standards for human exposure to electromagnetic fields were insufficient to provide an assurance of safety. Part of this report looked at Chronic Fatigue Syndrome and suggested that prolonged exposure to 50-Hz power frequency (extremely low frequency) fields may be one of the causative factors in the condition (15).

This hypothesis was strengthened in 1998 by a number of patient case studies compiled with the assistance of several doctors connected with the Australasian College of Nutritional and Environmental Medicine (ACNEM). These case studies indicated that prolonged exposure to environmental level powerline frequency magnetic fields appeared to be capable of causing CFS symptoms and insomnia, at least in some people (16).

In February 1999 a Victorian Workers Compensation Case from 1991-1992 was obtained by this writer from the office manager at *Ross House*, 247-251 Flinders Lane, Melbourne. This case examined a number of workplace illnesses affecting female office workers at Ross House, which were diagnosed as Chronic Fatigue Syndrome (CFS). The Workcare investigation found that excessive electromagnetic fields from a large electrical substation directly below

the office building where the women worked were the common factor in the symptoms reported by all of the women. The symptoms were:

Chronic tiredness / fatigue, insomnia: waking around 3 am with an inability to go back to sleep, stress, an inability to concentrate, fluctuating hormone levels, anaemia, a facial rash, depression, severe premenstrual tension, a feeling of listlessness, light headedness, "a permanent severe case of jet lag"

When the women stopped working in that office, virtually all of the symptoms stopped. A full copy of the Workcare files on this case is freely available online (17).

POWER TRANSMISSION LINES AND PSEUDO IRON DEFICIENCY (PID)

In 1991, as a result of public protests, media attention and a number of court cases over possible health hazards from the twin 400 kV transmission lines built in close proximity (0 -100 Meters) to the French village of Coutiches, near Lille, the national power supplier, Electricite de France, agreed to fund regular medical check-ups for a number of residents who lived close to the lines. A total of 117 residents had a check-up and blood analysis every six months. The initial findings, presented at the *Assemblée Nationale* in 1994, reported the following symptoms in the group:

General tiredness, (chronic fatigue), headaches, hypernervosity, hypotension, iron deficiency (later identified as pseudo iron deficiency), 2 cases of severe anxiety / depression, 1 bone marrow cancer death in 1992, nausea and dizziness, insomnia - especially in children. It was noted that the children's insomnia would disappear when the power (and magnetic fields) was lower than usual and return when the power got back to full level. The children often could not sleep at all and often were sent to relatives' homes, where they could normally. (18)

Similar symptoms were also found in a 2008 community survey by the French organisation *Criirem*. Sleep disturbance, memory problems, headaches, irritability and depression were significantly more frequent amongst those living close to two transmission lines than in those living further away (19).

In 1994-95 while working in a hospital in Lille, France, Dr. Eric Hachulla and colleagues noticed a number of patients whose blood analysis showed a previously unknown condition. All had addresses in one area – Coutiches, and all lived close to the controversial 400-kV transmission lines. A small-scale study was arranged consisting of 31 men, 34 women and 26 children living less than 200 metres from the lines. The control group were recent blood donors at the Lille blood transfusion centre, who did not live close to the lines. Most of the people living close to the lines, with magnetic field exposures of

2.0 mG (0.2 mT) or more, had a blood condition characterised by low serum iron levels, but no symptoms of anaemia, hemoglobin levels were normal, iron stocks were normal in most cases with no decrease of ferritin, which normally is associated with an iron deficiency. Hachulla called this “pseudo iron deficiency”(PID) and felt that the findings were quite robust and clearly demonstrated an objective, measurable biochemical effect of living near transmission lines. The abnormal blood condition returned to normal when people moved away from the lines, but this took several months. The same effects were seen in people living in another town, Bolezeele, near similar transmission lines.

Hachulla concluded that EMFs may modify iron metabolism in populations subjected to 2 mG (0.2 mT) or more, with a high bone marrow incorporation of the iron (which would explain the low serum iron level) and a rapid metabolism of haemoglobin, sometimes with non-incorporation of iron (Fe) in the liver (20).

In early February 2002 a copy of the Hachulla paper and transcripts of conversations with Eric Hachulla were given to Analytical Reference Laboratories Pty. Ltd, Melbourne Australia for their advice on testing for PID. The laboratory said that it was a relatively simple test to conduct (21). However, no follow-up research has yet been done.

The implication of the French findings is that the blood condition of PID may be an easily verifiable biological marker for ELF power-frequency electromagnetic field exposure down to a prolonged 2 mG (0.2 mT) exposure, a level found in many living and working environments. Will PID also be found with chronic RF exposures as well? No research has yet been conducted to investigate this possibility.

THE AUSTRALIAN CHRONIC FATIGUE SYNDROME (CFS) INVESTIGATION

In December 1998, a paper was published in the Journal of the Australasian College of Nutritional and Environmental Medicine (JACNEM) on the possibility that impaired immune function associated with CFS may in some instances be linked to chronic low-intensity exposure to extremely low frequency (ELF) electromagnetic fields. The authors concluded that although the link between ELF EMFs and cellular dysfunction was far from proven, sufficient evidence existed to suggest a causal link, and that this should be included in treatment options (22).

Following this line of inquiry, a pilot study was funded, the findings of which were published in the *ACNEM Journal* in April 2002. This study examined the power frequency magnetic field exposures of a group of 49 patients who were being treated for CFS by medical practitioners. None of the participants identified as electrosensitive and none felt that exposure to electromagnetic fields was a possible factor in their illness. The researchers identified 14 of the 49 subjects with prolonged (mainly night-time) home exposures over a 2 mG (0.2 mT) benchmark level. After excluding three for failing to meet the

study criteria, 11 subjects were left with an average prolonged night-time exposure level of 7.1 mG (0.71 mT), and were designated as the exposed Group A. Group B, the control group, consisted of 35 of the 49 subjects who had an averaged night time EMF exposure of 0.67mG (0.067 mT).

Action was taken to reduce Group A's exposures to under 2 mG (0.2 mT) and no such advice was given to Group B. Both groups were followed for six months. 55% of Group A reported a definite improvement in their symptoms, while 14% of Group B reported a definite improvement in health. 64% of Group A reported improvement in sleep quality while 12 % of Group B reported an improvement in sleep quality. The findings of this study indicated that prolonged nighttime ELF magnetic field exposure of 2 mG and over (+ 0.2mT) may interfere with sleep and that reducing exposures may improve sleep quality (23) (24).

2) RADIOFREQUENCY (RF) FIELD EXPOSURES

STUDY ON HEALTH EFFECTS OF THE SHORTWAVE TRANSMITTER STATION OF SCHWARZENBURG, BERNE, SWITZERLAND (MAJOR REPORT)

In 1939, a short-wave RF transmitter was installed at Schwarzenburg, near Berne. Another antenna was added in 1954 with three 150 kW outputs (6.1-21.8 MHz) and a 250-kW antenna was added in 1971. Health complaints associated with this activity have been reported by the population in the surroundings of the transmitter since the seventies. In March 1990 a petition seeking scientific evaluation of the health damage allegedly caused by the transmitter was handed to the Swiss Federal Department of Traffic and Energy (SFDTE). In October 1990, the Head of SFDTE commissioned a study. In August 1995 the study reported significant changes in various indicators, increasing with proximity to the mast and significantly worse in elderly people. Symptoms included increased nervousness, restlessness, difficulty in falling asleep and maintaining sleep, general weakness, tiredness and joint pains. The conclusion was:

"Insomnias and joint pains, especially in the elderly, were more frequently reported in Zone A than in Zones B and C (decreasing exposures with increased distance). They showed a dose-response relationship with the logistic regression and they were not related to a health-worry personality. Further studies are of need to establish a biophysical mechanism.... "Our results indicate a higher frequency of disorders of a neurovegetative nature among residents up to about 1000 m from the transmitter, and are highly suggestive of a direct effect of the radio shortwave transmitter on sleep quality. The other complaints appear to be mediated by the sleep disorder" (25).

GERMAN REVIEW OF THE RUSSIAN ELF AND RF MEDICAL RESEARCH LITERATURE 1960-1996 (ELF AND PREDOMINANTLY RF EXPOSURE)

In 1997 Karl Hecht and Hans-Ullrich Balzer from the Institute of Stress Research, Berlin, were

commissioned by the German Federal Ministry for Postal Services and Telecommunications to compare the difference between West European and the former Soviet Union EMR standards. They reviewed 1,500 papers from the Russian medical research literature 1960 to 1996. This research predominantly consisted of medical examinations carried out by company physicians, involving several thousand industrial workers subjected to electromagnetic fields from sources including radar stations and high-voltage electrical substations. The period of exposures ranged up to 20 years, with a large list of conditions seemingly related to exposure and length of exposure. Commonly reported were sleep disorders and Neurovegetative Asthenia (26) (27). In July of 1997 this author communicated with Hans-Ullrich Balzer who replied with the following:

We can affirm that similar effects like CFS were described in many Russian investigations ... Because CFS was unknown at that time in the CIS (Soviet Union) ... it was named a lot of times as Neurovegetative Asthenia (28).

RF FROM ADVANCED METERING INFRASTRUCTURE (AMI) ALSO CALLED SMART METERS

The Victorian Government mandated the roll out of smart meters in 2006. When the rollout began in 2009, newspaper articles soon started appearing about people claiming that ever since a smart meter was installed on their home they were having health problems, primarily insomnia and tinnitus – especially when the meter was close to the bedroom. Proponents of the rollout responded that smart meter transmissions were brief, infrequent and thus incapable of causing health effects. However, a document from Pacific Gas and Electric (USA) showed that a smart meter network running over a 24-hour period actually emitted up to 190,000 transmission pulses (29) and measurements in a Melbourne home with a recently installed smart meter also found brief but very frequent RF transmissions (30).

Little or no research has been done on the possible health impacts of prolonged proximity to this completely new source of RF radiation (31). A rare exception is the 92-case study by Melbourne medical practitioner Federica Lamech, published in the US clinical journal *Alternative Therapies in Health and Medicine*, which reveals that the most commonly reported symptoms from exposure to wireless smart meters were insomnia, headaches, tinnitus, fatigue, cognitive disturbances, dysesthesias (abnormal sensations) and dizziness, and that the effects on people's lives were significant (32).

RECOMMENDATIONS

With the rapid development of new communications technologies, such as smart phones, smart electricity grids, the 5th generation (5G) communications network and the Internet of Things (IoT), where thousands of devices will be wirelessly connected with a densification of small cell antennas, human

exposure to radiofrequency fields will continue to increase (33, 34). In addition, a recent research review paper by Dimitris Panagopoulos (University of Athens) published in *Mutation Research* indicate that the increasingly complex wave forms emitted by wireless technology may be significantly more bioactive and damaging even for shorter exposure durations (35).

It is unfortunate that the vast bulk of research on the possible biological effects of radiofrequency fields has focused on heating effects, with the official exposure standards limited to this consideration. As a result of this limitation, scientific data on possible biological effects not related to tissue heating has been largely discounted as it fails to conform to the standard's thermal emphasis.

There now is an urgent need for independent research in this area which has been recognized by Australian National Register of Environmental Sensitivities (ANRES). ANRES is creating a national register on the prevalence of environmental sensitivities (ES) from both chemical and ELF/RF sources in order to provide evidence to highlight the need for recognition and assistance for those affected (36, 37).

A failure to undertake this research, based on reliance on thermally based standards should itself be considered a potential risk to public health in Australia.

<https://www.emfacts.com/papers/>

BIOGRAPHY

Don Maisch has been directly involved in standard setting specific to possible health effects from exposure to electromagnetic radiation (EMR) since 1993.

He has served on the Standards Australia committee for telecommunications EMR exposure standards and was a consultative committee member for a revised Australian government powerline exposure standard (now concluded). In 2010 he received a PhD from the University of Wollongong for his thesis on conflict of interest and bias in telecommunications standard setting. He has published a number of papers in the ACNEM Journal on various health aspects of EMR exposure.

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