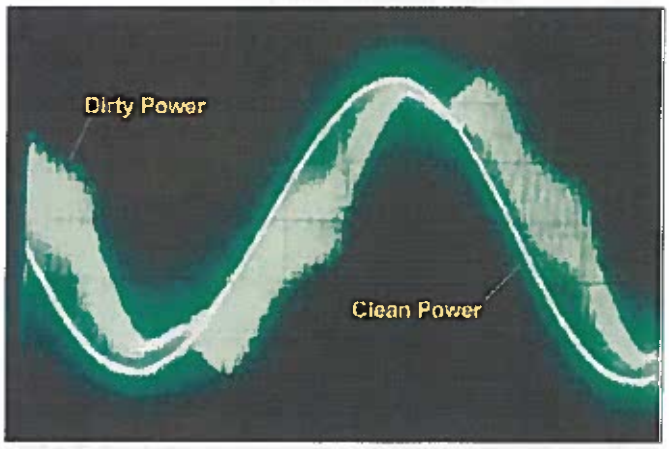

The health effects of electrical pollution

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The health effects of electrical pollution

Americans are surrounded by electrical devices – computers, VCRs and a plethora of household gadgets and consumer appliances. There is also the assumption that the electricity (and associated electrical phenomena) are safely confined to the wires carrying electricity and to the electrical devices themselves.

For a variety of reasons, including the very design of the electrical distribution system, this assumption is no longer valid.

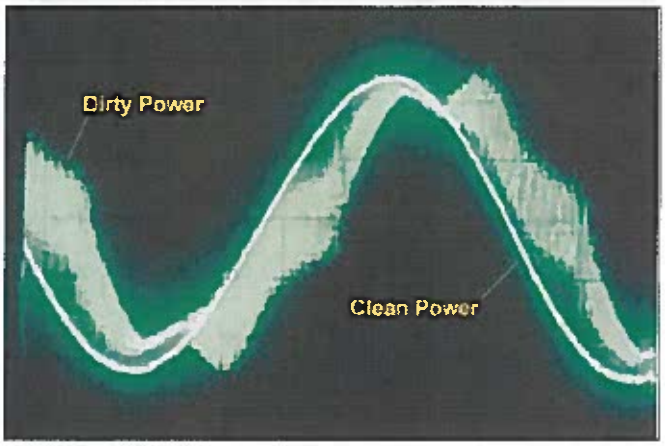
Electricity is a trusted component of contemporary civilization. Few notice the poles, wires, substations and transformers that deliver electricity. Fewer still pay any attention to the hidden lattice of wires in the walls of homes, offices, churches, factories and schools.

Yet all contribute to an increasingly dangerous electrical environment that has largely escaped systematic monitoring. The increased demand for electricity, and the proliferation of computers and other electronic devices have markedly increased our exposure to electrical phenomena. These phenomena are a ubiquitous presence in our lives, albeit invisible and odorless.

There is the widespread (and mistaken) assumption that our electrical environment has been carefully studied and monitored and, save for a few exceptions, found to be harmless.

The truth is that the millions of Americans live and work in environments that subject them to a variety of harmful electric phenomena.

One of the most potent contaminants is radio-frequency radiation.



The green area in the oscilloscope display shown above represents 'dirty' power that contaminates normal (60 Hertz) electricity.

'I have no doubt in my mind that at the present time that the greatest polluting element in the earth's environment is the proliferation of electro-magnetic fields. I consider that to be far greater on a global scale than warming... '
Robert O. Becker, M. D., Author of Cross Currents *and* The Body Electric:

Radio-frequency radiation

Of particular concern is the high-frequency current created by computers and other electronic devices, which is often called "dirty current." This current is created by numerous devices and is conducted nearly everywhere. The wiring in buildings then acts as antennae for the current, silently and insidiously assaulting those who play and work nearby.

In other words, the wires that deliver electricity have also become conduits for deadly high-frequency radiation, a form of electrical pollution that has largely escaped attention by the medical community.

The increased prevalence of this radio-frequency current has coincided with an alarming increase in the prevalence of ailments such as fibromyalgia, chronic fatigue syndrome, attention deficit disorder, diabetes and asthma.

Innumerable studies have shown there is no "safe" level of exposure to radio-frequency current, which now routinely flows through the wiring of homes, schools and offices. It is a deadly "byproduct" of our electronic age.

Pervasive and deadly

Electrical pollution is indiscriminate. It affects young and old, women and men, mothers and infants, the rich and poor, secretaries and farmers, doctors and lawyers, factory workers and scientists.

Until its unsuspecting victims take action to reduce their exposure, symptoms worsen. There is no relief, no cure, no hope. Lives become a numbing maelstrom of despair and a desperate attempt to alleviate symptoms.

The harmful biological effects of exposure to electrical pollution have been established in numerous studies conducted during the past 50 years. Several countries have established

standards limiting exposure to EMF, "dirty" current and other sources.

In the United States, however, environments are seldom monitored for electrical pollution. The limited standards governing "dirty" current, for example, are applied only in industrial settings, and then only when levels are high enough to affect computers, motors and other equipment.

Until recently, people had no way of monitoring levels of dirty current in the environment. The introduction of a relatively inexpensive meter that could be plugged into a conventional outlet to monitor levels of this current led to some startling revelations.

Hundreds of people found that their health problems worsened during exposure to dirty current, and that they were exposed to this current in a variety of locations. The invention of a convenient filter that removes radio-frequency radiation provided noticeable and immediate relief to thousands of people. Some have managed to create or find environments where the levels are lower. However, most have found it impossible to find environments where levels are uniformly safe. .

The following selected accounts are just a few of hundreds of similar stories that dedicated investigators have encountered during the past four years. It should be remembered that these investigations occurred outside the framework of institutional support that usually funds studies of this type.

The integrity of these investigators is beyond reproach. They conducted these studies at considerable personal and financial sacrifice. They were conducted by investigators who have desperately sought to have the scientific and medical community thoroughly and systematically investigate their concerns.

Their requests have been ignored. Instead, they have often been subjected to scathing criticism and ridicule.

Most of those who have learned that their health has been adversely affected by electrical pollution had previously engaged in a lengthy, fruitless and costly search to ascertain the source of their ailments, and to seek relief.

They were increasingly debilitated by their ailments, though they sought the best medical advice they could afford. They became discouraged and desperate as they lost the ability to function as productive members of society. Many face impoverishment. They were caught in a vortex of despair, whose causes seemed beyond the reach of science. Some of these conditions acquired labels. Others didn't.

There was no relief beyond palliative care. A cure seemed beyond hope.

All experienced remarkable improvements in their conditions after removing radio-frequency current from their household wiring.

Symptoms of exposure to radio-frequency radiation (radio wave sickness)

Neurological: headaches, dizziness, nausea, difficulty concentrating, memory loss, irritability, depression, anxiety, insomnia, fatigue, weakness, tremors, muscle spasms, numbness, tingling, altered reflexes, muscle and joint paint, leg/foot pain, "Flu-like" symptoms, fever. More severe reactions can include seizures, paralysis, psychosis and stroke.
Cardiac: palpitations, arrhythmias, pain or pressure in the chest, low or high blood pressure, slow or fast heart rate, shortness of breath.
Respiratory: sinusitis, bronchitis, pneumonia, asthma.
Dermatological: skin rash, itching, burning, facial flushing.
Ophthalmologic: pain or burning in the eyes, pressure in/behind the eyes, deteriorating vision, floaters, cataracts.
Others: digestive problems; abdominal pain; enlarged thyroid, testicular/ovarian pain; dryness of lips, tongue, mouth, eyes; great thirst; dehydration; nosebleeds; internal bleeding; altered sugar metabolism; immune abnormalities; redistribution of metals within the body; hair loss; pain in the teeth; deteriorating fillings; impaired sense of smell; ringing in the ears.
(excerpted from *No Place To Hide* by Arthur Firstenberg, April 2001)

Dr. Martin Graham, emeritus professor of computer science and electrical engineering, University of California, Berkeley, and inventor of a filter that removes radio-frequency radiation from household wiring.

A public health crisis

A basic precept of science developed in the 14th century is known as Ockham's razor, which can be paraphrased as accepting the theory that results in the most accurate predictions.

The symptoms associated with overexposure to radio-frequency radiation (also known as radio wave sickness) clearly describe the symptoms associated with many of the supposedly inexplicable ailments that have become more common in recent decades.

The relationship between exposure to radio-frequency radiation and these ailments clearly warrants additional independent investigation.

Investigations of human health concerns and electrical pollution are now left solely to the discretion of electrical utilities. This is unacceptable and is unlikely to change. In Wisconsin, for example, state health officials have not undertaken a single investigation of the health complaints of farm families with concerns about electrical pollution, even though these families have requested such an investigation for almost 30 years.

Any discussion of electrical phenomena involves terms that are unfamiliar to most people. This is true in any detailed discussion of a scientific topic. However, it poses a particularly formidable obstacle to the public's understanding of the problem because the issue is often framed exclusively in technical language. This has proven to be a formidable barrier in attempts to draw public attention to the issue, especially as the objectivity of many investigators is in doubt.

It need not be this way. Electrical pollution is analogous to water pollution. "Clean" water enters our households and it leaves via a separate route after it becomes "dirty." The same is true of electricity, only the contaminated current doesn't leave via a separate route. Instead, it has been allowed to intermingle with clean current – and has been allowed to enter the environment by a variety of paths.

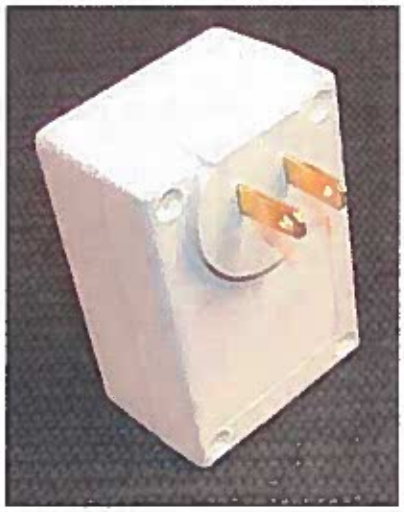
As with polluted water, there are several electrical pollutants. They have synergistic effects. Examining each in isolation fails to accurately assess their harmful biological effects.

While there are legitimate concerns over what levels and types of electrical pollution are acceptable, there is no uncertainty over the fact that electrical pollution is present in our environment -and no uncertainty whatsoever that there is no safe exposure level for radio-frequency radiation.

The most immediate concern is to develop methods to eliminate or prevent exposure to harmful levels. Also, health officials should be encouraged to utilize the instruments that accurately measure electrical pollution and develop the appropriate protocols for their use. This should not be left to the electric utilities.

Time to begin

This is an auspicious time to begin such an effort because investigators with the academic credentials and technical competence have already created much of the foundation for this work. Such investigations would be prohibitively expensive if these resources were not available. Moreover, even if the resources were available to fund these investigations



The "Stetzerizer," the Graham/Stetzer original filter that can be plugged into household electric receptacles to remove radio-frequency radiation.

(which would initially require hundreds of thousands of dollars), the objectivity of the results would be subject to question unless (as is now possible) the complete independence of the investigators could be assured.

The following general factors should be considered when considering the experiences of victims of electrical pollution:

• They involve a wide variety of health concerns. In medicine, this often detracts from credibility as researchers increasingly seek to link specific disease agents or factors with specific ailments. However, the accounts are consistent with the pervasive assault on the immune system characteristic of electrical pollution, and with the heterogeneous nature of electrical phenomena, and the wide divergence in routes and duration of exposure.

• Seldom is there a complete reversal of symptoms or a "cure." This appears to reflect the inability to achieve an environment free of electrical pollution.

• Electrical pollution exacerbates many health conditions, although there appears to be a cluster of symptoms common to all forms of overexposure.

•There appears to be a "threshold" of exposure, after which recovery becomes more problematic and sensitivity increases.

•The medical community seldom, if ever, considers electrical pollution in the etiology of ailments.

• "Stray voltage" research, which involves the short-term exposure of cows to low levels of "clean" electricity is not germane to the human health concerns addressed here, even though it has often been cited as "proof" that electrical pollution has no adverse effects on human health.

• Many of those affected by electrical pollution require immediate relief. The most relevant test of whether electrical pollution is a human health concern is to provide an environment that is free of all sources of electrical pollution. The particular levels and routes of exposure that are of most concern in each environment can be addressed later.

• Providing an environment that is free of electrical pollution would be the simplest, least expensive (and most powerful) test of the hypotheses concerning the relationship between electrical pollution and the adverse effects on human health.

Dan Hager

Dan Hager, 50, is a large man, whose joviality belies the health problems that doctors said were supposed to have killed him by now.

He's had a variety of occupations, including stints as a welder, machinist and driving trucks and buses. He had no history of serious health problems when, eight years ago, he was nearly crippled by aching joints and pain in the lower back. There were times when his feet were so sensitive he could barely walk. He would often inexplicably lose his balance and fall.

Numerous doctors were unable to ascertain the cause of his health problems, although all agreed that his health was deteriorating. Hager eventually was prescribed 12 medications for pain, swelling, seizures and depression in an increasingly futile attempt to stay healthy enough so he could maintain the campground he and his wife, Marge, operated in central Wisconsin.

Two years ago, a neighbor recounted how her health improved after she installed filters to lower levels of electrical pollution. After studying the information she provided, Hager realized his symptoms mimicked those of radio wave sickness, right down to the pain in his teeth. Hager decided to try it himself, and made several filters.

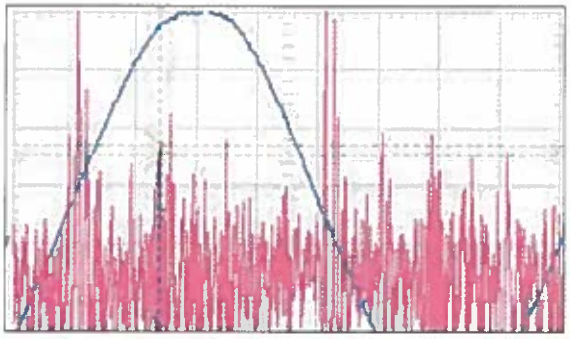
"Right away, I felt more energetic. The headaches went away and my sleep was more restful." he said. He was no longer plagued by sleep apnea and no longer prone to losing his balance. He subsequently reduced the number of prescriptions to four.

Doctors were never able to identify the cause of his ailments, although some predicted he would never recover the mobility and strength he lost and predicted that the deterioration would progress. One ascribed his ailments to

Relief after receiving medical treatment for electrocution.

nerve damage. Hager concurs with the diagnosis.

Hager believes his nerves were damaged by the flow of current through his body. He links the start of his health problems to a change in the electrical distribution system in the area to accommodate the increased demand for electricity. Then, too, the campground is next to a lake in a low-lying region, conditions that favor the flow of electricity through the ground. Hager has employed several methods to reduce ground currents, but none are completely effective.



The illustration above, which shows the high frequency current riding on the 60-cycle waveform, was measured in a classroom occupied by a teacher who recently died of a brain tumor. The teacher in the adjoining room had recently died from leukemia. Dr. Vitaly Reznik, professor of hygiene and epidemiology in the Republic of Kazakhastan and an expert on the effects of radio-frequency radiation, said the energy contained in the waveform was twice that considered safe by that nation's standards, which are based on 'high-frequency components that known to cause an array of health problems in humans,' including cancer and leukemia.

His pain was alleviated after a doctor treated him for injuries usually associated with electrocution. Hager has purchased several oscilloscopes and tries to help neighbors understand the risks posed by electrical pollution.

He had back surgery in 1998 and was very slow to recover. "It took two months to be able to walk out the front door and go about 30 feet," he says. He attributes the slow healing to electrical pollution.

His sister has been diagnosed with rheumatoid arthritis and struggled for almost a year while doctors tried to find the right medications for her. Many were ineffective and had undesirable side effects. Dan measured the radio frequencies in her home and installed filters a year ago. Her mobility has improved, there's less swelling in her hands and she sleeps much better. "Her doctors " can't believe how well she's doing," Dan says. She attributes her improved health to the filters.

Catherine Kleiber

Catherine Kleiber's serious health problems began in 1996, six months after moving to a farm she and her husband, Dan, operated in southern Wisconsin. She was 23 and until then, hadn't experienced any serious health problems. Both were recent graduates of the University of Wisconsin-Madison.

The symptoms initially included a sore, dry throat, fatigue, and a low-grade fever and chills. She was unable to concentrate. Doctors couldn't identify a cause. Tests for throat infections were negative. Three years later, she was diagnosed with chronic fatigue syndrome.

Catherine noticed unusual patterns in her symptoms. They were worse at certain times (on Saturday night and Sundays, for example) and during certain weather conditions (worse when it rained, better during droughty conditions). There

Continued on page 6

One school's experience

When filters were installed in an elementary school in Wisconsin recently, staff members quickly noticed a remarkable difference in how they felt and an improvement in the behavior of the students.

The guidance counselor at the school said the migraine headaches she had experienced six months after starting to work at the school disappeared. She also discontinued her allergy medication.

"I feel more motivated and refreshed to do my job in the best manner I can. Overall, I feel our students and staff have greatly benefited from these filters. I hope that someday all school districts in Wisconsin will be required to have their schools tested and filters installed if the need is there," she wrote.

"Ever since the filters were installed in the building I have been feeling much better. I do not get headaches and I do not feel tired all the time. Also, I have more energy than before the filters," wrote Ruth Pfaff, the school secretary.

Lisa Gunderson, a teacher at the school for five years, said she had experienced numerous health problems since she started working at the school, including "extreme fatigue, headaches, forgetfulness, and increased anxiety over minor happenings." A doctor prescribed anxiety medication, which did not relieve the symptoms.

"I had considerable doubts about electrical pollution being the reason for these symptoms but was pleasantly surprised and extremely pleased to find relief a short time after filters were installed in our building. I am not currently taking any medications and am feeling great. My symptoms are no longer present and I have not had any changes in my work habits or lifestyle," Ms Gunderson wrote.

Shanon Rodenberg, also a teacher, wrote that she did "not have the same asthma symptoms" after the filters were installed.

"The other thing I have noticed is my memory is better," she wrote.

Constance M. Alvin, The reading specialist at the school for 10 years said she had experienced "fatigue, headaches, stress, and general feelings of malaise throughout the school year, with the end of the year being the most unpleasant. These changes were pronounced enough to prompt my husband to comment each year that when June came around he would get his 'real wife' back."

Soon after filters were installed, she noticed she was not as fatigued after parent-teacher conferences in January and March, and her concentration improved.

"I have not changed my work habits or anything in my personal life that would contribute to these changes I have noticed," she wrote

Mindoro Elementary School, N181 State Rd. 108, Melrose, WI 54642; (608) 857-3410

A nurse's perspective

Char Sbraggia, the nurse for the school district, wrote that there has been a remarkable decline in the severity and incidence of asthma among students after filters were installed.

Many students previously required nebulizer treatments once or twice a day while at school, she wrote. During the year after filters were installed, she didn't administer one nebulizer treatment and "of the 37 students with inhalers, only three of them use the inhaler for their exercise-induced asthma before Phy Ed," she wrote.

"Teachers are stating they are less fatigued and tired," she wrote. "The sense of smell came back for me. I lost it for three years and the doctors said it was my allergies."

She also reported that students "seem to have more energy and seem less tired." Members of the staff also report a reduction in their use of allergy medications and in the incidence of migraines.

One teacher's experience

November 30, 2003

My life changed one year ago.

The past 3.5 years of my life are filled with sad memories of serious health problems. The list of my symptoms includes fatigue, memory loss, facial flushing, headaches, numbness, loss of taste and smell, eye irritation, sleep disturbances, double vision, sinus infections, and bronchitis.

These health conditions began when school started and gradually went away throughout the summer months. I missed more school in one year than I had in the previous 10 years of teaching. I went from doctor to doctor searching for answers. I had two MRI's of my brain, blood tests, neurological examines and yet no answers. I went to my optometrist, chiropractor, allergist, general practitioner, and neurologist. Everyone was concerned, but no one had any answers. So my life went for the next three years. I was finally diagnosed with benign MS.

My students suffered. It was a 50-50 chance I would call them their correct names. The days and weeks blended into a time in my life I barely remember except for the pain of being me. I was so busy trying not to fall when I went for a walk while I had double vision I missed the sights of spring. For years I would go to bed by 6 p.m. so I could get up for school the next day. I was always exhausted. Last year my headaches were so severe I didn't make it a complete week for the first three months of school. I was miserable. I had decided at that point I would give up teaching in hopes of getting my good health back.

The only people I let into my sad little world were my parents and brothers. Everyone felt helpless. When I went to bed at night I would often cry in my pillow to hide the true fear I felt. I was trapped in a horrible world with no hope in sight.

One year ago everything changed.

Continued on following page

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My school brought in Mr. Dave Stetzer, a power quality expert. He identified problems in our electrical environment. Mr. Stetzer filtered our school to eliminate the dirty electricity riding on the line. My headaches stopped immediately and so did the exhaustion that was my life. My health from that point has been wonderful. People who know me best see me as a new person. A person they use to know, but hadn't seen for years. All signs and symptoms of benign MS are gone. The health concerns that once consumed my life are no longer an issue. I once again enjoy life.

I attribute this change in my life to the filters that surround my world. The filters that eliminated the electrical pollution we are all exposed to every day, everywhere. I have found filters to be a simple solution that changed my life and a countless number of people I know.

I am forever thankful to have my life back!

Angela Olstad
Teacher/Principal
Olstad@mel-min.k12.wi.us

The state health department had attributed the problems at the school to mold and undertook two projects, costing more than $100,000, to correct the problem, with no discernible decrease in the health problems at the school. The cost of the filters — $18,000 for three buildings, Olstad says.

People tend to take her account seriously, she says, because they remember how sick she was just a year ago when her face always had a purplish-red tint.

She has asked officials with the state to investigate her concerns and to consider taking similar action in other schools around the state. She has not received a reply.

Utility representatives have criticized the school's actions as a waste of money.

Continued from page 4

seemed no logical reasons for those patterns until she realized that they coincided with periods of peak electrical demand and changes in soil conductivity.

Catherine learned about the relationship between her condition and electrical pollution after reading an article in an agricultural publication about farmers' attempts to deal with so-called "stray voltage."

She contacted the industrial electrician who was helping farmers and immediately turned off the power in the house. She says there was a "definite improvement" in her health and that of her husband. Both immediately experienced more restful sleep, for example.

Sicker when the soil is more conductive

They also installed several types of filters and have employed a variety of measures to limit their exposure to electrical pollution. All have had beneficial health effects. It has been impossible to completely eliminate electrical pollution from their environment, however. She is adversely affected by the high-frequency bursts of current create by strobe lights on nearby cellular towers, for example.

Since learning about electrical pollution, Catherine has been tireless in her efforts to warn others of the danger. She established a web site about the topic (www.electricalpollution.com) and frequently addresses agricultural and other groups, encouraging them to seek legislative remedies for the problems.

"People whose health has been most affected are most interested (in electrical pollution) because they have the most to gain," she says.

Shivani Arjuna

Shivani Arjuna, 59, doesn't think she would be alive today if she hadn't learned about electrical pollution.

Two years ago, she began to experience incidents in which her blood pressure and heart rate would suddenly skyrocket, accompanied by extreme heart arrhythmias even though she had no history of heart problems and her blood pressure had always been low.. She was conveyed to the emergency room of the local hospital twice; doctors couldn't find anything wrong. After $18,000 in tests, including an MRI of her brain, doctors couldn't arrive at a diagnosis and eventually said she was experiencing "panic attacks."

Her life was characterized by months of poor sleep, She usually required two hours to get to sleep, due to tension and severe intestinal spasms that began as

'I was nearly an invalid.'

soon as she laid down. She would awaken every couple of hours. She thought her problems might somehow be related to her bed, but conditions didn't improve when at other locations in her home. (All those areas later proved to have high levels of radio-frequency radiation.)

"I was so weak I felt as if I was made of paper," she says. "I was nearly an invalid. My husband cared for me." Homeopathic remedies alleviated some of the symptoms, but she obtained real relief only after reducing radio-frequency levels around the house.

Most homes require 20 filters. It took 37 filters to reduce levels of dirty current in her home. Industrial electrician Dave Stetzer said levels of radio-frequency current in her home were among the highest he had measured. (Her utility said its measurements, which were made at the same time, revealed nothing of concern.)

Arjuna is now so electrically sensitive that even the arcing in a car's electrical system affects her and prevents her from driving. She is essentially homebound as the electrical pollution in most public places affects her severely.

She and her husband have taken several measures to reduce her exposure to harmful electrical phenomena, including the installation of shielded phone lines and modifying the hot water heating system, which conducts ground current, to reduce her exposure in the kitchen to "bearable" levels. They have also stopped using several electrical heating baseboards that were broadcasting radio-frequency radiation.

She now gives workshops on the effects of electrical pollution and methods to reduce exposure. She has learned that many people are bothered by electrical pollution, even though they aren't as electrically sensitive as she is.

Once people have experienced an uncontaminated environment, they realize how bad they feel in contaminated environments, she says. Those who experience only polluted environments have no idea how they are affected.

The Jansky Family

The health problems of the Jansky family became worse about a year ago. Everyone in the family began experiencing bouts of unexplained illnesses, including stomach cramps and headaches. One son was hospitalized with severe headaches, although doctors didn't provide a diagnosis. Tom, 45, was not as severely affected as his six children and wife, Brenda, 42, which he attributes to the fact that he worked away from the house. Their children are home-schooled and remained at home all day.

The most worrisome development was the diagnosis of diabetes in their son, Daniel, 11. Their daughter was diagnosed with diabetes at 10 months of age; doctors said it was unusual for the disease to afflict two children in the same family in this manner.

Tom read an article about electrical pollution. "When I read it, I thought, 'Wow. That sounded just like us,'" said Tom. He had measurements made in their home and installed 20 filters immediately after learning there were high levels of radio-frequency current in the home's wiring.

"The family's health problems pretty much disappeared," says Tom. Most surprising to them was a dramatic reduction in the insulin requirements of their two diabetic children.

They have confirmed the relationship between electrical pollution and insulin levels several times. For three weeks during the summer, they vacationed in a remote area of Montana, which was free of electrical pollution. The blood sugar levels

A remarkable improvement in their children's diabetes

of both children dropped and remained "very stable," says Tom. Brenda notes that blood sugar levels remained stable, regardless of the children's level of activity.

In April, the children's blood sugar levels began climbing and became difficult to manage. When the family visited a friend who lived more than 30 miles away, their children's blood sugar levels decreased markedly, (and are still declining), which they subsequently attributed to the fact that their friend's house was located in a sandy region where the soil was less conductive. They remained at the house for several days to confirm their initial observation.

"I'm convinced this (electrical pollution) is an issue," says Tom. They have shared their observations with their children's doctors, who have attributed their experiences to "coincidence."

Nancy H.

Nancy H., who wants to remain anonymous., 42, often chokes up as she recites the health problems that have plagued her family, a litany of grief and sorrow that is disproportionately large for a family of five. She is divorced with four children.

The harrowing chronicle began more than 15 years ago when she moved with her family to a small town in north central Wisconsin. At the time, she instinctively knew something was "wrong."

It was a presentment that she has since learned to trust although at the time, she couldn't identify what in the environment had led to the feeling.

The health problems worsened when she moved to a house in a rural area.

Immediately after the move, her infant son, who had placidly slept through the night for several months, began doubling up in pain and screaming, for reasons that doctors weren't able to ascertain.

Her children always seemed sick with colds, fevers, congestion and slight temperatures. Her boys were shorter than normal, One son experienced severe growth pains and aching legs. Her daughter had crippling migraines.

Her two older children developed severe ear infections One son suffered a 50 percent hearing loss, the other son's loss of hearing was even more extensive.

During one harrowing year, her sons in first, third and fifth grade were lethargic and suffered from severe bowel problems characterized by food passing through nearly undigested. They had dark circles under their eyes, slept excessively, with poor growth and learning difficulties.

"The boys would be playing, and suddenly they would get headaches and stomach aches," says Nancy. A team of doctors at a major metropolitan hospital confirmed that the children were sick,

but could not diagnose either the ailment or the cause. One doctor suspected cancer.

In the search for answers, Nancy had the water and air tested, stopped eating homegrown vegetables in case there was something in the soil, and eliminated any foods (such as Alar-treated apples) that had been implicated in any type of ailment. She sought medical help so frequently that some doctors questioned whether she was fabricating the ailments to get attention. It was one more sickening obstacle for a heartsick mother trying to alleviate the suffering of her children.

Nothing helped but exactly one year and one day after the boys became sick, the intestinal ailments inexplicably vanished.

Nancy's health had also declined. After suffering from severe fatigue, weakness and inability to concentrate, she was diagnosed with multiple sclerosis. And although her daughter didn't suffer as much as the boys, her fingernails would slough off and her hair would fall out by the handful. Nancy now thinks that the conductive metal grid in the suspended ceiling of her sons' bedroom may explain why

Feeling worse when neighbors use more electricity

they were often affected more than her daughter.

Electrical appliances in the house often failed. Nancy kept boxes of telephones that had gone bad because she somehow felt that they might be related to what her family had experienced. Light bulbs frequently burned out. Other major electrical appliances required frequent repairs.

On April 2, 2001, she installed filters in her house. Nancy says the family's health improved noticeably within a week. She began thinking clearly and was no longer fatigued. Others commented that she no longer stuttered and stammered.

She uses a meter to monitor electrical conditions and notices that her condition worsens when levels of electrical pollution increase.

"It's a world of difference," Nancy says. Her children took longer to improve but they, too, have more energy. "For the first time in their lives, I don't have to take them to the doctor anymore," Nancy said.

Marcy Fry

Marcy Fry can trace the downward trajectory in her health to the birth of her second child 16 years ago. A subsequent temporary diagnosis of an underactive thyroid, which went away without medication in a few months, explained some of the symptoms, but not the panic attacks, the exhaustion, the lack of restful sleep and jolting awake in a total panicked state at the same time in the middle of the night.

Her condition worsened and she could no longer work after her office was moved to a former school whose electrical system hadn't been updated to accommodate computers and other electronic equipment.

She has been off work since June 4, 1999, when, she was finally diagnosed with chronic fatigue syndrome, fibromyalgia, panic disorder and irritable bowl syndrome. She linked these ailments to electrical pollution when she participated in a preliminary study of filters. During the study, the filters would be turned on and off at intervals. Participants in the study weren't told when the filters were on, but Marcy says she knew immediately.

The study was conducted over the holiday season, a period of peak electrical demand. "It was a double whammy when they turned them off," she says.

She's had the filters in her house ever since. She is still exhausted and very thirsty most of her waking hours, but she is no longer as badly afflicted with irritable bowel syndrome, nor as prone to the bouts of anger, panic and mood swings that characterized her behavior before she was forced to quit her job as a recreation director.

She believes her health is still strongly affected by electrical pollution. The filters removed radio-frequency current from her home's electrical distribution system but not from the rest of the environment. Measurements have shown that her home environment is in a sea of electrical pollution, including ground currents.

She worries about her children, who often have trouble focusing, a condition that she also attributes to electrical pollution.

Kurt Gutknecht

Kurt Gutknecht, 56, is a journalist who has written extensively about electrical pollution.

More than four years ago, he asked why dairy farmers in Wisconsin were still complaining about so-called "stray

'The nation's largest public health problem'

voltage" almost three decades after the issue was first publicized.

He found more than he anticipated – what he now calls "the nation's largest public health problem." He discovered that humans were as sick from electrical pollution as livestock, and that the problem wasn't confined to rural areas.

After his articles appeared, he was inundated with calls from farm families who had lost their farms due to the problem, with no hope of restitution. He visited dozens of farms in three states. Most families at locations where levels were high also had severe health problems.

He says the problem persists in large part because the government has ceded oversight to utility interests. "The utilities' ability to control access to the technology used to measure electrical pollution lets them bury the issue under a cloud of technical jargon and half-truths," he says.

But he says the most disturbing aspect of the problem is the fact that the government, with the complicity of selected researchers, has abandoned all pretense of independent oversight and objectivity. "I was sickened at what farm families experienced when they lost their farms due to electrical pollution. Unfortunately, anyone who tries to get help for the problem receives the same treatment."

This inexpensive meter developed by Dr. Martin Graham detects levels of radio-frequency radiation on household wiring.

Gutknecht realized his home was polluted three years ago during Christmas when his family became extremely tired and depressed. Both conditions vanished after filters were installed. His office was so badly polluted that he was unable to think or write after spending a few hours in it. He complained to the local utility, who claimed there was no problem, although levels of pollution decreased after their "investigation."

"The full extent of the problem won't be apparent until journalists actually spend time in the field with independent, competent investigators," he says. Until then, he says the media will continue to report the opinions of "experts" who are either poorly trained or whose objectivity has been compromised.

Gutknecht was fired after continuing to write about the issue.

Jerry Daniels

Dairy farmer Jerry Daniels has dealt with so-called "stray voltage" on his Wisconsin farm for more than a decade. He says it's only when he took readings with equipment developed by Dr. Martin Graham that he was able to monitor the source and extent of the problem.

He discovered the levels of electrical pollution on a neighboring farm, where average milk production was much higher, were much lower than on his farm.

The 'proof' comes in helping people recover

On Daniels' behest, filters were installed in a local elementary school, reducing the incidence of severe headaches experienced by students and teachers. He has installed filters in the homes of friends, relatives and neighbors, who all report improvements in their health. A diabetic's insulin requirements declined by 50 percent. An 18-year-old, who had a brain operation to remove a tumor, was finally free of headaches after suffering for more than a year. His 84-year-old parents spent days at the fair with their grandchildren. They used to be tired after just three hours.

Another neighbor, who was retired and largely bedridden, said he was prepared to die after spending $100,000 at a regional medical clinic, where doctors couldn't diagnose his condition. He's now leading an active life after filters were installed in his home – and after removing his hearing aid. Daniels knows the hearing aid contributed to the man's problems, perhaps because it magnified pollution in the environment.

A woman recovering from a knee operation found exercise was too painful – until Daniels found her treadmill, which had a variable frequency drive motor, was producing high levels of radio-frequency radiation. His brother-in-law experienced severe heart arrhythmia after working around equipment with variable speed drives.

"I felt 10 years younger after installing the filters," he says.

Daniels realizes that these accounts don't constitute "proof" of the link between electrical pollution and health problems, but they have convinced him that it's a legitimate concern.

"Recovery (after installing filters) sometimes takes a while. After a month or so, people realize they no longer feel as bad," he says.

The electronics industry and the utilities should share responsibility for correcting the problem, he says.

"I know the problem is real."

Reports on the Health Effects of Electromagnetic Pollution

Compiled by:

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November 2009

Reports on the Health Effects of Electromagnetic Pollution

Table of Content

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Quotes

Electromagnetic Pollution: low frequency electromagnetic fields, dirty electricity, radio frequency radiation

"*We are living in an increasingly complex electrical environment and are inundated daily with electromagnetic frequencies ranging from less than 20 Hz (electric trains) to greater than 1 billion Hz (wireless telecommunication). Most of these frequencies are man-made and were not present until the invention and subsequent commercialization of* ***electricity*** *(early 1900s),* ***radio*** *(1920s),* ***radar*** *(1940s),* ***television*** *(1950s),* ***computers*** *(1970s), and* ***cell phones*** *(1980s).*" [Havas and Stetzer 2004. presented at the WHO conference on Electrical Hypersensitivity, Prague 2004. Dr Havas, Environmental and Resource Studies, Trent University, Peterborough, Canada]

Health Effects of Electromagnetic Pollution

"*Sickness is often the consequence of an interaction between a causative agent and a susceptible host, and adverse EMR appears to be one such causative agent.*" [Genuis 2007, Journal of the Royal Institute of Public Health, Dr. Genius. Faculty of Medicine, University of Alberta, Edmonton, Canada]

"*The results suggest that poor power quality may be contributing to* ***electrical hypersensitivity*** *and that as much as 50% of the population may be hypersensitive; children may be more sensitive than adults and dirty electricity in* ***schools*** *may be interfering with education and possibly contributing to disruptive behavior associated with* ***attention deficit disorder*** *(ADD); dirty electricity may elevate* ***plasma glucose*** *levels among* ***diabetics****, and exacerbate symptoms for those with* ***multiple sclerosis*** *and* ***tinnitus****.*" [Havas and Stetzer 2004, presented at the WHO conference on Electrical Hypersensitivity, Prague 2004,]

"***Diabetes, multiple sclerosis, ADD/ADHD, asthma chronic fatigue****, and* ***fibromyalgia*** *are increasing . . . Dirty electricity may be one of the contributors to these illness.*" [Havas 2007, Electromagnetic Biology and Medicine]

"*Dirty electricity is adversely affecting the lives of millions of people.*" [Havas and Stetzer 2004, presented at the WHO conference on Electrical Hypersensitivity, Prague 2004.]

Definition of electrical hypersensitivity according to the WHO:
"*. . . a phenomenon where individuals experience* ***adverse health effects*** *while using or being in the vicinity of devices emanating* ***electric****,* ***magnetic****, or* ***electromagnetic fields*** *(EMFs) . . . Whatever its cause, EHS is a* ***real*** *and sometimes a* ***debilitating*** *problem for the affected persons, while the level of EMF*

in their neighborhood is no greater than is encountered in normal living environments. Their exposures are generally several orders of magnitude ***under*** *the limits in* ***internationally accepted standards***." [WHO conference on Electrical Hypersensitivity, Prague 2004]

Schools

"*Scientific studies have repeated documented an increased risk of* ***childhood leukemia*** *associated with exposure to elevated magnetic fields. For this reason, it is advised that schools not be built near high voltage transmission lines, sub-stations or transformers and that computer stations be reconfigured to minimize student exposure to magnetic fields.*" [Havas 2007, Ontario Secondary School Teachers' Federation]

Diabetes and Dirty Electricity

"*Further, for 2 out of 3 individuals* ***blood glucose*** *is also changed by dirty power.*" [Dr. Lloyd Morgan 2003]

"***Insulin secretion*** *decreases under exposure to ELFMF. Hence, it might be desirable for* ***diabetic*** *patients who have insufficient insulin secretion from pancreatic islets to avoid exposure to an ELFMF.*" [Sakurai et al. 2004. An Extremely Low Frequency Magnetic Field Attenuates Insulin Secretion From the Insulinoma Cell Line,RIN-m. Bioelectromagnetics 25:160-166.]

"*According to Philips and Philips (2006) 3% of the population has electromagnetic hypersensitivity (EHS) and 35% have symptoms of EHS. If these percentages apply to* ***diabetics*** *then as many as 5-60 million diabetics worldwide may be responding to the poor power quality in their environment (Wild et al. 2004).*" [Havas 2007, Electromagnetic Biology and Medicine 25:259.]

Cancers

"*According to the World Health Organization Report up to 1 in 20* ***childhood leukemias*** *may be attributable to electromagnetic fields, with as many as 5% of cases of childhood leukemia due to low-frequency magnetic field exposure.*" [WHO]

"*Statistics showed that if a person [teacher] working in a [class] room where the GS units were above 2000 it increased their changes of getting cancer by 25%. If the number was above 1000 GS units the chances of getting cancer were increased by 15%.*" [Milham and Morgan 2007, Dr. Milham, MD, Washington State Department of Health (retired), Olympia, Washington]

Alzheimer's Disease

"*The association between occupational exposure to ELF-EMF and Alzheimer's disease was considered in five studies (66-70). All five studies showed increases in ne or more exposure groups with four studies (66-69) showing statistically significant increases . . . The one remaining study (70) was evaluated using data for twins and also suffered many limitations. These data are inadequate for interpreting the possibility of an association.*" [NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields. Prepared in Response to the 1992 Energy Policy Act (PL 102-486, Section 2118, NIH Publication No. 99-4493.]

Heart-Rate Variability

"*Changes in heart-rate variability were evaluated in a retrospective analysis of three previous studies (77). Some changes in heart-rate variability were observed, which according to the authors, could indicate a potential for increased risk of sudden cardiovascular death.*" [NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields. Prepared in Response to the 1992 Energy Policy Act (PL 102-486. Section 2118, NIH Publication No. 99-4493.]

Benefits of the Graham/Stetzer Filters

"*The Graham/Stetzer filters provide one method by which individuals can* ***improve power quality*** *in their home, work, or school environment.*" [Havas et al. 2004, Presented at the 3rd International Workshop on the Biological Effects of Electromagnetic Fields, Kos Greece, 2004.]

"*. . . individuals experienced major to moderate improvements in their health and well being after Graham/Stetzer filters improved power quality in their home or work environment.*" [Havas and Stetzer, 2004. presented at the WHO conference on Electrical Hypersensitivity, Prague 2004]

"*In our opinion, application of Graham/Stetzer filter causes the certain protective effect, reducing* ***death rate of chicken embryos.***" [Grigorjev 2004, Dr. Grigorjev Professor and Doctor of Medicine, Chairman of Russian National Committee on Non-Ionizing Radiation Protection, Moscow, Russia]

"*GS filters may be effective for improving other medical conditions such as* ***hyperlipidemia*** *and* ***hypercholesterolemia.*** *We have seen the subject's blood consistency change.*" [Sugimoto 2006. A study at the Natural Clinic Yoyogi in Tokyo. Preventive Healthcare Japan Co., Ltd.]

"*Filtration of dirty electricity reduced levels to under 30 GS units, and the patient noticed a dramatic and consistent improvement in* ***sleep*** *patterns within 1 week.*" [Genuis 2007. Journal of the Royal Institute of Public Health. Dr. Genius. Faculty of Medicine. University of Alberta. Edmonton, Canada]

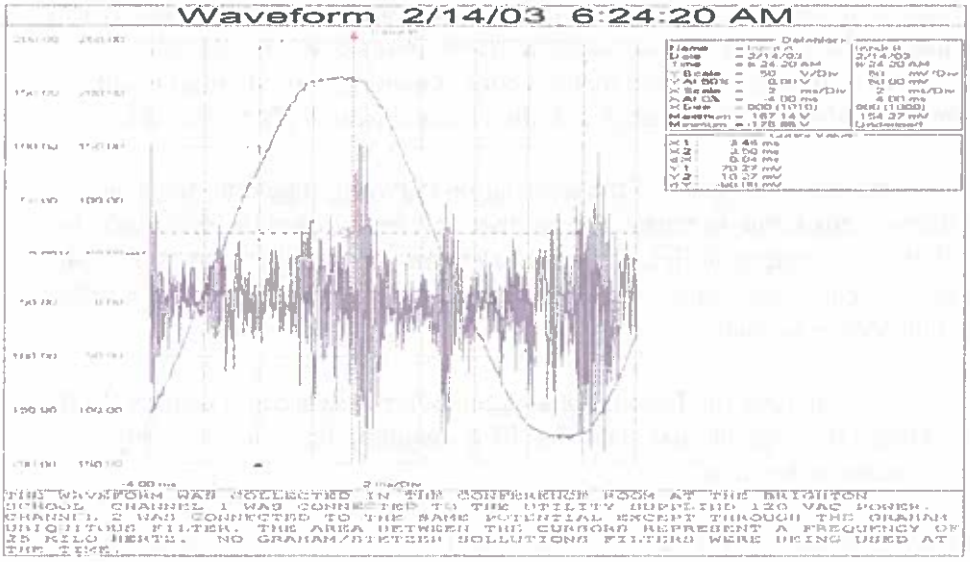
"*One teacher in the Wisconsin school that was filtered had been diagnosed with* ***multiple sclerosis*** *(MS). She was extremely tired, had double vision, had cognitive difficulties and could not remember the names of the students in her 4th grade class. Her health would improve during the summer but her symptoms returned in September. She assumed her problems were mold-related but her symptoms did not improve after the mold was removed from the school. Once the school was filtered her symptoms disappeared.* [Havas 2007. Electromagnetic Biology and Medicine 25:259]

"*Three days after 16 GS filters were placed in his home his symptoms began to disappear . . . He assumed his body was recovering spontaneously but he had been diagnosed with progressive* ***MS*** *and not relapsing/remitting MS, so spontaneous recovery was unlikely in his case.*" [Havas 2007. Electromagnetic Biology and Medicine 25:259]

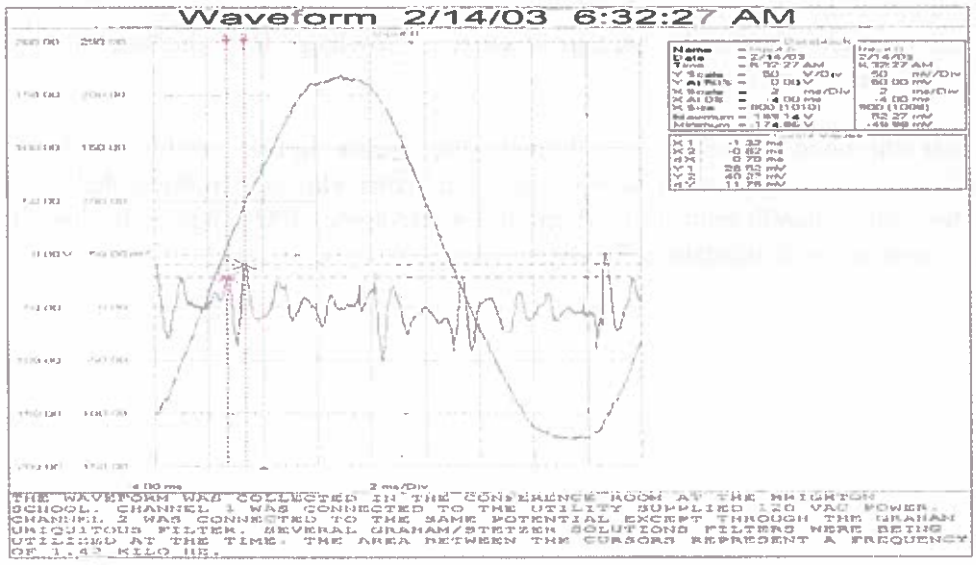
Brighton School Wisconsin, Feb 2003

Waveform in conference room of Brighton School without Graham Stetzer Filters (top graph) and with Graham Stetzer Filters (bottom graph).

No Graham Stetzer Filters



With Graham Stetzer Filters



WHO publication on Electromagnetic Fields (EMF)

According to a World Health Organisation Report up to 1 in 20 childhood leukaemias may be attributable to electromagnetic fields, with as many as 5% of cases of childhood leukaemia due to low-frequency magnetic field exposure.

The principle objective of the WHO study, published in June 2007, was to review the scientific literature on the biological effects of exposure to extremely low frequency (ELF) electric and magnetic fields, in order to assess health risks associated with exposure, and make recommendations on potential health protection programs. Frequencies studied ranged from 0 Hz to 100 kHz.

Report findings state that: "If the association between magnetic fields and childhood leukaemia is causal, the number of cases worldwide that might be attributable to magnetic field exposure is estimated to range from 100 to 2400 cases per year, based on values for the year 2000, representing 0.2 to 4.95% of the total incidence for that year."

Prior to this, in 2002 the International Agency for Research on Cancer (IARC) published a monograph that classified ELF magnetic fields as "possibly carcinogenic to humans".

Modern life relies heavily on electricity, and electric and magnetic fields are associated with all electricity flows. Consequently, EMF have become ubiquitous in our environment. It is known that exposure to EMF at extremely low frequencies induces electric fields and currents inside the body. However, the exact link between childhood leukaemia and extremely low frequency EMF remains unclear.

Based upon this research, the WHO recommends that government and industry should monitor science and that gaps in current knowledge form the basis of a new research agenda.

Whilst childhood leukaemia is a relatively rare disease, in Europe childhood cancer is increasing by more than 1% per year. Thus, although in the global context public health impact of extremely low frequency EMF may be limited, it may prove to be significant in Europe.

June 6, 2006

To all supporters of GS filters:

We have conducted a study at Natural Clinic Yoyogi in Tokyo today, with great support from the director Dr. Shirai, to check how a subject's blood sugar level changes when the EMF level is lowered by GS filters. The three subjects of the study were a 35-year-old male (Mr. I), a 60-year-old female (Ms. U) and a 48-year-old male (Mr. S). Mr. S. had been diagnosed as diabetic and was seeing a doctor. His fasting blood sugar level was over 300. He had been on medication. paying a lot of attention to his diet and also exercising, but he was having a hard time lowering his blood sugar level.

All three subjects finished their lunch at 12:10 PM. The first measurment of their blood sugar levels was taken at 3:30 PM. As it was more than 3 hours after the completion of their lunch, we consider these as fasting blood sugar levels. The measurement shows that the passing of time alone will not significantly lower blood sugar levels. The EMF level of the room where the study was conducted was over 2000 without GS filters and was not measurable. The blood sugar levels of the three subjects were 113 for Mr. I, 139 for Ms. U and 323 for Mr. S. Since average blood sugar level is between 60~110, we assumed the higher-than-usual readings of Mr. I and Ms. U, neither of whom had ever had any problems with high blood sugar levels, were due to the High EMF level of the room.

At 4:14 PM, thirty minutes after lowering the EMF level of the room using four GS filters to 30~35 GS units, we took another measurement. The readings were 100 (-13) for Mr. I, 110 (-29) for Ms. U and 290 (-33) for Mr. S. Numbers in parentheses show the changes in blood sugar levels. Since there were only two outlets in the room, we used two table taps to connect four GS filters and two meters. We have discovered that the amount of EMF lowered differs depending on where on the table taps GS filters are connected.

After another interval of 30 minutes, at 4:45 PM, we took a measurement of male subjects only. The readings were 93 (-20) for Mr. I and 274 (149) for Mr. S. Then, we disconnected all four GS filters and brought the EMF level back to over 2000. Thirty minutes later, at 5:15 PM, we took a measurement of Mr. S's blood sugar level. His reading did not go back up; it went down further, to 245 (-78). A surprised Mr. S said "My blood sugar level has not been this low lately even when I was taking clinic-prescribed medication".

The reason why the blood sugar level continued to lower after the filters were removed is because once cells start taking sugar in a normal fashion, the effect probably continues for a while. So, we can expect the GS filters to be effective even when installed only in a bedroom.

We not only measured the blood sugar levels but also used special equipment called QRS to check waves. I will report on that part of the study next time.

GS filters may be effective for improving other medical conditions such as hyperlipidemia and hypercholesterlemia. We have seen the subject's blood consistency change from thick to more fluid blood.

We provided the four filters and a meter to Mr. S for free of charge so that he can continue measuring his blood sugar level while he has the filters installed at his residence. He is seeing his specialist on the 8th. After hearing the results of his visit, I am planning to talk to Mr. Kohzu, Director of The Society of Preventive & Alternative Medicine, Japan Office.

Tatsuaki Sugimoto
Preventive Healthcare Japan Co., Ltd.

CONFIRMED:
The order of the Head State Sanitary Physician of the Republic of Kazakhstan
« _28_ » _November_ 2003_г. № 69

Permissible levels of high-frequency electromagnetic pollutions' voltage in a wires of industrial frequency alternating current

Sanitary-epidemiologic norms

1 General provisions

1. Sanitary-and-epidemiologic norms «Permissible levels of high-frequency electromagnetic pollutions' voltage in a wires of industrial frequency alternating current» (further - norms) define levels electromagnetic pollutions in electric wires of power supply of an industrial electric equipment, office techniques, electrical household appliances in a range 1 kiloHertz – 400 kiloHertz (further – kHz).

2. The present norms are directed on improvement and optimization of a sanitary-epidemiologic situation and prevention of environmental contamination by electromagnetic radiation, and also management of corresponding risk, in addition to existing norms.

3. Heads of the organizations and physical persons which activity is connected to operation of the industrial organizations using the equipment and devices, being sources of electromagnetic radiation, provide maintenance of requirements of the present norms.

4. In the present norms the following terms and definitions are used:

1) electromagnetic pollution – parasitic (casual) frequencies in a network of an alternating current of industrial frequency of 50 Hertz (further – Hz) which source is not determined;

2) electromagnetic pollutions – one of kinds of electromagnetic pollution in a range of frequencies 1 kHz – 400 kHz, arising in networks of an alternating current of industrial frequency.

2 Permissible level of electromagnetic pollutions' voltage

5. The permissible level of a high-frequency electromagnetic pollutions' voltage in a range of frequencies 1-400 kHz in a wires of an alternating current of industrial frequency of 50 Hz should not exceed 0,05 volts (further – V) 50 millivolts (further – mV).

Lg GS Units

3 Choice of points of the control

6. Control points get out in the socket of wires of an alternating current of industrial frequency (50 Hz), taking place near to a plug (socket) of a cable of the connected equipment. The number of control points depends on number of workplaces. In each control point one measurement is carried out.

4 Recommended devices for the control

7. For the control high-frequency electromagnetic pollutions in a range of frequencies (1-400) kHz in a wires of an alternating current of industrial frequency of 50 Hz are recommended to be used millivoltmeter, having corresponding characteristics and registered in the State Register of Republic of Kazakhstan.

5 Requirements to carrying out of measurement

8. The device is plugged into socket of an alternating current in a control point.

9. Tap switch of ranges necessary to put in position of 1-2 V.

10. If indications are not fixed or are small, tap switch put in position 100-999 mV or in position 1,1-99,9 mV, depending on a registered level of a voltage.

Results are registered and compared to the norms specified in item 5 of the present norms.

Japan Times

Tuesday, Oct. 23, 2007

Agency to set electromagnetism exposure limits

Kyodo News

The industrial safety agency will set up standards early next year to protect the public from exposure to extremely low-frequency magnetic fields that exist close to power lines and appliances whenever there are electric currents, officials said Monday.

An ordinance under the Electricity Enterprises Law will be revised to comply with a World Health Organization recommendations in June to set exposure limits against the biological effects of low-frequency electric and magnetic fields.

According to the WHO, high levels of exposure to electric and magnetic fields in the frequency up to 100 kilohertz can affect the nervous systems, resulting in acute health effects, including nerve stimulation.

The Nuclear and Industrial Safety Agency of the Ministry of Economy, Trade and Industry will take the step based on a working group report, the agency officials said. Currently no standards have been set under domestic laws for magnetic fields, while standards are set for electric fields.

Under the envisaged standards, the level of magnetic fields arising from a current would be capped at 100 microtesla in eastern Japan, where electric power operates at a frequency of 50 hertz, and 83 microtesla in western Japan with a frequency of 60 Hz, the officials said.

When the agency measured the magnetic field values at about 760 locations across Japan between 2003 and 2006, they were below the planned standards directly under the power lines. But figures were higher, 144 microtesla at the maximum, near some transformers installed on streets and lines running from underground cables to power poles.

The agency believes the values above the standards do not pose immediate risks, but it plans to urge power companies to take measures to reduce them, the officials said.

The agency also plans to discuss the fields' potential long-term effects, because everyday, chronic exposure to magnetic fields above 0.3 to 0.4 microtesla is considered a possible health risk based on epidemiological studies of childhood leukemia.

As for high-level exposures to electric and magnetic fields, adverse health effects have already been scientifically established. The International Commission on Non-Ionizing Radiation Protection issued in 1998 guidelines for limiting exposure to fields up to 300 gigahertz.

http://search.japantimes.co.jp/cgi-bin/nn20071023a5.html

Electromagnetic Health.org

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Medical Director of Switzerland's Paracelsus Clinic Takes Stand on Hazards of Electromagnetic Pollution - 'Electromagnetic Load' a Hidden Factor in Many Illnesses

10.02.2009 by admin Category **Electromagnetic Health Blog**

Listen to **Dr. Rau Interview**.

Thomas M. Rau, MD, Medical Director of the Paracelsus Clinic

February 10th, 2009. Dr. Thomas Rau, Medical Director of the world renowned Paracelsus Clinic in Lustmühle, Switzerland says he is convinced 'electromagnetic loads' lead to cancer, concentration problems, ADD, tinnitus, migraines, insomnia, arrhythmia, Parkinson's and even back pain. At Paracelsus (**www.paracelsus.ch**), cancer patients are now routinely educated in electromagnetic field remediation strategies and inspectors from the Geopathological Institute of Switzerland are sent to patients' homes to assess electromagnetic field exposures.

Of note, Dr. Rau says a strategy to consider for those experiencing 'electrical sensitivity' symptoms is to remove the electromagnetic 'hot spot' in the head created by the presence of metal fillings. Concern is thus not only for the 'neurotoxic' aspect of mercury in fillings, an increasingly understood hazard, but because fillings themselves act as antennas in the presence of electromagnetic fields from cell phones and cell towers, wi-fi networks, portable phones, and other sources of radiofrequency radiation.

Rau says the removal of dental fillings can be an important early step in reducing electrical sensitivity, allowing some people to live in homes they otherwise could not tolerate.

Cultures have shown beneficial bacteria grows more slowly in the presence of electromagnetic fields, says Rau, allowing pathological organisms to dominate. Thus, a strategy with electrically sensitive patients, or with those facing chronic conditions, is the aggressive supplementation with probiotics

and other Biological Medicine approaches to balance intestinal flora. Many people with chronic infections likely linked to EMF exposures, such as Lyme Disease, are symptom- free after an aggressive microorganism rebalancing program.

Electrical sensitivity—originally known as radio wave sickness—is a sometimes debilitating experience created by these and other disregulating effects of electromagnetic fields. Linked to many acute and chronic illness conditions, electrical sensitivity is a serious emerging public health issue globally and a subject in which most doctors have no training.

A Petition to Congress, created by **www.ElectromagneticHealth.org** is now circulating on the internet, requesting Congress **1)** mandate the FCC lower exposure guidelines to reflect the large body of science showing biological effects at exposures much lower than current standards, **2)** repeal Section 704 of the Telecommunications Act of 1996, which rescinded state and local governments right to resist towers on health or environmental grounds, **3)** stop the roll out of the Wi-Max network until Congress better understands the potential health consequences, and **4)** accommodate citizens unable to function adequately in high EMF environments, including forbidding cell towers on school properties.

Exposing children in schools to radiation, known to impair brain function and learning, Rau describes as "criminal". He says, "It is unethical to expose children to electromagnetic load in this way. We know that power stations for electromagnetic waves like mobile phones are hurting the brains of children, so to put such stations into schools is really...*very, very, very* bad. Rau says, the question is, "Does the school, or does the society, really want to have intelligent, well-educated children, or not?" He says, "If you install mobile phone towers, which radiate to the children, their intelligence, their brain capacity, decreases. You will have more ADD children, you will have less function of the brain, which in the long term reflects on the intelligence of the children, of the possibility to really teach children, and in the long term, the more this overcomes society, the more we will have dumb children."

The reality of the health consequences of electromagnetic radiation eventually will have to be faced, and this will only happen with active pressure on Congress. It is estimated that 3-8% of populations in developed countries experience serious electrohypersensitivity symptoms today, and 35% experience mild symptoms. With increasing electromagnetic field exposures, these numbers, along with the suffering involved for people who are impacted, and the health care costs involved, are bound to go up.

neReport
on experimental work
«Estimation of efficiency of Graham/Stetzer filter at influence of a low-frequency electromagnetic field of 20 kHz on development of chicken embryos »
Experiment №2

The purpose of work.

The purpose of experiment №2 was to estimate of probable reduction of influence of electromagnetic fields of 20 kHz on development of chicken embryos by filter Graham/Stetzer.

Technique the circuit of experiment and the equipment of incubators were the same, as in experiment №1, and have been described in the previous report.

During all incubatory period in all three incubators the necessary temperature and the humidity required for successful development chicken embryos were supported. The temperature was in limits 37.5±0.8°C, humidity 53±5 %.

There were no any failures in work of the equipment during carrying out of experiment.

Radiating system.

The design and accommodation of radiating electrodes was described in the previous report. Difference from experiment №1 was that on electrodes the voltage from the frequency converter of the voltage loaded on 20-watt electric lamp moved. The frequency converter of company W.A.C Lighting Co, model EN-12P-AR, will transform voltage frequency of 50 Hz 120 V to a target voltage 12 V with frequency 20 kHz.

The electric circuit of experiment is submitted on fig. 1.

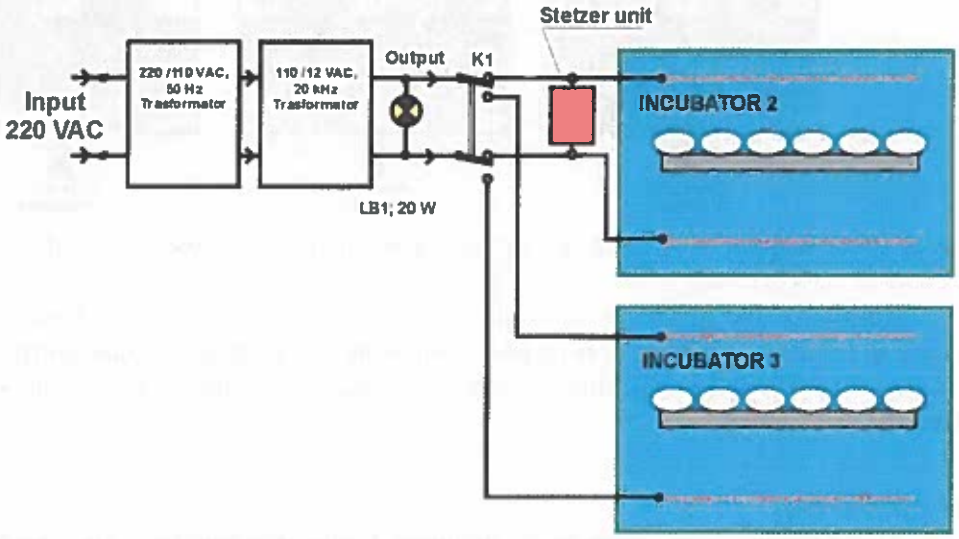

Fig. 1. The electric circuit of incubator electrodes connection in experiment.

With the help of key K1 incubators were serially connected to a source at 4 o'clock daily within 14 days.

The measured voltage from the converter at the included loading, on electrodes has made 6,7 V (root-mean-square value) in case of an incubator №3 and 0-0,1 V in case of connection of filter Grham/Stetzer (the Incubator №2).

Measurements of an electromagnetic field.

At carrying out of the instrumental control, the following parameters of electromagnetic field (EMF) were measured:

- Working (root-mean-square) values of intensity of electric field E_{RMS} [V/m] in a range of frequencies of 5-30000 Hz;
- M Peak intensity of electric field E_{PEAK} [V/m] in a range of frequencies of 5-30000 Hz.

Separate measurements of intensity of EMF electric component are executed at a level of accommodation of the pallet with eggs.

EMF sources worked in a regular mode.

The instrumental control was carried out at normal values of temperature and relative humidity of air.

For carrying out of measurements of EMF intensity the analyzer of variable electromagnetic field EFA-3 (factory № FM-0104) manufactures of firm " Wandel and Goltermann " (Germany), having the Certificate on the State checking № 04/1908, given SE "ВНИИФТРИ" (USRIPhTRM) was used. Validity of the certificate is till January, 20, 2005.

The arrangement of points of EMF measurement is submitted on fig. 2.

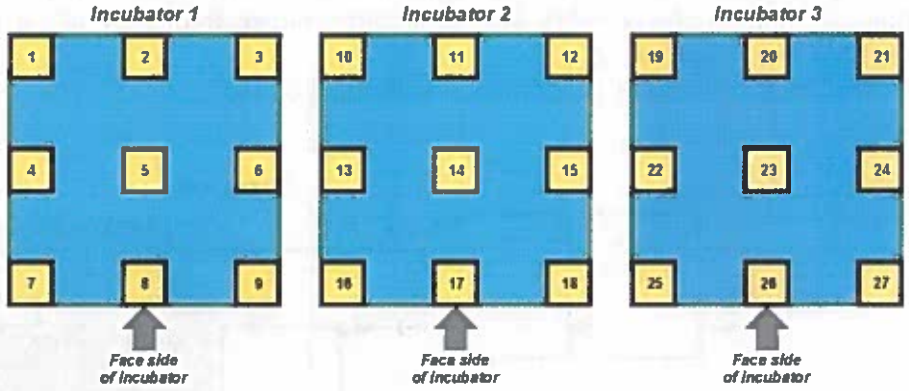

Fig. 2. An arrangement of points of the instrumental control of electric field intensity in incubators

Results of the instrumental control of EMF electric component intensity in incubators are resulted in table 1. The basic part of EMF values in all incubators is caused by industrial frequency of wires of 50 Hz at the working equipment of incubators and elements of circuits of sources of radiation.

Biological objects.

The breeding eggs were from Pedigree Farm "Kuchinsky", the Moscow oblast. Cross « Highsex, white». Average weight of eggs was 57 g, hatching out is 80±5 %. The breeding certificate № 18 from March, 31, 2004. Before a placing of eggs in an incubator all eggs were looked through on deficiency, beaten and with defects of a shell were rejected. In each incubator it has been incorporated on 56 eggs. Date of a placing is on March, 31, 2004 from 16:00 till 16-30 (from 4-00 p.m. till 4-30 p.m.).

Results of experiment.

The control of death rate of embryos carried out for 5-th. 7-th. 9-th. 11-th and 13-th days of development. The ending of development fixed for 21 day. For 5-th day of development of non-impregnant eggs which were not examined in the further analysis of the general sample have been determined. The basic results are submitted in table 2 and on fig. 3.

Table 1. Results of measurements of values of electric field intensity in incubators. (For incubators of 2 and 3 measurements are submitted for two modes: at switched off and at switched on EMF source - the switch of the lowering transformer)

Incubator	*№ points of measurement*	The fixed value			
		E_{RMS}, В/м		E_{PEAK}, В/м	
№ 1	1	45.6 ± 3.3		57,6 ± 3,9	
	2	61.5 ± 4.1		76,7 ± 4,8	
	3	48,6 ± 3,4		67,8 ± 4,4	
	4	24,6 ± 2,2		51,2 ± 3,6	
	5	28.9 ± 2.4		47,9 ± 3,4	
	6	35.3 ± 2,8		61,3 ± 4.1	
	7	18,2 ± 1,9		38,7 ± 2,9	
	8	20,8 ± 2,0		36,3 ± 2,8	
	9	24.3 ± 2.2		41,6 ± 3,1	
№ 2	mode	off	on	off	on
	10	208,9 ± 11,4	336,6 ± 17,8	342,8 ± 18,1	530,7 ± 27,5
	11	129,1 ± 7,5	480,1 ± 25,0	243,6 ± 13,2	754,3 ± 38,7
	12	153.7 ± 8.7	441.5 ± 23.1	253,9 ± 13.7	703,1 ± 36,2
	13	97.4 ± 5.9	438,2 ± 22.9	129.7 ± 7,5	694,0 ± 35,7
	14	14,2 ± 1.7	129,4 ± 7.5	25,8 ± 2,3	203.2 ± 11,2
	15	79,9 ± 5,0	363,5 ± 19,2	117,9 ± 6,9	566,6 ± 29.3
	16	109.2 ± 6.5	339.9 ± 18.0	180.5 ± 10.0	541,7 ± 28,1
	17	69.7 ± 4.5	290,0 ± 15.5	99,7 ± 6,0	451,5 ± 23,6
	18	120,1 ± 7,0	351,9 ± 18,6	167.3 ± 9.4	558.4 ± 28,9
№3	19	58.7 ± 3.9	289,7 ± 15,5	90,0 ± 5,5	531,2 ± 27,6
	20	55,7 ± 3,8	409,9 ± 21,5	83,7 ± 5.2	703.8 ± 36.2
	21	35,2 ± 2,8	740.5 ± 38,0	69.4 ± 4.5	1312.0 ± 66.6
	22	19,8 ± 2,0	376,5 ± 19.8	35,4 ± 2,8	687,1 ± 35,4
	23	6,3 ± 1,3	93,6 ± 5,7	14,8 ± 1,7	224,9 ± 12,2
	24	30,8 ± 2,5	379,1 ± 20,0	47,6 ± 3,4	707.9 ± 36.4
	25	23,1 ± 2,2	328.6 ± 17.4	39.8 ± 3.0	585,1 ± 30.3
	26	16,8 ± 1,8	357,0 ± 18.9	29,6 ± 2,5	636,4 ± 32,8
	27	29.9 ± 2.5	365,2 ± 19,3	47,9 ± 3,4	599,1 ± 31,0

Table 2. Death rate of chicken embryos in experiment.

Incubator №	Conditions	Quantity	non-impregnant	Impregnant	Embryos death								Hathing out	
					D5	D7	D9	D11	D13	D21	Sum	%	Sum	%
1	Protection	56	3	53	1	0	2	2	1	4	10	18,9	43	81,1
2	Witout protection	56	2	54	1	0	10	1	1	4	17	31,5	37	68,5
3	Control	56	2	54	1	0	6	2	1	3	13	24,1	41	75,9

The statistical analysis is submitted in the Appendix at the end of the report.

Changes of death rate of embryos is resulted on fig. 3.

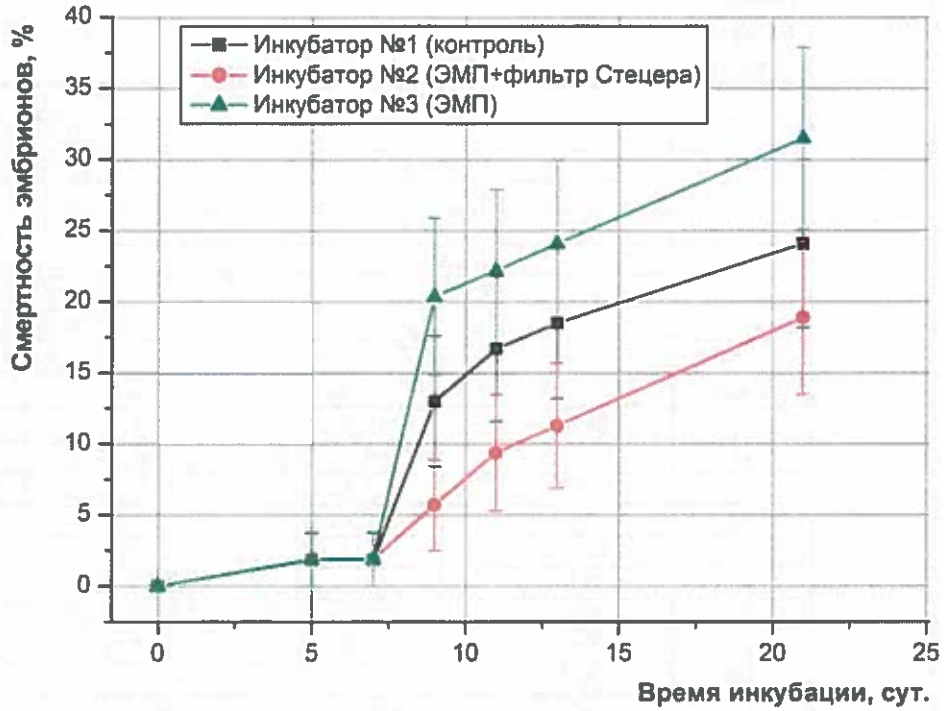

Fig. 3. Changes of death rate of embryos

Discussion of results.

The received results testify about reduced hatching of embryos in control group 75.9±5.9 %, at hatching out 80±5 %, specified in the breeding certificate for conditions of industrial breeding of chickens. However, the available difference is statistically doubtful.

Death rate in skilled groups 2 and 3 statistically differ from control and, accordingly, against 24.1±5.9 % in the control a little

The difference in death rate of embryos between two experimental groups is authentic and equal an incubator with use of Graham/Stetzer filter 18.9±5.4 %, and in an incubator with a source without protection (filter) is 31.5±6.4 % at 95 % to an estimation of confidential probability.

In our opinion, application of Graham/Stetzer filter causes the certain protective effect, reducing death rate of chicken embryos. It is possible to predict receptions of the greater effect, at increase in intensity of influenced electromagnetic field (20 kHz); in the present experiment the used

voltage on electrodes was insignificant and practically was not allocated at a level of pollutions – EMF of 50 Hz. In this connection, in our opinion, it is expedient to consider frequency of transformation for an influenced field with the purpose of determination of most biologically active frequencies.

The supervisor of studies.
Professor Yu.G.Grigorjev

The executive A.L.Vasin

Responsible for EMF measurements A.V.Merkulov

March, 29, 2004.

Appendix. Statistical analysis of results of embryos death rate.

Incubator 1 (control)	*D5*	*D7*	*D9*	*D11*	*D13*	*D21*	*Всего*
Average	0,018518519	0	0,11111	0,037037	0,018518519	0,055556	0,240740741
Standard error	0,018518519	0	0,04317	0,025941	0,018518519	0,031464	0,058726201
Median	0	0	0	0	0	0	0
Mode	0	0	0	0	0	0	0
Standard deviation	0,136082763	0	0,31722	0,190626	0,136082763	0,231212	0,431547684
Dispersion of sample	0,018518519	0	0,10063	0,036338	0,018518519	0,053459	0,186233403
Excess	54	-	4,65399	24,34393	54	14,47378	-0,46164034
Asymmetry	7,348469228	-	2,54615	5,044113	7,348469228	3,992335	1,247745171
Interval	1	0	1	1	1	1	1
Minimum	0	0	0	0	0	0	0
Maximum	1	0	1	1	1	1	1
Sum	1	0	6	2	1	3	13
Number	54	54	54	54	54	54	54
Level of reliability (95,0 %)	0,037143427	0	0,08658	0,052031	0,037143427	0,063109	0,117789787

Incubator 2 (EMF+filter)	*D5*	*D7*	*D9*	*D11*	*D13*	*D21*	*Всего*
Average	0,018868	0	0,037736	0,037736	0,018868	0,075472	0,188679
Standard error	0,018868	0	0,026425	0,026425	0,018868	0,036631	0,054257
Median	0	0	0	0	0	0	0
Mode	0	0	0	0	0	0	0
Standard deviation	0,137361	0	0,19238	0,19238	0,137361	0,266679	0,394998
Dispersion of sample	0,018868	0	0,03701	0,03701	0,018868	0,071118	0,156023
Excess	53	-	23,84083	23,84083	53	9,296951	0,708793
Asymmetry	7,28011	-	4,994194	4,994194	7,28011	3,308673	1,638133
Interval	1	0	1	1	1	1	1
Minimum	0	0	0	0	0	0	0
Maximum	1	0	1	1	1	1	1
Sum	1	0	2	2	1	4	10
Number	53	53	53	53	53	53	53
Level of reliability (95,0 %)	0,037861	0	0,053027	0,053027	0,037861	0,073506	0,108875

Part 1 of 8, Additional information found TheBrainCan.com , SolomonSeries.com, and https://www.youtube.com/solomonseries

Incubator 3 (EMF)	*D5*	*D7*	*D9*	*D11*	*D13*	*D21*	*Всего*
Average	0,018518519	0	0,18519	0,018519	0,018518519	0,074074	0,314814815
Standard error	0,018518519	0	0,05336	0,018519	0,018518519	0,035974	0,063796026
Median	0	0	0	0	0	0	0
Mode	0	0	0	0	0	0	0
Standard deviation	0,136082763	0	0,3921	0,136083	0,136082763	0,264351	0,468803136
Dispersion of sample	0,018518519	0	0,15374	0,018519	0,018518519	0,069881	0,21977638
Excess	54	-	0,80939	54	54	9,550792	-1,37943586
Asymmetry	7,348469228	-	1,66757	7,348469	7,348469228	3,346373	0,820419821
Interval	1	0	1	1	1	1	1
Minimum	0	0	0	0	0	0	0
Maximum	1	0	1	1	1	1	1
Sum	1	0	10	1	1	4	17
Number	54	54	54	54	54	54	54
Level of reliability (95,0 %)	0,037143427	0	0,10702	0,037143	0,037143427	0,072154	0,127958564

Part 1 of 8, Additional information found TheBrainCan.com , SolomonSeries.com, and https://www.youtube.com/solomonseries

Subjective Complaints of Persons Working in Rf Field (p. 30)

Headaches
Eyestrain
Flow of Tears
Fatigue
Weakness
Disturbed Sleep
Moody
Frequently Irritated
Unsociable
Mental Depression
Deterioration of Intellectual Functions
Notable Memory Impairment
Sluggishness
Inability to make decisions
Loss of Hair
Muscle Pain
Pounding of Heart
Breathing Difficulties
Difficulty in sex life
Increased perspiration of extremities
Decreased lactation in nursing mothers
Brittle fingernails

Effects of Rf Fields on Other Organs (p. 36)

Acceleration or retardation of breathing rate
Hemorrhaging and bleeding in internal organs
Decreased filtration in renal tubules
Increased activity of adrenal cortex
Hemorrhaging in the liver
Degeneration of hepatic cells
Enlargement of thyroid
Hyperthyroidism
Increase of radioactive iodine

Mahra, K., Musil, J., & Tuha, H. (1971). Electromagnetic fields and the life environment. (Translated from the Czech). San Francisco, CA: San Francisco Press, Inc.

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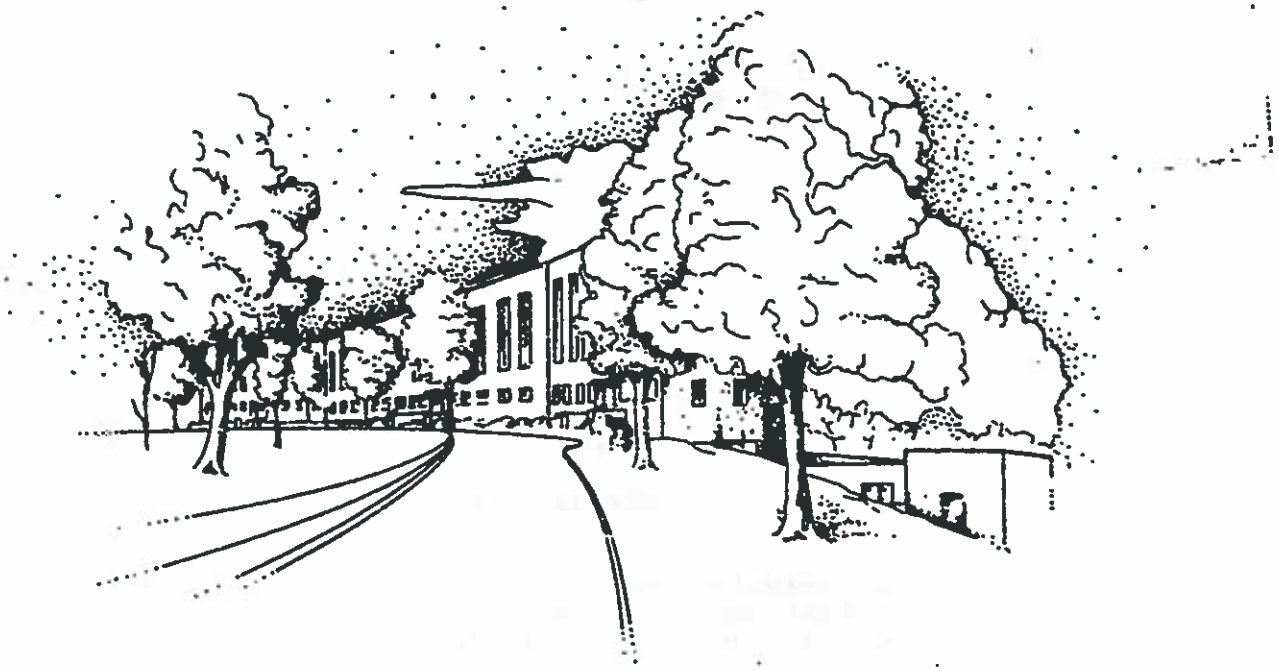

BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION

RESEARCH REPORT

MF12.524.015-0004B

REPORT NO. 2
REVISED

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BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION

Zorach R. Glaser, Ph.D.
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Research Report

Project MF12.524.015-0004B, Report No. 2

Naval Medical Research Institute
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4 October 1971

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ABSTRACT

More than 2000 references on the biological responses to radio frequency and microwave radiation, published up to June 1971, are included in the bibliography.* Particular attention has been paid to the effects on man of non-ionizing radiation at these frequencies. The citations are arranged alphabetically by author, and contain as much information as possible so as to assure effective retrieval of the original documents. An outline of the effects which have been attributed to radio frequency and microwave radiation is also part of the report.

*Three supplementary listings bring the number of citations to more than 2300.

Key Words

Biological Effects
Non-Ionizing Radiation
Radar Hazards
Radio Frequency Radiation
Microwave Radiation
Health Hazards
Bibliography
Electromagnetic Radiation Injury

The comments upon and criticisms of the literature made in this report, and the recommendations and inferences suggested, are those of the author, and do not necessarily reflect the views of the Navy Department or of the Naval Service.

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13. ABSTRACT

More than 2300 references on the biological responses to radio frequency and microwave radiation, published up to April 1972, are included in this bibliography of the world literature. Particular attention has been paid to the effects on man of non-ionizing radiation at these frequencies. The citations are arranged alphabetically by author, and contain as much information as possible so as to assure effective retrieval of the original documents. Soviet and East European literature is included in detail. An outline of the effects which have been attributed to radio frequency and microwave radiation is included as Chapter 1. The revised report (which supersedes DDC report AD#734391) is updated with the inclusion of three supplementary listings, and has incorporated many corrections and additions to the original 2100 citations.

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14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Biological effects						
Non-ionizing radiation						
Radar hazards						
Radio frequency radiation						
Microwave radiation						
Health hazards						
Bibliography						
Electromagnetic radiation injury						
Radiation adverse effects						

TABLE OF CONTENTS

Foreword

It is the hope of the author that this bibliography will provide guidance to the diffuse and conflicting literature on the biological responses to electromagnetic radiation at radio- and microwave-frequencies, with particular reference to the effects of concern to man. Such guidance is needed in the formulation and appraisal of criteria and limits of human exposure to "non-ionizing" radiation, and in the planning and conduct of future research.

The original plans were to categorize and key the literature citations to the "outline of biological and clinical effects" (Chapter 1). This proved to be a much more difficult and time-consuming task than anticipated, and was actually completed only for about 400 papers. Thus, the letter-number combinations given in square brackets for some of the "A" through "C" citations refer to the outline. [NV] indicates the citation was "not verified".

The standard format used throughout the bibliography is: author, (date), journal, volume, (issue): page, "title". The authors are alphabetized, and in chronological order. Multiple authors are also alphabetically ordered according to the second, third, etc., author. Inclusive pagination is given where possible, as is the original language of the citation. Report accession and translation numbers (some of which are cited in Appendix A), and alternate sources are listed when known. The title of books is underlined. When the title of the report was not available (or not given), a short (one line) description of the paper is listed whenever possible. Reports in which the name of the author was not given are listed chronologically using the format, "title", reference, source, (date). In many cases the citation was obtained from secondary (and tertiary) sources. For this reason it was impossible to put every citation into a consistent format.

In a few cases, papers have been cited which were presented at symposia or meetings devoted to the present topic, even when the report title suggests that it does not pertain directly to the topic. This has been done to show the wide range of items considered relevant (at least at the time of the meeting, and by the organizing chairman) in past years. An example is "electroanesthesia".

A few citations of marginal and/or peripheral relationship have also been included so that the reader may judge the applicability to his individual research needs. Examples are reports dealing with the biological effects of static and alternating magnetic fields, experimental techniques using radio frequency and microwave radiation (e.g., electron spin resonance, and nuclear magnetic resonance spectroscopy), and microwave exposure limits, regulations, and standards.

References for a few limited-distribution government reports are available upon request.

The author welcomes information which will correct errors and omissions (both of which no doubt exist). Copies of new papers would be greatly appreciated, and would encourage updating and revising the bibliography periodically.

ACKNOWLEDGMENTS

The assistance and support received during the preparation of this bibliography have been considerable, and I am happy to acknowledge my indebtedness and gratitude. Drs. John Keesey and Dennis Heffner, former and present Heads of the Biophysics Division, and Dr. Seymour Friess, Director of the Environmental Biosciences Department of the Naval Medical Research Institute, permitted me the opportunity to work on the bibliography, and offered frequent encouragement.

Acknowledgment is also due to many friends and associates for their helpful suggestions, comments, and loans and/or gifts of reports or other material, which have been invaluable in the course of the work. Mr. Glenn Heimer of the Naval Ship Engineering Center contributed an extensive collection of government reports and documents, many of which had not previously been cited in the open literature.

Special help in tracing and in the acquisition of relevant papers has been received from the librarians and staff members of the NMRI library: Mrs. Thelma Robinson, Mrs. Ernestine Gendleman, Mrs. Eleanor Capps, and Miss Deborah Grove. Their diligence and resourcefulness in tracing and obtaining copies of a large number of papers and reports, often in spite of incomplete and/or inaccurate citations given in other sources, enabled me to include many relevant items in the bibliography.

Mr. Christopher Dodge of the Scientific and Technical Center, Department of the Navy, provided much of the Soviet Bloc literature, linguistic and other technical assistance, and in addition offered valuable comments and encouragement throughout the preparation of this report. Especially noteworthy were the corrections and improvements suggested by Chris following his reading of the entire manuscript.

Helpful also in locating some of the Soviet literature was Mr. E. S. Serebrennikov, of the Science and Technology Division, The Library of Congress.

Credit is due Mrs. Anna Woke (of this Institute) for translating many of the German papers; to Dr. Emilio Weiss, who translated from the Italian, and to Mrs. Edith Pugh who typed many "first drafts"; also to Mrs. Rhoda Glaser for her help in many aspects of the work.

Mrs. Fannie Epstein deserves special mention for her outstanding editorial assistance, and especially for the heroic typing, organization, and checking of the entire report.

The Outline of Reported Biological Phenomena ('Effects') and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation, is patterned after that given by R. Murray, et al., in an article entitled, "How safe are microwaves", which appeared in Non-Ionizing Radiation 1(1):7-8 (1969). Some of the "effects" were listed in the report by S. F. Cleary and W. T. Ham, Jr., entitled, "Considerations in the evaluation of the biological effects on exposure to microwave radiation", (Background document, Part I, 1969, for the Task Force on Research Planning in Environmental Health, Subtask Force on Physical Factors in the Environment). The discussion and suggestions offered by Byron McLees, Edward Finch, Lewis Gershman, and Christopher Dodge relating to the Outline are also gratefully acknowledged.

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CHAPTER 1

Reported Biological Phenomena ("Effects") and Some Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation (See Note)

A. Heating of Organs* (Applications: Diathermy, Electrosurgery, Electrocoagulation, Electrodesiccation, Electrotomy)

1. Whole Body (temperature regulation defects), Hyperpyrexia
2. Skin
3. Bone and Bone Marrow
4. (a) Lens of Eye (cataractous lesions - due to the avascular nature of the lens which prevents adequate heat dissipation.) (b) Corneal damage also possible at extremely high frequencies.
5. Genitalia (tubular degeneration of testicles)
6. Brain
7. Sinuses
8. Metal Implants (burns near hip pins, etc.)

The effects are generally reversible except for 4a.

B. Changes in Physiologic Function

1. Striated Muscle Contraction
2. Alteration of Diameter of Blood Vessels (increased vascular elasticity), Dilation
3. Changes in the Oxidative Processes in Tissues and Organs
4. Liver Enlargement
5. Altered Sensitivity to Drug Stimuli
6. Decreased Spermatogenesis (decreased fertility, to sterility)
7. Altered Sex Ratio of Births (more girls!)
8. Altered Menstrual Activity
9. Altered Fetal Development
10. Decreased Lactation in Nursing Mothers
11. Reduction in Diuresis (Na^+ excretion via urine output)
12. Altered Renal Function (decreased filtration in tubules)
13. Changes in Conditioned Reflexes
14. Decreased Electrical Resistance of Skin
15. Changes in the Structure of Skin Receptors of the (a) Digestive, and (b) Blood-Carrying Systems
16. Altered Blood Flow Rate

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* It is also reported that low levels of irradiation produce a cooling effect - "hypercompensation".

Note: These effects are listed without comment or endorsement since the literature abounds with conflicting reports. In some cases the basis for reporting an "effect" was a single or a non-statistical observation which may have been drawn from a poorly conceived (and poorly executed) experiment.

17. Alterations in the Biocurrents (EEG?) of the Cerebral Cortex (in animals)
18. Changes in the Rate of Clearance of Tagged Ions from Tissue
19. Reversible Structural Changes in the Cerebral Cortex and the Diencephalon
20. Electrocardiographic (EKG) Changes
21. Alterations in Sensitivity to Light, Sound, and Olfactory Stimuli
22. Functional (a) and Pathological (b) Changes in the Eyes: (a) decrease in size of blind spot, altered color recognition, changes in intraocular pressure, lacrimation, trembling of eyelids; (b) lens opacity and coagulation, altered tissue respiration, and altered reduction-oxidation processes
23. Myocardial Necrosis
24. Hemorrhage in Lungs, Liver, Gut, and Brain } At Fatal Levels
25. Generalized Degeneration of all Body Tissue } of Radiation
26. Loss of Anatomical Parts
27. Death
28. Dehydration
29. Altered Rate of Calcification of Certain Tissue

C. Central Nervous System Effects

1. Headaches
2. Insomnia
3. Restlessness (Awake and During Sleep)
4. Electroencephalographic (EEG) Changes
5. Cranial Nerve Disorders
6. Pyramidal Tract Lesions
7. Conditioned Reflex Disorders
8. Vagomimetic Action of the Heart; Sympaticomimetic Action
9. Seizures, Convulsions

D. Autonomic Nervous System Effects

1. Neuro-vegetative Disorders (e.g., alteration of heart rhythm)
2. Fatigue
3. Structural Alterations in the Synapses of the Vagus Nerve
4. Stimulation of Parasympathetic Nervous System (Bradycardia), and Inhibition of the Sympathetic Nervous System

E. Peripheral Nervous System Effects

Effects on Locomotor Nerves

F. Psychological Disorders ("Human Behavioral Studies") - the so-called "Psychophysiologic (and Psychosomatic) Responses"

1. Neurasthenia - (general "bad" feeling)
2. Depression
3. Impotence
4. Anxiety
5. Lack of Concentration
6. Hypochondria
7. Dizziness
8. Hallucinations
9. Sleepiness
10. Insomnia
11. Increased Irritability
12. Decreased Appetite
13. Loss of Memory
14. Scalp Sensations
15. Increased Fatigability
16. Chest Pain
17. Tremor of the Hands

G. Behavioral Changes (Animal Studies)

Reflexive, Operant, Avoidance, and Discrimination Behaviors

H. Blood Disorders

(V = in vivo)
(v = in vitro)

Changes in:

1. Blood and Bone Marrow
2. Phagocytic (polymorphs) and Bactericidal Functions of Blood (V,v)
3. Hemolysis Rate (increase), (a shortened lifespan of cells)
4. Sedimentation Rate (increase), (due to changes in serum protein levels or amount of fibrinogen (?))
5. Number of Erythrocytes (decrease), also number of Hyaline cells
6. Blood Glucose Concentration (increase)
7. Blood Histamine Content
8. Cholesterol and Lipids
9. Gamma (also α and β) Globulin, and Total Protein Concentration
10. Number of Eosinophils
11. Albumin/Globulin Ratio (decrease)
12. Hemopoiesis (rate of formation of blood corpuscles)
13. Leukopenia (increase in number of white cells), and Leukocytosis
14. Reticulocytosis

I. Vascular Disorders

1. Thrombosis
2. Hypertension

J. Enzyme and Other Biochemical Changes

Changes in activity of:
1. Cholinesterase (V,v)
2. Phosphatase (v)
3. Transaminase (v)
4. Amylase (v)
5. Carboxydismutase

6. Protein Denaturation
7. Toxin, Fungus, and Virus Inactivation (at high radiation dose levels), Bacteriostatic Effect
8. Tissue Cultures Killed
9. Alteration in Rate of Cell Division
10. Increased Concentration of RNA in Lymphocytes, and Decreased Concentration in Brain, Liver, and Spleen
11. Changes in Pyruvic Acid, Lactic Acid, and Creatinine Excretions
12. Change in Concentration of Glycogen in Liver (Hyperglycemia)
13. Alteration in Concentration of 17- Ketosteroids in Urine

K. Metabolic Disorders

1. Glycosuria (sugar in urine; related with blood sugar?)
2. Increase in Urinary Phenol (derivatives? DOPA?)
3. Alteration of Rate of Metabolic Enzymatic Processes
4. Altered Carbohydrate Metabolism

L. Gastro-Intestinal Disorders

1. Anorexia (loss of appetite)
2. Epigastric Pain
3. Constipation
4. Altered Secretion of Stomach "Digestive Juices"

M. Endocrine Gland Changes

1. Altered Pituitary Function
2. Hyperthyroidism
3. Thyroid Enlargement
4. Increased Uptake of Radioactive Iodine by Thyroid Gland
5. Altered Adrenal Cortex Activity
6. Decreased Corticosteroids in Blood
7. Decreased Glucocorticoidal Activity
8. Hypogonadism (usually decreased testosterone production)

N. Histological Changes

1. Changes in Tubular Epithelium of Testicles
2. Gross Changes

O. Genetic and Chromosomal Changes

1. Chromosome Aberrations (e.g., linear shortening, pseudochiasm, diploid structures, amitotic division, bridging, "sticky" chromosomes, irregularities in chromosomal envelope)
2. Mutations
3. Mongolism
4. Somatic Alterations (changes in cell not involving nucleus or chromosomes, cellular transformation)
5. Neoplastic Diseases (e.g., tumors)

P. Pearl Chain Effect (Intracellular orientation of subcellular particles, and orientation of cellular and other (non-biologic) particles)

Also, orientation of animals, birds, and fish in electromagnetic fields

Q. Miscellaneous Effects

1. Sparking between dental fillings
2. Peculiar metallic taste in mouth
3. Changes in Optical Activity of Colloidal Solutions
4. Treatment for Syphilis, Poliomyelitis, Skin Diseases
5. Loss of Hair
6. Brittleness of Hair
7. Sensations of Buzzing Vibrations, Pulsations, and Tickling About the Head and Ears
8. Copious Perspiration, Salivation, and Protrusion of Tongue
9. Changes in the Operation of Implanted Cardiac Pacemakers
10. Changes in Circadian Rhythms

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RADIOFREQUENCY/MICROWAVE RADIATION BIOLOGICAL EFFECTS AND SAFETY STANDARDS: A REVIEW

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The study of human exposure to radiofrequency/microwave (RF/MW) radiation has been the subject of widespread investigation and analysis. It is known that electromagnetic radiation has a biological effect on human tissue. An attempt has been made by researchers to quantify the effects of radiation exposure on the human body and to set guidelines for safe exposure levels. A review of the pertinent findings is presented along with the American National Standards Institute (ANSI) recommended safety standard (C95.1-1982) and the United States Air Force permissible exposure limit for RF/MW radiation (AFOSH Standard 161-9, 12 Feb 87). An overview of research conducted in the Soviet Union and Eastern Europe is also included in this report.

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Radiofrequency/Micowave Radiation Biological Effects and Safety Standards: A Review

Scott M. Bolen
June 1988

Abstract

The study of human exposure to radiofrequency/microwave radiation has been the subject of widespread investigation and analysis. It is known that electromagnetic radiation has a biological effect on human tissue. An attempt has been made by researchers to quantify the effects of radiation on the human body and to set guidelines for safe exposure levels. A review of the pertinent findings is presented along with the American National Standards Institute (ANSI) recommended safety standard (C95.1-1982) and the United States Air Force permissible exposure limit for RF/MW radiation (AFOSH Standard 161-9, 12 February 1987). An overview of research that was conducted in the Soviet Union and Eastern Europe is also included in this report.

I. INTRODUCTION

In 1956, the Department of Defense (DOD) directed the Armed Forces to investigate the biological effects of exposure to radiofrequency/microwave (RF/MW) radiation. The Army, Navy, and Air Force Departments commissioned a Tri-Service Program under the supervision of the Air Force to meet the DOD directive [14], [15]. The Rome Air Development Center and the Air Research and Development Headquarters were ultimately given responsibility to manage the program. On July 15-16, 1957 the first of four Tri-Service Conferences was held to discuss the effects of RF/MW radiation. These conferences were the first major effort put forth by the scientific community to explore the biological effects of exposure to RF/MW radiation [14]. Since then, researchers have discovered a number of biological dysfunctions that can occur in living organisms. Exposure of the human body to RF/MW radiation has many biological implications. The effects range from innocuous sensations of warmth to serious physiological damage to the eye [1], [2], [5], [6], [8], [15]. There is also evidence that RF/MW radiation can cause cancer [8].

The absorption of RF/MW radiated energy causes biological reactions to occur in the tissue of the human body. In order to determine safe exposure levels and to understand the effect of RF/MW radiation it is necessary to know the absorption characteristics of the human tissue. The National Institute for Occupational Safety and Health (NIOSH) [8] has reported several physical properties that account for energy absorption in biological materials. Factors which govern energy absorption include: (1) strength of the external electromagnetic (EM) field, 2) frequency of the RF/MW source, 3) the degree of hydration of the tissue, and 4) the physical dimensions, geometry, and orientation of the absorbing body with respect to the radiation EM field [8]. There is some disagreement among researchers in determining a specific measure for the dose of RF/MW radiation contracted by

biological materials. The most commonly accepted measure is the Specific Absorption Rate (SAR). The SAR is defined as the rate at which RF/MW radiated energy is imparted to the body - typically in units of watts per kilogram (W/Kg) [4]. The deposition of energy specified in terms of milliwatts per square centimeter (mW/cm^2) over the irradiated surface is also widely accepted [9].

Based on the known absorption rates and the inherent biological effects of RF/MW radiated energy, researchers have put forth a number of standards regarding safe exposure levels. In some instances standards recommended by different examining authorities are in conflict. For example, the USAF Standard 161-9 (enacted 12 February 1987) allows for a permissible exposure level of 10 mW/cm^2 for persons working in restricted areas and 5 mW/cm^2 for persons working in unrestricted areas [10]. The ANSI guideline specifies a maximum safe exposure level of 5 mW/cm^2 over the whole-body area for anyone in contact with RF/MW radiation [9]. These differences reflect the way in which each examining authority has interpreted the available RF/MW radiation exposure data.

II. BIOLOGICAL EFFECTS

Exposure to RF/MW radiation is known to have a biological effect on animals and humans. Damage to major organs, disruption of important biological processes, and the potential risk of cancer represent the dangers of RF/MW radiation to living organisms. Pulsed radiation appears to have the greatest impact on biological materials [8].

The response of biological materials to the absorption of thermal energy is the most perceptible effect of exposure to RF/MW radiation [7]. The energy emitted from an RF/MW source is absorbed by the human tissue primarily as heat. In this case, the radiated energy is disposed in the molecules of the tissue. Dipole molecules of water and protein are stimulated and will vibrate as energy is absorbed throughout the irradiated tissue area. Ionic conduction will also occur in the same area where the radiation is incident. It is from these two natural processes that radiant energy is converted into heat [11]. The thermal effect of continuous wave (CW) and pulsed radiation is considered to be the same [13].

Nonthermal responses can be less noticeable and are often more difficult to explain than thermal effects. These responses are related to the disturbances in the tissue not caused by heating. Electromagnetic fields can interact with the bioelectrical functions of the irradiated human tissue [8]. Research conducted in the Soviet Union and Eastern Europe suggests that the human body may be more sensitive to the nonthermal effects of RF/MW radiation [3].

There are many reported biological effects to humans and animals that are exposed to RF/MW radiation. A review of the important findings is given in the following:

A. Heating Effect on the Skin

Most RF/MW radiation penetrates only to the outer surface of the body. This is especially true for RF/MW frequencies greater than 3 GHz where the likely depth of penetration is about 1-10 mm [3]. At frequencies above 10 GHz the absorption of energy will occur mostly at the outer skin surface. Since the thermal receptors of the body are contained primarily in this region, the perception of RF/MW radiation at these frequencies

may be similar to that of infrared (IR) radiation [3], [6].

In 1937, J. Hardy and T. Oppel published an investigative paper on the thermal effects of IR radiation. Their findings were used by Om Gandhi and Abbas Riazi [6] to explain the thermal effect of RF/MW radiation on the human body (the reference for Hardy and Oppel can be found in [6]). Figure 1 shows the results obtained from the 1937 report. As described by Gandhi and Riazi, the findings presented by Hardy and Oppel show that sensations of warmth begin to occur when the whole-body is irradiated at a CW power density of about 0.67 mW/cm^2. Hardy and Oppel based their work on exposure to IR radiation. From other published reports, Gandhi and Riazi noted that there is a correlation between the radiating frequency of the incident RF/MW energy and the threshold for perception. For example, on an exposed area of the forehead of 37 cm^2 a perception of warmth was reported for incident power densities of 29.9 and 12.5 mW/cm^2 from sources radiating at 3 and 10 GHz respectively [6].

Other observations made by Hardy and Oppel showed that when smaller body areas were irradiated, larger power densities were required to stimulate the thermal receptors in the skin. Gandhi and Riazi were able to confirm this result with reports from recent papers. They found that irradiation of an exposed body area of 40.6 cm^2 to a power density of about 21.7 mW/cm^2 yielded the same thermal perception as did the irradiation of a smaller body area of 9.6 cm^2 to a power density of about 55.9 mW/cm^2. Hardy and Oppel reported that thermal sensations occurred within about 3 seconds after irradiation of the body tissue. More recent findings indicate a reaction time of closer to 1 second [6].

Gandhi and Riazi [6] have also reported that the depth of penetration of RF/MW radiation has an impact on the power density threshold needed to stimulate the perception of warmth. As a comparison, IR radiation will not penetrate the outer body surface as deeply as RF/MW radiation emitted at a frequency of 2.45 GHz. Clinical observations have shown that irradiation of the ventral surface of the arm by an RF/MW source radiation at 2.45 GHz will cause a sensation of warmth when the incident power density is about 26.7 mW/cm^2. For incident IR radiation a perception of warmth occurs at a power density of 1.7 mW/cm^2. They estimated that at millimeter wavelengths the perception of warmth may occur at a power density level of about 8.7 mW/cm^2.

Exposure to higher levels of radiation can cause serious biological effects. Because of the physical dimensions and geometry of the human body, RF/MW radiated energy is nonuniformily deposited over the whole-body surface. Some areas on the skin and outer body surface will absorb higher amounts of the radiated energy. These areas will be marked by "hot spots" of high temperatures [7], [11], [16]. Experiments conducted on laboratory animals have shown, that skin burns typically occur in the areas of hot spots. The penetration of RF/MW radiation also causes skin burns to be relatively deep [11]. In experiments sponsored by the Tri-Service Commission, it was reported that RF/MW radiation burns over the rib cages of dogs caused severe subcutaneous damage that did not visibly appear for weeks after the injury was sustained [20]. Burns can cause increased vascular permeability. This can lead to significant losses of body fluids and electrolytes. Serious burns can suffer fluid losses for a few days. Blood circulation can be altered in the effected area and other biological functions could be indirectly affected [12].

B. Whole-Body Hyperthermia

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Thermal energy absorbed by the whole-body can cause a rise in body temperature. When the human body is irradiated by an RF/MW source at an incident power density of 10 mW/cm^2 there will be a rise in body temperature of about 1° C. The total thermal energy absorbed at this power density is about 58 watts. Typically, at rest the human basal metabolic rate is about 80 watts and it is about 290 watts during periods of moderate activity. Exposure of the human body to low power RF/MW radiation does not appear to impose any appreciable thermal hazard. These figures were reported by The U.S. Department of Health, Education and Welfare [3].

Adverse biological effects can occur when the body is subjected to high doses of RF/MW radiation [16]. In this instance large amounts of thermal energy can be absorbed by the body. A dramatic influx of energy can overburden thermoregulatory mechanisms. If excess heat cannot be exhausted the core temperature of the body will rise to a dangerous level resulting in hyperthermia [12], [16]. The biological response to excess heat buildup is the dilation of blood vessels at the surface of the skin and the evaporation of water through sweating. These are the primary mechanisms for heat dissipation. Hyperthermia can cause severe dehydration and the loss of electrolytes such as sodium chloride. Other harmful effects include fever, heat exhaustion, and heat fatigue. Heat stress is the most serious consequence of hyperthermia. Cardiac failure and heat stroke can result from heat stress [12].

It has also been noted that hyperthermia may cause injury to blood-brain barrier (BBB) [19]. This barrier refers to the several biological materials that separate the essential elements of the central nervous system from the blood [18]. High cerebral temperatures exceeding 43°C may damage the BBB. The result can be a disruption of blood vessel continuity or integrity and degradation of the flow of blood and other body fluids in the brain [19].

C. *Local Hyperthermia*

The nonuniform deposition of RF/MW radiated energy over the whole-body surface causes the body to be heated unevenly. Local areas where temperatures rise above 41.6°C can experience damage to the tissue [16]. In these areas it is possible that harmful toxins could be released as result of the high temperatures. Heating can cause cell membranes and blood capillaries to become more permeable. An increase in capillary permeability can lead to a loss of plasma proteins. The denaturation of proteins can also occur within cells [11], [16]. This can lead to changes in the physical properties and biological functions of proteins [18]. Denaturation of proteins can also cause polypeptide and histamine-like substances to become active [11], [16]. Histamines can stimulate gastric secretion, accelerate the heart rate, and cause the dilation of blood vessels resulting in lower blood pressure [18]. Areas of the body where blood circulation is poor or where thermal regulation is insufficient, are more susceptible to injury [11].

D. *Carcinogenic Effects*

The carcinogenic effects of exposure to RF/MW radiation are not well known. It is difficult to clinically establish a link to cancer. The problem that researchers have in linking

RF/MW radiation to cancer is that the disease itself is prevalent and can be caused by a variety of environmental factors. In fact cancer is the second leading cause of death in the United States. There are, however, published reports that reveal some insights into the carcinogenic nature of RF/MW radiation. Nonthermal effects may provide important clues to the understanding of carcinogenic reactions in the human body [8],[32].

i. Pathological Reports

In 1962, S. Prausnitz and C. Susskind reported experimental results that showed an increase in cancer among test animals exposed to RF/MW radiation. In the experiment, 100 male Swiss albino mice were irradiated by a 10 GHz RF/MW source at an incident power density of about 100 mW/cm^2. The mice were exposed for 4.5 minutes/day, 5 days/week for a total of 59 weeks. It was noted that irradiation caused the whole-body temperature of the mice to rise about 3.3°C. Upon examination, it was found that 35% of the mice had developed cancer of the white blood cells. The disease was observed as monocytic or lymphatic leucosis or lymphatic or myeloid leukemia. Only 10% of a similar control group had developed cancer [21].

There have been a few allegations that RF/MW radiation has induced cancer in humans [8], [15]. The NIOSH Technical Report [8] cites charges made in the early 1970's against Philco-Ford and The Boeing Corporation that occupational exposure to RF/MW radiation caused cancer among employees. One incident was reported at each company. At Philco-Ford it was claimed that exposure caused a rare form of brain cancer to manifest in one worker that eventually resulted in death. In each case, there was no scientific proof that RF/MW radiation had induced cancer in the company employees. There was also a report that EM fields induced cancer in an individual that worked at the U.S. Embassy in Moscow. Again, there was no scientific evidence that supported the claim [8].

Recently, the Observer Dispatch, a local newspaper published in Utica, New York, reported that a major study has just been completed in Sweden. The study concluded that children who live near high power lines have a greater risk of developing leukemia than children who live farther away from the power lines. The study involved 500,000 people and provided some evidence to link the electromagnetic fields produced by low frequency power lines to cancer. The researchers, however, cautioned against drawing firm conclusions as a result of the research [33]

ii. Effect on Chromosomes

It has been observed that disturbances in chromosomic activity can cause cancerous aberrations to occur in the human body. In 1974, a paper published by K. Chen, A. Samuel, and R. Hoopingarner (reference found in [8]) reported that chromosomal abnormalities can be linked to chronic myeloid leukemia. Serious genetic mutations can also result from such abnormalities that can lead to malignancies in the tissue [8].

In 1976, A. A. Kapustin, M. I. Rudnev, G. I. Leonskaia, and G.I. Knobecva (reference found in [17]) reported alterations in the chromosomes of bone marrow cells in laboratory animals that were exposed to RW/MW radiation. They exposed inbred albino rats to a 2500 MHz RF/MW source at incident power density levels of 50 and 500 uW/cm^2. Irradiation lasted for 7 hours/day for 10 days. Upon examination of the animals, they

observed chromosomal anomalies that appeared in forms described as polyploidy, aneuploidy, chormatic deletion, acentric fragments and chromatic gaps [17].

The NIOSH Technical Report [8] summarizes the findings of several researchers. Chromosomal and mitotic anomalies have been observed in a variety of animal and human cells for varying exposures to RF/MW radiation. Pulsed and CW radiation ranging in frequency from 15 to 2950 MHz and power densities from 7 to 200 mW/cm^2 have caused abnormalities to occur in chromosomes. The reported affects include: linear shortening of the chromosomes, irregularities in the chromosomal envelope, abnormal bridges and stickiness, translocations, chromosomal breaks and gaps, chromatid breaks, acentric chromosomes, dicentric chromosomes, deletions, fragmentation, and ring chromosomes [8].

iii. Mutagenic Effects

Reported evidence indicates that biological interaction with EM fields can cause the formation of mutagens in cells. In 1974, three Soviet researchers, Danilenko, Mirutenko, and Kudrenko (reference found in [8]) published results showing a mutagenic effect of RF/MW radiation. Mutagens were observed to form in cells that were irradiated by a pulsed RF/MW source operating at 37 GHz and 1 mW/cm^2 power intensity. They concluded that irradiation of tissue by pulsed RF/MW sources causes cell membranes to become more permeable to destructive chemical mutagens [8].

Results published in 1963 by G. H. Mickey (reference found in [8]) showed hereditary changes to occur in drosphila germ cells that were exposed to pulsed modulated RF/MW radiation for carrier frequencies between 5-40 MHz [8]. Evidence of RF/MW induced teratogenesis in animals has also been reported by researchers. The effect of exposure to CW radiation was observed by Rugh and McManaway in 1976 (reference found in [8]). They found gross congenital abnormalities in rodent fetuses that were irradiated by a 2450 MHz RF/MW source at an incident power intensity of 107.4 mW/g [8].

iv. Lymphoblastoid Transformations

Lymphoblastoid Transformations refer to changes in the physical nature of lymphoblasts. Mature lymphoblast cells (i.e. lymphocytes) participate in the immune system of the body [18]. Lymphoblastoid transformations induced by RF/MW radiation appear to be similar to transformations present in disorders contributing to abnormal growth in lymphoid tissues and in certain types of leukemia. RF/MW radiation induced transformations, however, do not appear to be malignant and are not likely to spread among healthy cells [8].

W. Stodlink-Baranska reported (reference found in [8]) lymphoblastoid transformations to occur when human lymphocyte cells were exposed to a 2950 MHz pulsed RF/MW source at power density levels of 7 and 20 mW/cm^2. In 1975, P. Czerski also reported (reference found in [8]) observing lymphoblastoid transformations after irradiation of purified human lymphocyte suspensions by an RF/MW source radiating at 2950 MHz for variable power density levels. In addition, Czerski reported acute transformations occurring in adult mice and rabbits that were irradiated by a pulsed RF/MW source radiating at 2950 MHz and at low power density levels of 0.5 and 5 mW/cm^2 respectively [8].

v. Oncogenic Effects

Oncogenic effects have been linked to imbalances in the regulatory mechanisms of the body. A 1974 report published by E. Klimkova-Deutschova (reference found in [8]) claimed that persons exposed to RF/MW radiation experience biochemical reactions. The report indicated alterations in fasting blood sugar levels, a decrease in the ability to dispose of normal metabolic waste, and depressed serum levels of pyruvate and lactate. These biochemical reactions point to the possibility of regulatory malfunctions occurring in the body. It has been suggested that certain regulatory imbalances may promote the growth of tumors. A change in hormonal levels has been observed to cause oncogenic effects in tissues that require hormonal balances to function properly. The presence of hormones in other tissue areas may effect the development of existing tumors in those areas [8].

E. Cardiovascular Effects

Most of the cardiovascular effects of RF/MW radiation have been reported by researchers in the Soviet Union and Eastern Europe. Soviet investigators claim that exposure to low levels of RF/MW radiation that are not sufficient to induce hyperthermia can cause aberrations in the cardiovascular system of the body [7].

One experiment performed on rabbits indicates that several types of cardiovascular dysfunctions could be possible. An RF/MW source radiating at 2375 MHz was used to irradiate rabbits for a test period of 60 days under varying field intensities. For field strengths ranging from 3-6 V/M researchers noted a sharp increase in the heart rate of the animals. This effect was observed to subside with time. Exposure to field strengths of 0.5-1.0 V/M caused the heart rate to become slower than normal. No effect was reported for rabbits that were exposed to EM field intensities below 0.2 V/M [17]. Other effects that have been observed by Soviet researchers, are alterations in EKG and low blood pressure [7], [17].

The NIOSH Technical Report [8] references a Soviet study published in 1974 by M. N. Sadcikoiva that suggests some connection between RF/MW radiation exposure and the potential for cardiovascular disturbances in humans. Researchers examined 100 patients suffering from radiation sickness. It was found that 71 of the patients had some type of cardiovascular problem. Most of these patients had been exposed to RF/MW radiation for periods ranging from 5-15 years. A smaller group of patients exposed for shorter time periods also experienced cardiovascular irregularities. The study concluded that there is a probable link between exposure to RF/MW radiation and cardiovascular disease [8].

F. The North Karelian Project

In response to earlier Soviet reports, the World Health Organization (WHO) decided to conduct a comprehensive study on the biological effects of exposure to RF/MW radiation. In 1976, M. Zaret published the results of the study (reference found in [8]). The WHO investigation focused on the population of North Karelia, a remote area of Finland that borders the Soviet Union. This region was selected because of its close proximity to a then Soviet early warning radar station. North Karelia is geographically located in the path of intercontinental ballistic missiles that would originate from the midwest United States. To

detect these missiles, the Soviets constructed a number of high power tropospheric scattering radar units adjacent to nearby Lake Ladoga. The operation of these units exposes the residents of North Karelia to large doses of ground and scatter radiation. The WHO investigation found evidence linking exposure of RF/MW radiation to cardiovascular disease and cancer. The North Karelian population suffered from an unusually high number of heart attacks and cases of cancer. In addition, it was found that the affliction rate of these diseases was much higher among residents living closest to the radar site [8].

G. Hematologic Effects

There is evidence that RF/MW radiation can effect the blood and blood forming systems of animals and humans. Experiments conducted in the Soviet Union have indicated changes in blood cell levels and alterations in the biological activities of hematologic elements. Other investigators have reported similar effects [7], [8], [17].

The results of an experiment reported in 1979 by V. M. Shtemier showed a decrease in the biological activity of butyryl cholinesterase in rats that were exposed to pulsed RF/MW radiation (reference found in [17]). The experiment subjected 15 rats to a 3000 MHz pulsed RF/MW source with an incident power density of 10 mW/cm^2. The rats were irradiated for 1 hour/day over several days. After 42 days, there was a loss of biological activity of the butyryl cholinesterase enzyme caused by a decrease in the concentration of the enzyme in the bloodstream of the rats [17]. Cholinesterase is a catalyst in the hydrolysis of acetylcholine into choline and an anion. Choline is a useful enzyme that prevents the deposition of fat in the liver [18].

In another experiment, 20 male rats were exposed to a 2376 MHz pulsed RF/MW source with an incident power density of 24.4 mW/cm_2. Each rat was exposed for 4 hours/day, 5 days/week for 7 weeks. Blood samples were taken periodically and examined for anomalies. After repeated exposures, it was discovered that the number of lymphocytes and leukocytes (white blood cells) in the bloodstream of the rats was lower than normal. The biological activity of alkaline phosphatase in neutrophil leukocytes was also found to increase when the rats were irradiated [17].

The results of several other experiments are summarized in the NIOSH Technical Report [8]. RF/MW radiation has been observed to cause: an increase in the amount of exudate in bone marrow, the transient disappearance of fat cells from bone marrow, destruction and loss of essential bone marrow cells, underdeveloped marrow, a decrease in the number of red blood cells, and an imbalance in the number of lymphocytes in the bloodstream [8].

H. Effect to the Central Nervous System

There is documented evidence that exposure to RF/MW radiation can cause a disturbance in the central nervous system (CNS) of living organisms [3], [8], [11], [17]. Soviet investigators claim that exposure to low-level radiation can induce serious CNS dysfunctions. Experiments conducted in the Soviet Union and Eastern Europe have exposed live subjects to radiation levels that are near or below the recommended safe levels prescribed by the ANSI Standard and the USAF AFOSH Standard [17].

Part 1 of 8, Additional information found TheBrainCan.com , SolomonSeries.com, and https://www.youtube.com/solomonseries

i. Pathological Report

Soviet investigators claim that the central nervous system (CNS) is highly sensitive to RF/MW radiation [3], [8], [11], [17]. The NIOSH Technical Report [8] summarized the results of a pathological study published by A. A. Letavet and Z. V. Gordon in 1960. The researchers reported that several CNS related disorders were discovered among 525 workers exposed to RF/MW radiation. The symptoms were listed as: hypotension, slower than normal heart rates, an increase in the histamine content of the blood, an increase in the activity of the thyroid gland, disruption of the endocrine-hormonal process, alterations in the sensitivity to smell, headaches, irritability, and increased fatigue. Other researchers have acknowledged similar biological responses [8].

ii. Soviet Union Experimental Results

Several experiments have been performed in the Soviet Union and Eastern Europe that demonstrate a variety of biological effects that can occur in living organisms. observations of laboratory animals subjected to low power EM fields showed alterations in the electrical activity of the cerebral cortex and disruptions in the activity of neurons [17].

L. K. Yereshova and YU. D. Dumanski (reference found in [17]) exposed rabbits and white male rats to a continuous wave 2.50 GHz RF/MW source. The animals were irradiated for 8 hours/day over a period of 3 to 4 months at power density levels of 1, 5, and 10 uW/cm^2. It was observed that rabbits exposed to the 5 and 10 uW/cm^2 power density levels suffered alterations in the electrical activity of the cerebra cortex and disturbances to the conditioned reflex response. They concluded that exposure to RF/MW radiation caused perturbations in the higher functioning centers of the CNS in the laboratory animals [17].

An experiment conducted by V. R. Faytel'berg-Blank and G. M. Fcrevalov demonstrated the biological effects of RF/MW radiation on the activity of neurons (reference found in [17]. They subjected chinchilla rabbits to a 460 MHz RF/MW source at incident power densities of 2 and 5 mW/cm^2. Only the heads of the rabbits were irradiated and exposures lasted for 10 minutes. Exposure at the 2 mW/cm^2 power density level caused neuronal activity to increase and evoked an electroencephalogram (EEG) activation reaction. Neuronal activity was observed to decrease at the higher power density level. These results indicated that RF/MW radiation can cause neurophysiological alterations in animals. These biological responses may be dependent on the intensity of the radiation [17].

iii. Behavioral Effects

Exposure to RF/MW radiation has been observed to cause a disruption in the behavior of animals. Experiments conducted on rats and nonhuman primates indicates that conditioned responses can be altered as a result of irradiation. Researchers indicate that behavior may be the most sensitive biological component to RF/MW radiation [1], [7], [9], [29].

D. R. Justesen and N. W. King (reference found in [7]) reported experimental results that demonstrated a degenerative behavioral effect in laboratory animals that were exposed to RF/MW radiation. The results were published in 1970. They exposed rats to a 2450 MHz multimodal resonating cavity system. Exposure was periodic with irradiation times lasting for 5 minutes and recurring every 5 minutes. This cycle as sustained for 60 minutes. The

experiment tested the effect of irradiation at whole-body energy absorption rates of 3.0, 6.2, and 9.2 W/Kg. It was observed that for a SAR of 6.2 W/Kg the behavioral performance of the rats degraded significantly and activity usually terminated at the end of the 60 minute exposure period [7].

In 1977, James Lin, Arthur Guy, and Lynn Caldwell [29] reported experimental results that showed alterations in the behavioral response of rats that were exposed to RF/MW radiation. White female rats were trained to execute a "head raising" movement in return for a food pellet. The total number of such movements was counted during each exposure session in order to quantify the effect of irradiation. The animals were exposed to a 918 MHz RF/MW source at power density levels of 10, 20, and 40 mW/cm^2. Clinical observations showed that baseline responses remained unchanged for irradiation at the lower power density levels of 10 and 20 mW/cm^2. At 40 mW/cm^2, however, behavioral responses decreased rapidly after 5 minutes of continuous exposure. After about 15 minutes of exposure, behavioral activity terminated. It was determined that the peak energy absorption at 40 mW/cm^2 was about 32 W/Kg and the average absorption was 8.4 W/Kg over the whole-body surface [29].

iv. Synergetic Effect of Drugs RF/MW Radiation

In 1979, J. R. Thomas et al. reported that psychoactive drugs and RF/MW radiation may have a synergetic effect on living organisms (references for Thomas can be found in [1]). Experiments were conducted on laboratory animals. Male albino rats were administered dextroamphetamine and irradiated with a pulsed 2450 MHz RF/MW source at 1 W/cm^2 power intensity for periods of 30 minutes. It was found that the number of clinical responses observed per minute in the rats diminished more rapidly under the stimulus of both agents than in the control condition where just the drug was administered. This indicates that the effects of RF/MW radiation may be enhanced by certain drugs [1].

v. Analeptic Effect in Animals

Pulsed RF/MW radiation was reported to have an analeptic effect in laboratory animals. Experimental results presented by R. D. McAfee in 1971 showed that anethesized animals could be awakened by irradiation from a pulsed 10 GHz RF/MW source. The energy incident on the test animals was estimated to have a power density of between 20-40 mW/cm^2. Experiments conducted on rats showed that these animals were aroused from states of deep sleep by irradiation. It was observed that the blood pressure of a rat decreased simultaneously with the arousal response and that laryngeal spasms would occur when the rat was awakened. McAfee reported that the laryngeal spasms would obstruct the airway causing convulsions, asphyxiation, and eventually death. Other experiments performed on rabbits, cats, and dogs showed that these animals could also be awakened by irradiation. The larger animals, however, did not asphyxiate themselves, The blood pressure of the dogs and cats was observed to rise as they were awakened. In all cases, the arousal response was stimulated only when the head of the animal was irradiated. The body temperature of the test animals was not observed to rise as a result of irradiation. This indicates that the analeptic effect of RF/MW radiation may be nonthermal in nature [20].

I. Immunological Effect

Exposure to RF/MW radiation has been observed to cause physical alterations in the essential cells of the immune system and a degradation of immunologic responses [7], [17]. Experimental results published by Soviet and Eastern European researchers indicate that irradiation can cause injury and trauma to the internal body organs that comprise the immune system. Even exposure to low levels of RF/MW radiation can impair immunologic functions [17].

As discussed earlier, lymphoblasts can undergo physical alterations as a result of irradiation. Lymohiblastoid mutagens are similar in structure to leukemia cells [8]. Lymphoblasts are the precursors to leukocyte cells that participate in the immune system [18].

In 1979, N. P. Zalyubovskaya and R. I. Kiselev (reference found in [17]) reported that exposure to RF/MW radiation caused serious damage to the immune system of laboratory animals. They exposed mice to an RF/MW source radiating at 46.1 GHz with an incident power intensity of 1 mW/cm^2 for 15 minutes/day for 20 days, it was observed that the number of leukocytes in the bloodstream of the mice decreased as a result of irradiation. Effective quantities of enzymatic proteins in serum that combine with antigen-antibody complex and antibacterial agents such as lysozyme were also reduced. Zalyubovskaya and Kiselev reported a decrease in the phagocytic activity of neutrophils and a diminished resistance to infections caused by tetanic toxins. Immunity to typhoid and other tetanic toxins induced by vaccination or by the administration of antitoxins was rendered ineffective. Further examination of the mice revealed injury and trauma to the internal body organs. Irradiation had caused physical alterations in the thymus, spleen, and lymph nodes. The lymphoid organs suffered a total loss of mass [17].

J. Effect on the Eye

Clinical studies indicate that exposure to RF/MW radiation causes physiological damage to the eye that can result in loss of sight. It has been observed that irradiation causes the formation of cataracts in the lens of the eye. Tissue damage appears to be the result of thermal trauma induced by the heating property of RF/MW radiation. Experiments conducted on laboratory animals have demonstrated severe ocular damage as a result of exposure [30], [31].

i. Ocular Sensitivity

Exposure of the eye to RF/MW radiation causes physical duress that can lead to damage of the ocular tissue. The incident power intensity and the duration of radiation exposure are factors that determine the amount of tissue damage. The lens of the eye appears to be most susceptible to RF/MW energy radiated at frequencies between 1-10 GHz. For this frequency range, it has been observed that lens fibers will suffer irreversible damage to a greater extent than other ocular elements [30]. Lens fibers are elongated, thread-like structures that form the substance of the lens [18]. In 1979, Stephen Cleary reported [30] that cataracts are formed in the lens as a result of alterations in the paracystalline state of lens proteins. Physical, chemical or metabolic stress may be responsible for opacification of

the lens [30].

ii. Experiments on Rabbits

Severe tissue damage has been observed in rabbits that have been exposed to RF/MW radiation. Stephen Cleary [30] reports that intense radiation exposure can cause "immediate tearing, injection, pupillary constriction, and anterior turbity" in the rabbit eye. Lens opacities can occur when the eye is irradiated by a 2450 MHz RF/MW source at incident power density levels of 100-300 mW/cm^2. At this exposure level, cataracts have been observed to form 24-48 hours after irradiation [30]. In 1976, Kramer, Harris, Emery, and Guy (reference found in [30]) reported observing the formation of cataracts in rabbit eyes that were exposed to 2450 MHz RF/MW radiation at an incident power density level of 180 mW/cm^2 for an exposure time of 140 minutes [30].

Acute ocular damage and the formation of cataracts appears to be the result of local hyperthermia of the eye. It has been observed, however, that trauma induced by heating of the ocular tissue may be unique to the exposure effects of RF/MW radiation [30]. In 1975, Kramer, Harris, Emery, and Guy (reference found in [30]) reported subjecting rabbits to hyperthermia not induced by exposure to RF/MW radiation. Heating caused the intra-ocular temperature of the eye to rise above normal. The retrolental temperature was reported to be about 42°C during the test period. Hyperthermia was sustained for approximately 30 minutes. Despite heating conditions that were similar to exposure from RF/MW radiation, lens opacities did not occur in the rabbit eyes [30]. Similar results have been reported by other researchers [30]. These results indicate that hyperthermia alone may not be sufficient to cause the formation of cataracts. Direct exposure to RF/MW radiation may be necessary to induce opacities in the lens [30].

iii. Cataracts in Humans

Exposure to RF/MW radiation is known to cause cataracts in the human eye. Several cases have been documented that report RF/MW induced cataracts in humans. Typically, lens opacities have resulted from exposure levels that are greater than specified by the various safety standards. However, minimum exposure levels sufficient to cause ocular damage are not certain [30].

In 1970, Zaret, Kaplan and Kay (reference found in [30]) reported a large number of cataracts induced in humans as result of occupational exposure. This report cited 42 cases of chronic exposure to RF/MW radiation. They reported that workers suffered damage to the posterior lens capsule. In one case, exposure periods lasted about 50 hours/week for 4 years. During most of the 4 year period the incident average power density level was approximately 10 mW/cm^2. For one 6 month period, however, power density levels may have reached 1 W/cm^2 [30].

In 1966, S. Cleary and B. Pasternack (reference found in [30]) published the results of an epidemiological study of military and industrial microwave workers. It was reported that minor alterations had occurred in the ocular lenses of the workers as a possible result of chronic RF/MW radiation exposure. Defects were found in the posterior pole of the lens. Cleary and Pasternack noted that the number of minor ocular defects was related to the specific occupational duties of the workers. The greatest number of defects was found

among persons working in research and development jobs. The results of the study were based on a comparison of the microwave workers with a similar control group. The researchers concluded that exposure to RF/MW radiation had caused the lens of the eye to age faster than normal [30].

Similar cases of RF/MW radiation induced ocular damage have been reported by other researchers. In one case, a 22 year old microwave technician was exposed 5 times over a 1 month period to a 3 GHz radiation source. The incident power density level was about 300 mW/cm^2 and irradiation lasted approximately 3 minutes during each exposure time. It was reported that the technician had developed bilateral cataracts as a result of irradiation [30]. In another case, M. Zaret (reference found in [30]) reported that a 50 year old woman had developed cataracts after intermittent exposure to a 2.45 GHz microwave oven. The incident power density levels were about 1 mW/cm^2 during operation of the oven and as high as 90 mW/cm^2 when the oven door was opened [30].

K. Auditory Effect

Individuals exposed to pulsed RF/MW radiation have reported hearing a chirping, clicking or buzzing sound emanating from inside or behind the head. The auditory response has been observed only for pulsed modulated radiation emitted as a square-wave pulse train. The pulse width and pulse repetition rate are factors that appear to determine the type of sound perceived [1], [31].

James Lin [31] reports that the sensation of hearing in humans occurs when the head is irradiated at an average incident power density level of about 0.1 mW/cm^2 and a peak intensity near 300 mW/cm^2. Auditory responses have been observed for a frequency range of 200-3000 MHz and for pulse widths from 1-100 us [32].

III. RF/MW ENERGY DEPOSITION

The absorption of RF/MW radiated energy causes biological reactions to occur in living organisms. In order to understand the potential effects of RF/MW radiation, it is important to quantify the absorption characteristics of biological materials. Researchers have identified several principal factors that govern the absorption of RF/MW energy by the human body. Experimental results have indicated that clothing thickness, physical dimensions, degree of hydration, and the resonance frequency of the human body are important parameters that determine the amount of energy absorbed by the body [1], [8], [9], [16], [22].

A. Specific Absorption Rate (SAR)

The specific absorption rate (SAR) is a measure of the dose of RF/MW energy absorbed by biological materials. It is intended to give a quantitative understanding to the absorption of energy. The SAR is defined as the amount of energy that is imparted to the body as a function of body mass [4]. SAR's are usually expressed in terms of watts of incident power per kilograms of irradiated body mass (W/Kg) [4], [9].

B. Depth of Energy Penetration

It is known that RF/MW radiated energy will be absorbed by the tissue of the human body. The depth of energy penetration into he tissue depends primarily on the wavelength of the incident radiation and the water content of the tissue [3], [6].

Energy emitted in the millimeter-wave band is not likely to penetrate to more than about 1 or 2 mm into the tissue [6]. Essentially, RF/MW energy radiated at wavelengths less than 3 centimeters will be captured in the outer skinsurface. RF/MW wavelengths from 3 to 10 centimeters will penetrate to a depth of about 1 to 10 mm. The greatest depth of penetration into the body will occur at wavelengths between 25 to 200 centimeters. At these wavelengths RF/MW radiated energy can directly effect internal body organs and cause serious injury. The human body is reported to be "transparent" to RF/MW radiated energy emitted at wavelengths greater than 200 centimeters. Also, at frequencies above 300 MHz it has been observed that the depth of energy penetration fluctuates rapidly with changes in frequency. In general, the depth of energy penetration into the body will decline as the frequency of the incident radiation increases. At 10 GHz, the absorption of RF/MW energy will be similar to IR radiation [3]. These figures were published by the U. S. Department of Health, Education and Welfare [3].

The water content of the human tissue will also influence the depth of energy penetration into the body. Millimeter-wave radiation is reported by Ghandi and Riazi [6] to penetrate less than 2 mm into the body because of the "Debye relaxation of the water molecules" in the tissue [6]. The Debye Effect was observed by a Dutch physicist named Peter Debye [23]. He discovered that EM waves are absorbed by a dielectric because of molecular dipoles present in the dielectric material [24]. Water molecules are essentially dipoles constructed from atoms of hydrogen and oxygen. Biological materials such as skin are dielectrics that consist mostly of water. Hence, these dielectrics are rich in molecular dipoles and are able to quickly absorb millimeter-wave radiation. High frequency radiation emissions are not expected to penetrate deeply into the human body [6].

C. Effect of Geometry

The orientation of the human body with respect to the incident EM field will determine the amount of RF/MW energy that is absorbed by the tissue. Experimental results published by Om Gandhi in 1980 indicate that the condition for maximum absorption occurs when the electric field is parallel to the major axis of the body and the direction of the field propagation is from arm to arm. Figure 2 shows the amount of energy absorbed versus the radiating frequency for various EM field orientations [22].

D. Effect of the Resonance Frequency

Researchers have reported that the human body will absorb the greatest amount of RF/MW energy from sources radiating at the whole-body resonance frequency [1], [9], [22], [25], [27]. The ANSI Standard [9] reports that the human body will absorb 7 times more energy from radiation emitted at the resonance frequency than at a frequency of 2450 MHz [9]. Experiments conducted on fabricated human models have been used to determine the resonance frequency of the human body [22]. Partial-body resonances have also been

observed by researchers. Computer simulation techniques have been used to estimate the resonance frequency of the human head [26].

The free space whole-body resonance frequency is reported to be between 61.8-77 MHz for a Standard Model of Man [9], [22], [25]. The standard model depicts an average man standing 175 cm tall [9]. Experimental results tend to differ somewhat from numerical calculations. The ANSI Standard [9] reports the whole-body resonance frequency to be 70 MHZ [9]. Similarly, experimental results presented by Hagman, Gandhi, and Durney [25] indicate the resonance frequency to be between 68-71 MHz. However, calculations put forth by the same researchers place the whole-body resonance at 77 MHz [25]. In 1980, Om Gandhi reported that the maximum absorption of energy will occur at frequencies where the free space wavelength (λ) of the incident radiation is about 2.50-2.77 times greater than the major length (L) of the body (i.e. $\lambda > 23.50L$-$2.77L$). This formula puts the value of the resonant frequency between 61.8-68.5 MHz for a standard model of man. When the human body is in contact with the electrical ground, the whole-body resonance frequency is reduced to about 47 MHz [22]. Figure 3 shows the SAR versus the incident EM field frequency for conditions of free space and grounding [22].

Numerical calculations have been presented by Hagman, Gandhi, D'Andrea, and Chatterjee [26] that indicate the free space resonance frequency of the human head to be about 375 MHz [26]. In a separate report, Gandhi determined that the head resonance will occur when the free space wavelength of the incident radiation is about 4 times the diameter of the head [22]. The condition for maximum energy absorption occurs when the direction of the EM field propagation is parallel to the long axis of the body. This orientation differs from the condition determined for RF/MW energy absorption by the whole-body. Figures 4 and 5 show the absorption of energy versus frequency for different EM field orientations [26].

E. Effect of Clothing

Clothing can act as an impedance matching transformer for RF/MW radiation. In 1986, Gandhi and Riazi [6] reported that the coupling efficiency of clothing may be as high as 90-95 percent for incident radiation in the millimeter-wave band. They determined that the thickness of the clothing and frequency of the incident radiation are important factors in the coupling condition. Figure 6 shows the relationship between clothing thickness and coupling efficiency as a function of frequency. The authors note that wet or damp clothing may actually reduce the amount of energy absorbed by the body because of the Debye relaxation of the water molecules [6].

IV. RF/MW RADIATION EXPOSURE STANDARDS

Exposure of living organisms to RF/MW radiation can have a potentially dangerous biological effect. To ensure the public safety and to safeguard the workplace against unnecessary RF/MW radiation exposure, protective guidelines have been adopted by the United States and several other nations. The maximum safe exposure levels recognized by individual examining authorities tends to vary as a result of differing interpretations of the

available RF/MW exposure data. There is a large distinction between permissible exposure levels observed in the United States and the Soviet Union. East Block countries have set more stringent standards than nations in the West [3], [8], [11], [22].

A. ANSI Standard C95.1-1982

In response to the need for a national RF/MW radiation protection guide, the American Standards Association commissioned the Department of the Navy and The Institute of Electrical and Electronics Engineers to cooperate in formulating an acceptable standard for safe radiation exposure levels. In 1960, the Radiation Hazards Standards Project was established to coordinate the efforts of researchers. Since then, work has progressed and in 1982 a modern RF/MW radiation protection guide was established. The American National Standards Institute (ANSI) designated this guide as C95.1-1982 [9]. Presently, a new ANSI guide is due for publication in May 1993. The new guide is entitled "ANSI/IEEE C95.1-1992". This guide will supersede C95.1-1982 when it is published.

i. Recommendations

The ANSI C95.1-1982 Standard specifies the maximum recommended RF/MW radiation exposure levels over a frequency range of 300 KHz to 100 GHz. Typically, the standard calls for an exposure of no more than 5 mW/cm^2 for frequencies between 1500 MHz to 100,000 MHz. The reader should consult with the actual ANSI publication for the detailed recommendations. In addition, the standard limits the whole-body SAR to 0.4 W/Kg and indicates that the spatial peak SAR should not exceed 8.0 W/Kg over any one gram of tissue. For both CW and pulsed EM fields the exposure time should not exceed 6 minutes at the recommended levels. These maximum safe levels are not intended to apply to the medical treatment of patients where irradiation is sometimes useful in combating diseases like cancer. The standard does pertain to the general public and to persons that work in electromagnetic environments. There are two exceptions to the recommendation: 1) at frequencies between 100 KHz and 1 GHz the maximum exposure levels may be exceeded as long as the stated SAR values are not violated and 2) at frequencies between 300 KHz and 1 GHz the exposure levels may be exceeded if the output power of the radiating device is less than 7 W [9].

ii. Philosophy

An explanation of the recommended maximum exposure levels is given as part of the protection guide. The ANSI Standard is intended to afford the best possible protection of human life against RF/MW radiation exposure. The biological effect on the human body for all RF/MW frequencies and modulation schemes is not known, therefore, investigators sought to interpret the available data in a way that would allow for the construction of the best possible RF/MW radiation protection guide. Investigators emphasized studies that reported harmful or potentially serious biological effects. Unlike past standards, researchers agreed that the modern protection guide would also account for the nonthermal effects of RF/MW radiation [9].

The safe exposure levels expressed by the ANSI guideline were determined for far field exposures. The plane wave model used to specify the maximum exposure levels may not be accurate to describe conditions in the near field. However, the power density levels expressed in the protection guide are not considered great enough to induce EM fields with sufficient energy intensities capable of exceeding the recommend SAR's [9].

In selecting a measure for the dose of RF/MW radiation, it was recognized that the SAR does not encompass all of the important factors necessary to determine safe exposure levels. The modulation frequency and peak power of the incident EM field should also be considered. Some of the investigators warned that extra care should be taken by persons that are subjected to pulsed EM fields or by fields that are modulated near the whole-body resonance frequency [9]

In assessing the biological effects, it was found that behavior was the most sensitive biological component to RF/MW irradiation. It was observed that behavioral effects were reversible for exposure to carrier frequencies between 600 MHz and 2450 MHz when whole-body SAR's were limited to between 4 and 8 W/Kg. For these SAR's, power densities were calculated or measured to range from 10 mW/cm^2 to 50 mW/cm^2. Behavioral effects were considered to be among the most serious consequences of exposure to RF/MW radiation [9].

It was established that in order to ensure an acceptable margin of safety the whole-body average SAR should not exceed 0.4 W/Kg. Most of the researchers concluded that this was a necessary and reasonable standard. The exceptions cited in the recommendations were justified on the basis of the total rate of energy absorption by the human body. The Standard reports that small radio transceivers are able to emit EM fields that exceed the prescribed power density levels. Such devices, however, are not expected to compromise the prescribed maximum SAR levels. In general, compliance with the ANSI RF/MW protection guide is the best safeguard against harmful biological effects [9].

B. USAF PEL (AFOSH Standard 161-9, 12 February 1987)

Since the early investigations of the Tri-Service Commission, the United States Air Force has recognized the need to establish an RF/MW protection standard. The USAF permissible exposure level (PEL) is specified in AFOSH Standard 161-9 enacted 12 February 1987. This standard stipulates maximum safe RF/MW radiation exposure levels over a frequency range of 10 KHz to 300 GHz. The PELs are shown in Figures 7 and 8 [10].

In general, the USAF protection guideline agrees with the ANSI Standard except that a distinction is made between exposure to persons in restricted and unrestricted areas. No explanation for this policy is given in the USAF Standard. The PEL for restricted areas shows only a slight alteration from the ANSI recommendation. For a frequency range of 1500-300,000 MHz the USAF PEL is given as 10 mW/cm^2. The PEL put forth by the USAF is intended to protect personnel from harm by limiting the whole-body SAR to 0.4 W/Kg. Exposure periods at the maximum safe levels should be limited to 6 minutes. It is also recommended that exposure in the near zone to RF/MW sources radiating at less than 30 MHz may require a separate evaluation to determine safe exposure levels of irradiation [10].

C. Canada Western Europe

Concern over safe RF/MW radiation exposure levels has sparked controversy and sharp debate in many countries around the world. The ANSI Standard is currently recognized by most countries of the Free World including Canada, the United Kingdom, Sweden, France, and West Germany [8], [22].

D. Soviet Union & Eastern European Standards

The RF/MW radiation exposure standards prescribed in the Soviet Union and Eastern Europe are more conservative than standards adopted by countries in the West [3], [8], [11]. In the Soviet Union, permissible exposure levels for whole-body irradiation are specified for various time intervals. RF/MW radiation exposures may not exceed 0.01 mW/cm^2 for 3 hours/day, 0.1 mW/cm^2 for 2 hours/day, and 1.0 mW/cm^2 for 15-20 minutes provided that safety goggles be worn [3]. Czechoslovakia has recommended a maximum exposure level of 0.025 mW/cm^2 for an average working day [8].

Investigators in the Soviet Union and Eastern Europe have placed a great emphasis on the nonthermal effects of biological exposure to RF/MW radiation. They contend that electromagnetic interactions with the bioelectrical and biochemical functions of the body constitute a more serious health risk than effects from thermal heating. Nonthermal disruptions have been observed to occur at power density levels that are much lower than are necessary to induce thermal effects. Soviet researchers have attributed alterations in the central nervous system and the cardiovascular system to the nonthermal effect of low level RF/MW radiation exposure [3], [8].

The U. S. Department of Health, Education and Welfare [3] reports that the differing standards put forth by the East and West may be attributed to philosophical differences in basic research. Soviet investigators were intent on examining the effect of RF/MW radiation on the conditioned reflex response of living organisms whereas their counterparts in the West do not view this effect as an appropriate endpoint to research [3]. Recently, however, researchers in the West have sought to account for nonthermal effects in modern permissible RF/MW radiation exposure standards [9].

V. CONCLUSION

Exposure to RF/MW radiation is known to have a biological effect on living organisms. Research conducted over the past 30 years has provided a basis for understanding the effect of irradiation of biological materials. Experimental evidence has shown that exposure to low intensity radiation can have a profound effect on biological processes. The nonthermal effects of RF/MW radiation exposure are becoming important measures of biological interaction with EM fields. Modern RF/MW radiation protection guides have sought to account for the effects of low level radiation exposure. Adherence to the ANSI Standard [9] should provide protection against harmful thermal effects and help to minimize the interaction of EM fields with the biological processes of the human body [9].

It is essentially the absorption of RF/MW energy that causes stress and trauma to biological systems. The greatest amount of energy will be absorbed when the incident radiation is emitted at the resonance frequency of biological material [9], [22]. In this regard, RF/MW radiation emitted at nonresonant frequencies should be absorbed to the

greatest extent when the radiating mode is a pulsed signal. The generation of such signals creates transient responses that will match the resonant frequencies of biological materials. Nonresonant pulsed RF/MW radiation may be more harmful to living organisms than CW radiation emitted at nonresonant frequencies.

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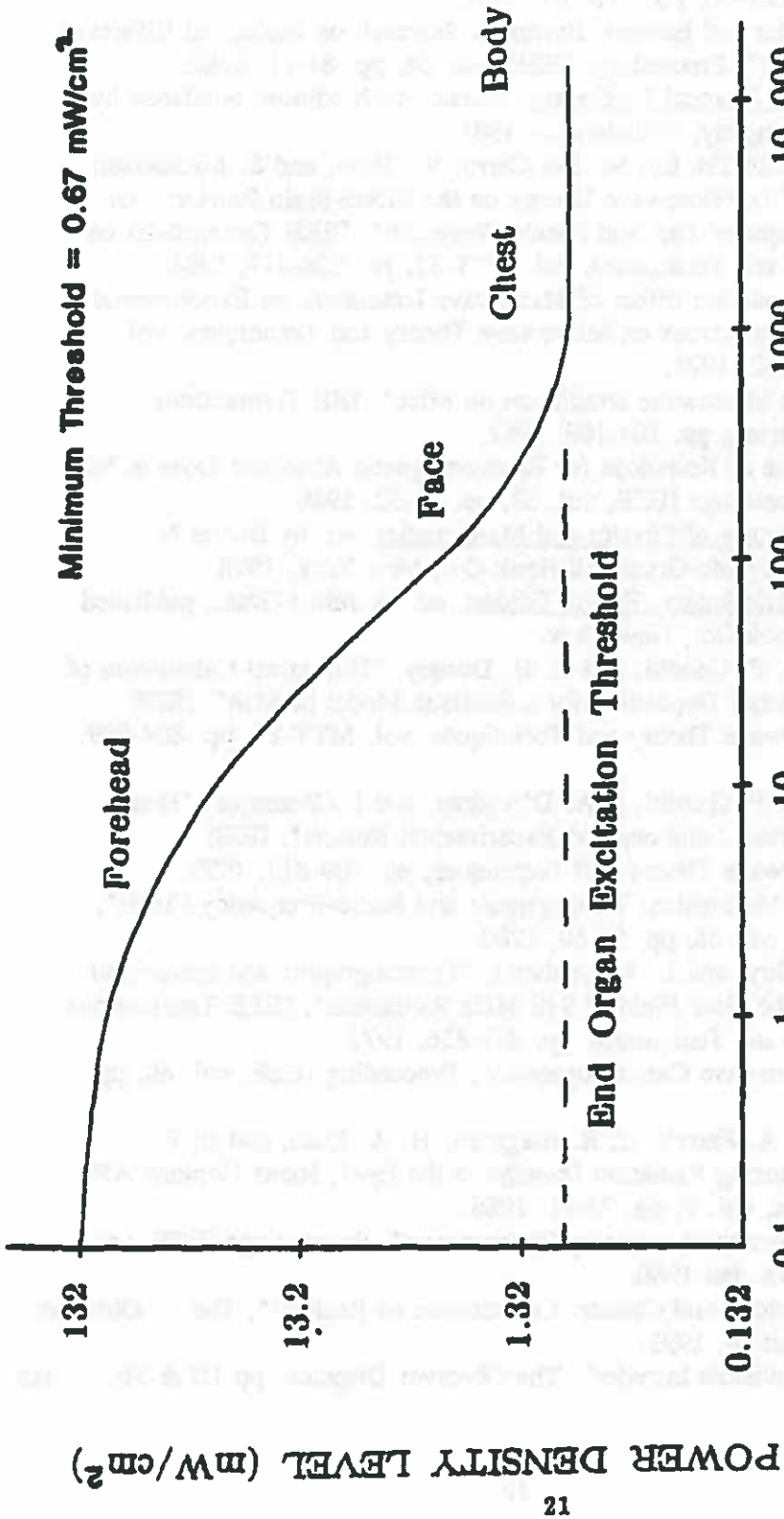

Figure 1: Observed threshold of infrared perception.
Absorbed continuous wave intensity versus exposed body area.

(ref: J. Hardy & T. Oppel, results reported by Om Gandhi and Abbas Riazi, IEEE MTT-34, pp. 228-235, Feb 1986)

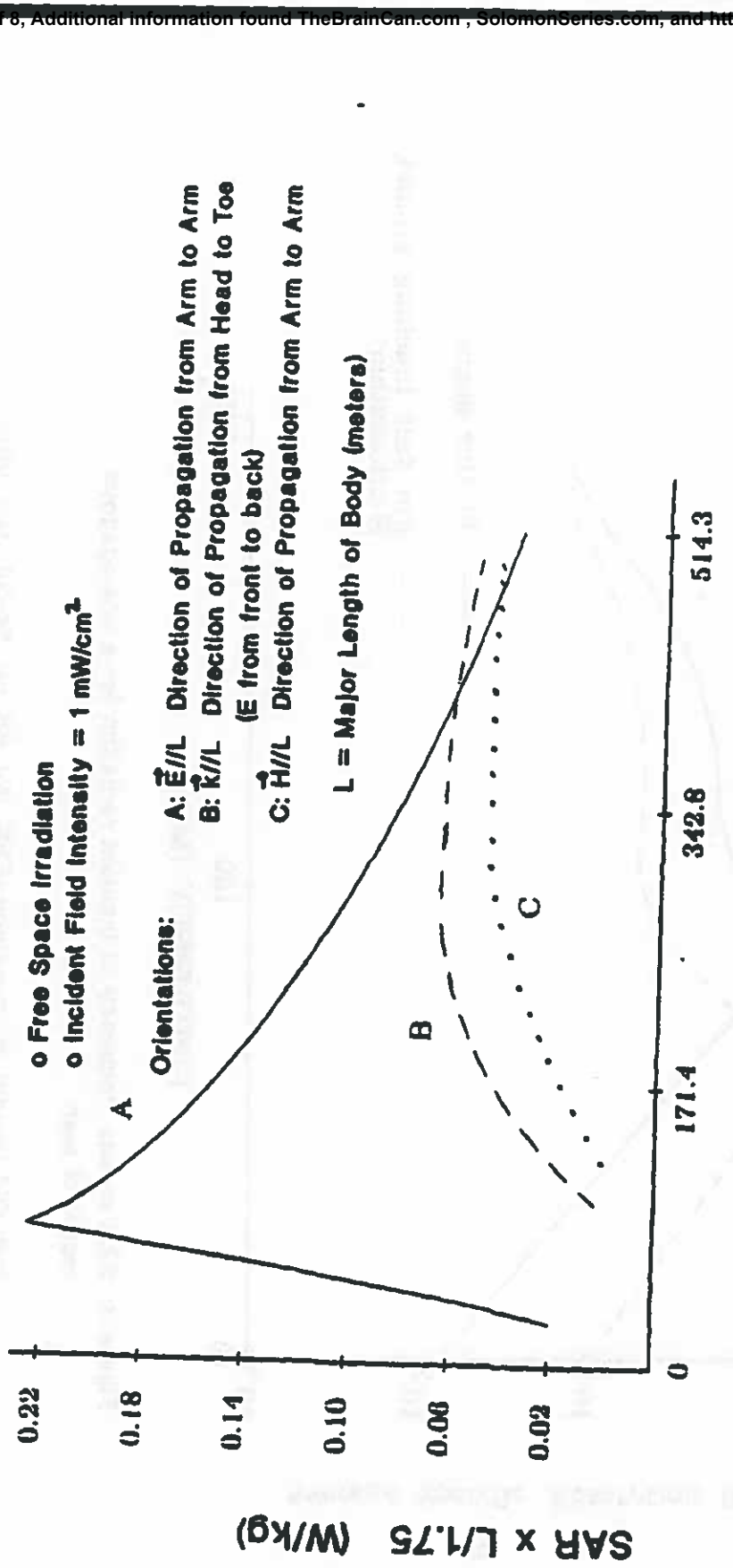

Figure 2: Comparison of field orientations for whole-body exposure of humans. Normalized SAR versus normalized radiated wave frequency.

Ref: Om Gandhi, Proceedings IEEE, Vol. 68, pp. 24-32, Jan 1980)

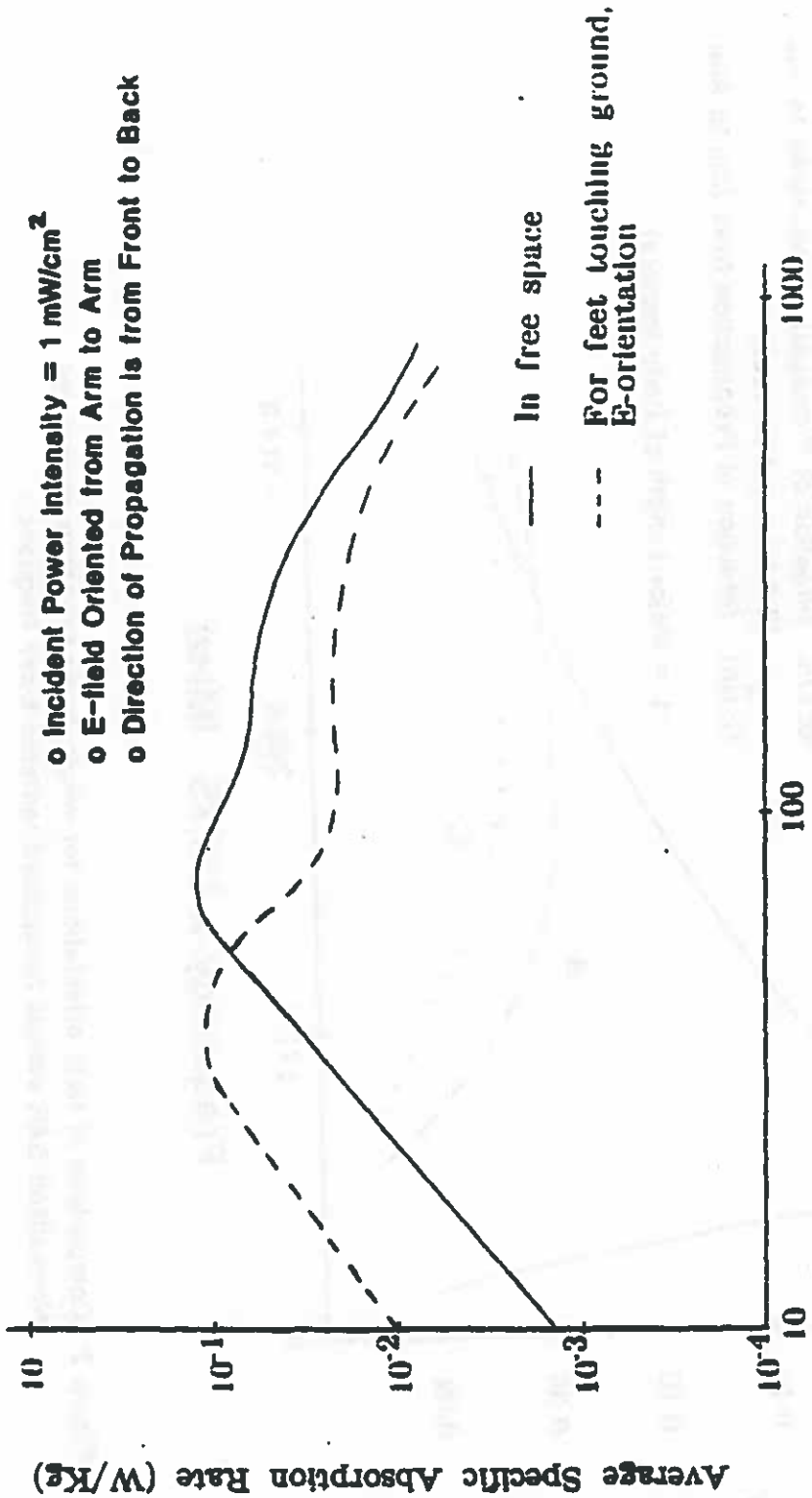

Figure 3: SAR versus frequency of incident radiation for a homogenous model of man.

(ref: OM Gandhi, Proceedings IEEE, Vol. 68, pp. 24–32, Jan 1980)

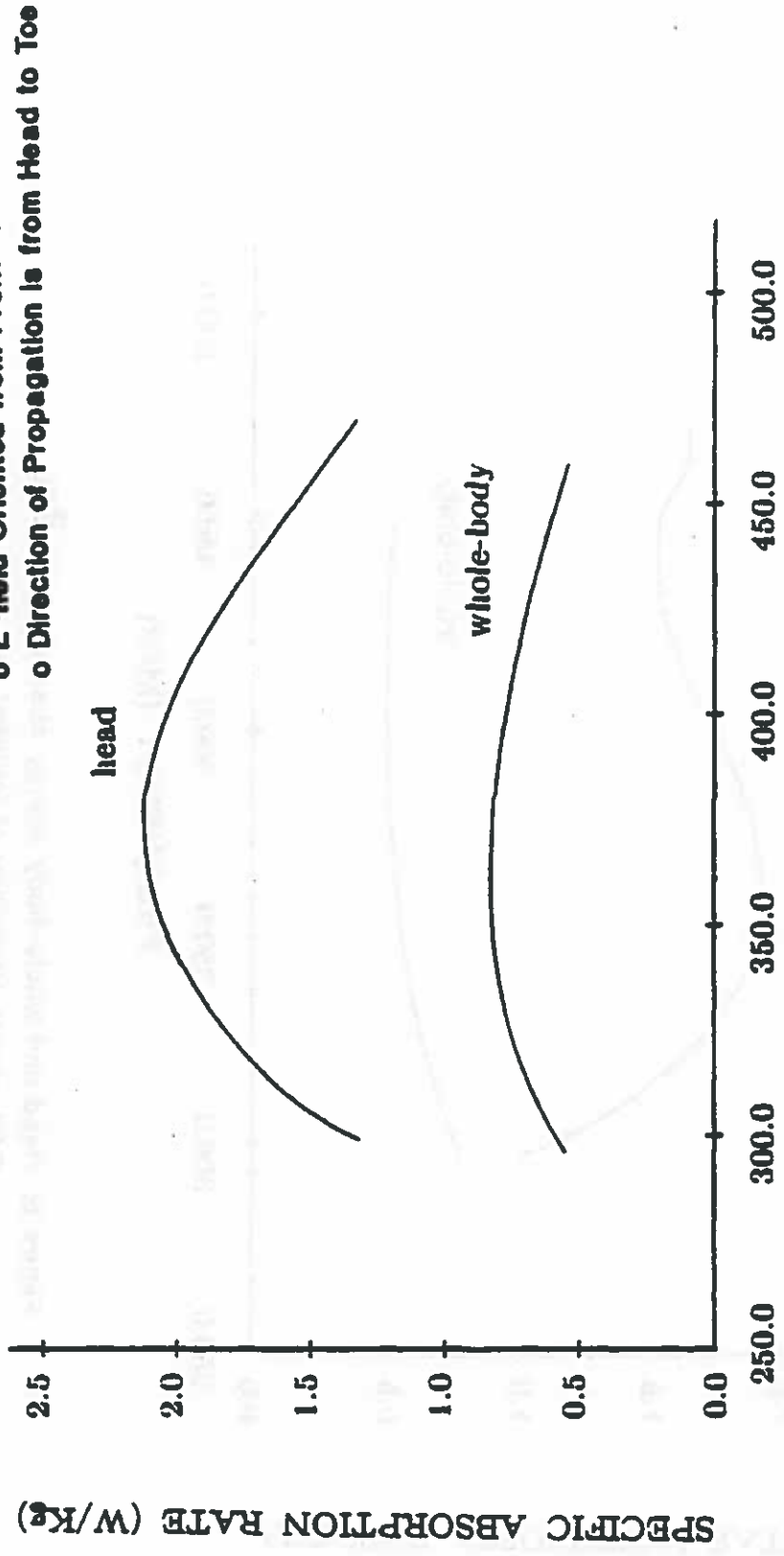

Figure 4: Head and whole-body energy absorption. SAR versus frequency of incident radiation.

(ref: Hagmann, Gandhi, D'Andera, and Chatterjee, IEEE MTT-27, pp. 809-813, Sep 1979))

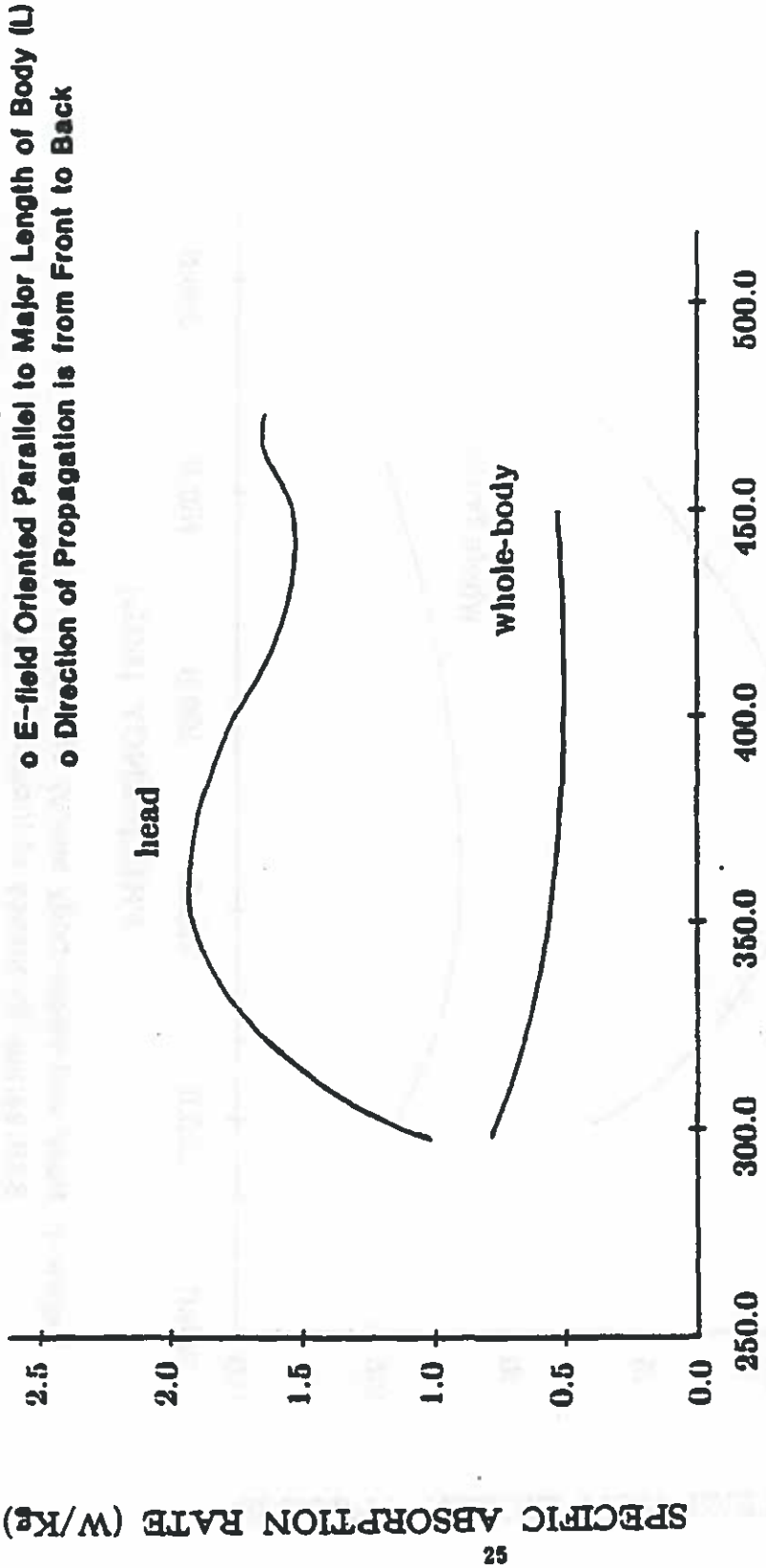

Figure 5: Head and whole-body energy absorption for $\vec{E}$//L.
SAR versus frequency of incident radiation.

(ref: Hagmann, Gandhi, D'Andera, and Chatterjee, IEEE MTT-27, pp. 809-813, Sep 1979)

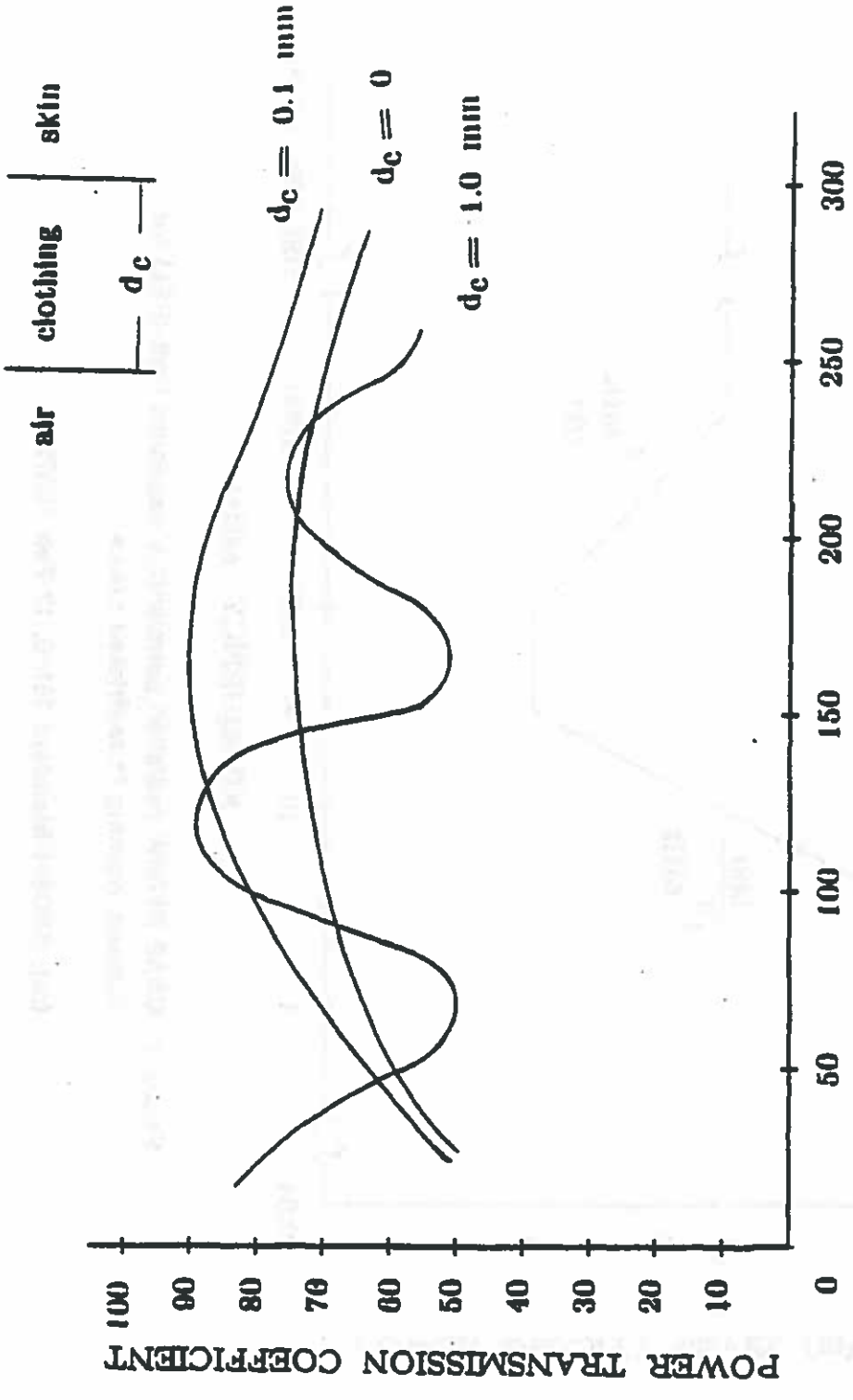

Figure 6: Comparison of transmission coefficient with and without clothing; no air gap between skin and exterior clothing.

(ref: Om Gandhi and Abbas Riazi, IEEE MTT-34, pp. 228-235, Feb 1986)

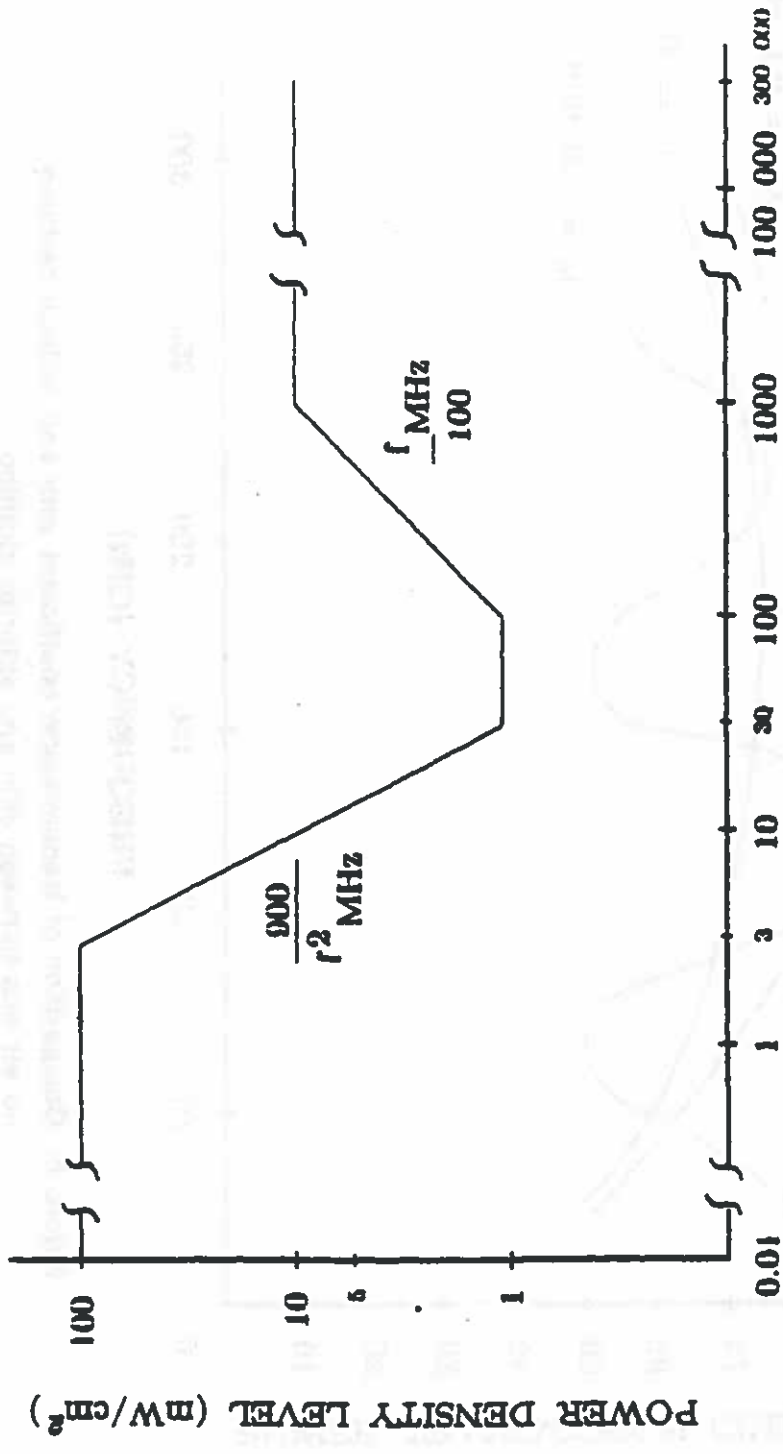

Figure 7: USAF RF/MW radiation permissible exposure limit (PEL) for humans working in restricted areas.

(ref: AFOSH Standard 161-9, 12 Feb 1987)

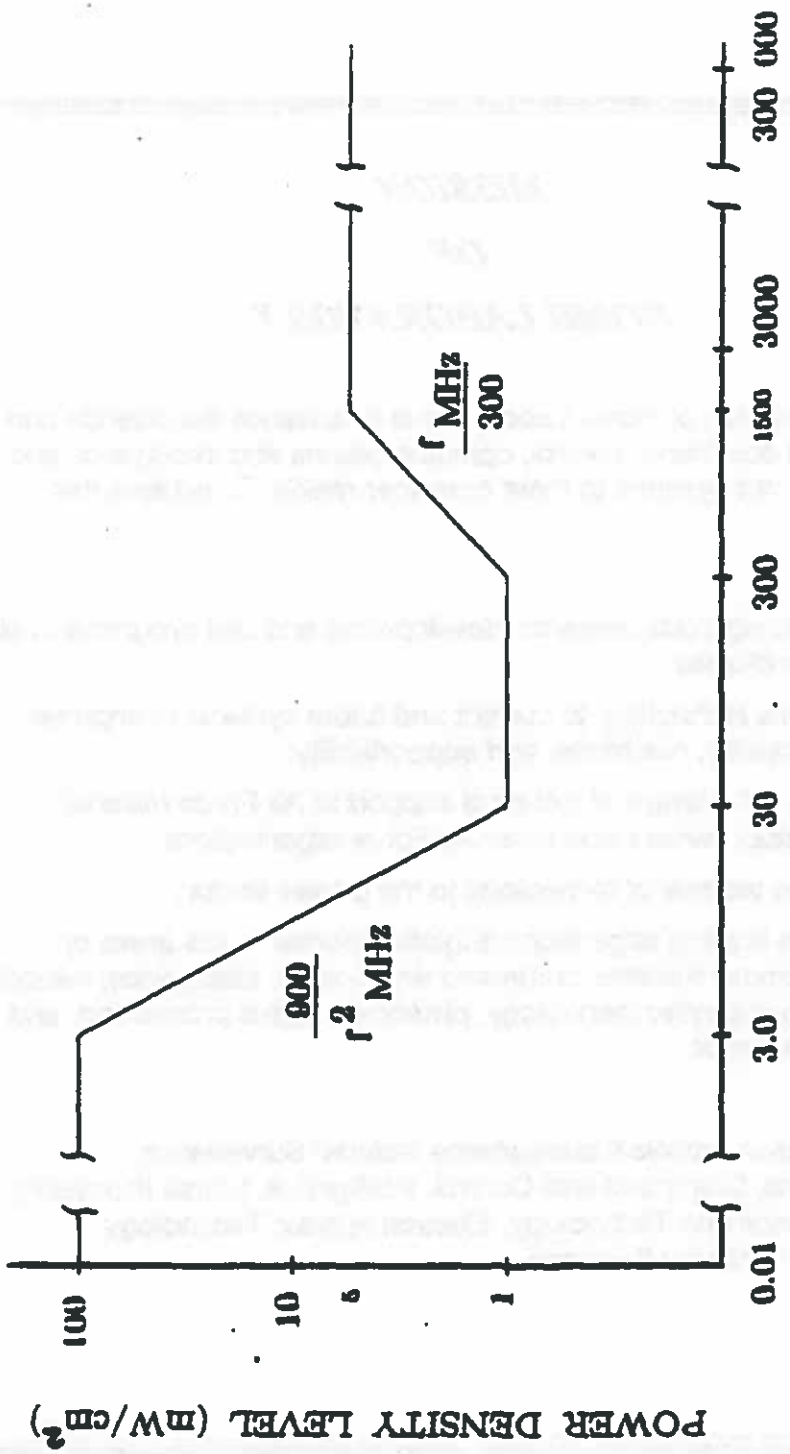

Figure 8: USAF RF/MW radiation permissible exposure limit (PEL) for humans working in unrestricted areas.

(ref: AFOSH Standard 161-9, 12 Feb 1987)

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OF

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Melrose-Mindoro

N181 State Rd. 108 • Melrose, WI 54642

Ron Perry, Superintendent
Del Deberg, High School Principal
Tracy Dalton, K-8 Principal

High School – (608) 488-2201 or (608) 857-3417
Fax – (608) 488-2805
Melrose Elementary – (608) 488-2311
Mindoro Elementary – (608) 857-3410

CHANGES NOTED SINCE FILTERS INSTALLED

In the years previous to the filters being installed, several children required inhalation treatments for their asthma in the spring and in the fall. Many of them required nebulizer treatments once or twice a day while at school. I have not had to administer one nebulizer treatment this past year and of the 37 students with inhalers, only three of them use the inhaler for their exercise-induced asthma before Phy Ed.

Teachers are stating they are less fatigued and tired.
The sense of smell has come back for me. I lost it for three years and the doctors said it was my allergies.
The students seem to have more energy and appear and seem less tired.
Several staff who doctored regularly for allergies have not had to take medication or see their doctor because they are having less problems.
Students whom have been diagnosed with migraine headaches have had their headaches reduced no headaches at all.
I feel that our faculty and students have had improved health overall since the filters have been installed.

Char Sbraggia R.N.
District Nurse

Dirty Power and Healthy Schools is it Possible?
What do dairy cows and students have in common?

Magda Havas, Ph.D., Environmental & Resource Studies Program at Trent University.

Last January I received a phone call from Michelle Illiatovitch in Toronto who told me that both she and her daughter, Kestra, were electrically sensitive. Shortly after some renovations Kestra began to feel ill. She noticed that the lights in her bedroom were flickering so they called in an electrician who corrected the problem that related to the loose wires in the fuse box. Kestra's health improved dramatically but she still felt tired and had frequent, headaches, fuzzy thinking, depression, chest pain and nausea.

Michelle's niece, Catherine, developed chronic fatigue shortly after moving to a farm in Wisconsin. She read that some farmers in her area were experiencing health problems and they were also having difficulty with their dairy herds and that Dave Stetzer was helping the farmers solve their problems, which were electricity-related.

She contacted Mr. Stetzer who told her to turn the power off in her home. She did this and began to feel better almost immediately. She then purchased some of his equipment to measure her home and to filter out the dirty electricity. Shortly after installing the electric filters, also known as capacitors, her health began to improve. She was so impressed she contacted her Aunt Michelle to share the good news.

Michelle also bought some filters, which plug into an electrical outlet, and installed them in her home. Not only did her health improve but the health of everyone improved including her dog and her husband.

Kestra was feeling much better at home but when she went to school she became ill again. Michelle asked the school principal if she could install some filters in the school to help her daughter. Joy Kurtz, the Principal of Willow Wood School agreed.

That's when Michelle phoned me.

She wondered if I would do a study to determine the effectiveness of these filters. I was familiar with electrical-sensitivity but it was my understanding that a very small percentage of our population is likely to be electrically-sensitive and because the symptoms are so vague it's difficult to know if it's indeed electrical-sensitivity or something else that's causing the problem.

The symptoms for sensitivity vary. Some develop headaches when they go shopping in stores that have bright halogen lights. Others become tired or can't think clearly. Some develop skin rashes after using a computer. In severe situations people can even loose consciousness. Generally those with electrical sensitivity prefer incandescent lighting to fluorescent lighting.

I was skeptical this study would show anything partly because I was skeptical about the effectiveness of the filters and partly because I felt the population of teachers and students was too small. But I was also intrigued and agreed to design a questionnaire.

No one in the school, apart from the Principal and the head Custodian, knew what we were doing. It was necessary to keep the teachers in the dark initially so that psychological bias would not play a role in the answers they provided. This is referred to as a "blind" experiment.

We measured the electromagnetic environment in the school with and without the filters. The filters removed many of the microsurges on the electrical wiring in the school but did not change the electric or magnetic fields, which were already low. These microsurges consist of high frequency energy on an electrical wire and are generated by various appliances and equipment.

At the end of the study that lasted 6 weeks, 3 weeks without and 3 weeks with the filters, I received several boxes of completed questionnaires. The real work began.

I analyzed the teacher results first and was amazed by what I found. Of the more than 40 teachers, 26 responded regularly. Of these 26, 4 did not change, 4 were slightly worse and 18 improved while the filters were installed. In decreasing order of magnitude this is what we found. While the filters were installed, 46% of the teachers experienced less fatigue, 42% were less frustrated, 35% were more satisfied with their work, 35% had a greater sense of "well-being", 27% were less irritable, 23% had more energy, 23% experienced less body pain, and 19% had fewer headaches. And all of this occurred during February, a month we normally associate with the "blahs."

Preliminary analysis of the student results shows that both high school and elementary students improved more during the afternoon than in the morning. In elementary school, student disruptions were reduced by an average of 3 to 4 minutes per class, which allows more teaching time. The high school results were less conclusive.

While the results are encouraging and suggest that these filters can improve the school environment, it's necessary to repeat this study at other schools to see if the results are consistent. If they prove to be consistent then we may now have a tool to improve our electrical environment at home and at work. Just as we have air filters to remove airborne particulates and water filters to remove chemicals in our drinking water, Dave Stetzer has designed a filter that reduces indoor electrical pollution associated with electronic devices like computers and variable speed motors.

At a recent talk at Willow Wood School in Toronto, Mr. Stetzer said this filter would even reduce some of the microsurges entering your home from your neighbour next-door. His work on dairy farms in Wisconsin resulted in healthier cows and higher milk yields. While these filters are not the answer to all of our electrical problems, they may make living more tolerable for the small percentage of the population who are truly electrically-

sensitive and, if our results are correct, they may improve the quality of life even for those of us who aren't.

For more information or if you would like to have your school tested contact the author at mhavas@trentu.ca.

Presented at the 3rd International Workshop on the Biological Effects of Electromagnetic Fields, 4-8 October 2004, Kos, Greece

TEACHER AND STUDENT RESPONSE TO THE REMOVAL OF DIRTY ELECTRICITY BY THE GRAHAM/STETZER FILTER AT WILLOW WOOD SCHOOL IN TORONTO, CANADA.

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Abstract

The purpose of this study was to test the effect of the Graham/Stetzer microsurge filters on the wellbeing of teachers and on the behavior of their students in a private school (grades 1 to 12) in Toronto, Canada. GS filters remove electromagnetic frequencies from 4 to 100 kHz on indoor wiring and they were installed in this school because one of the students is electrically sensitive. Teachers were asked in a single blind study to complete a questionnaire daily between January and March 2003 for a 6-week period (3 weeks with and 3 weeks without filters). Eighteen teachers out of 49 completed the questionnaire enough times to enable statistical analysis. Symptoms improved for 55% of the teachers and got worse for 11% of the teachers while the filters were installed. Three teachers (16%) had no response to the filters and another three (16%) had mixed reactions (some symptoms improved and some got worse). Overall teacher wellbeing improved while the filters were in place. Teachers were less frustrated, less tired, less irritable. They were better able to focus and had better health, improved mood, and greater sense of accomplishment. Student response appeared to be age-specific with younger students responding more favorably than older students. This preliminary study needs to be repeated in other schools. If the Graham/Stetzer filters are as effective as they appear to be, then the dirty electricity in schools, homes, and offices can be reduced until other methods are in place to minimize the production and distribution of this form of electrical pollution.

Introduction

Electrosensitivity, also known as electrical hypersensitivity, is a relative new phenomenon that first received public attention in the early 1970s [1]. Symptoms of electrosensitivity resemble radiation poisoning experienced by radar workers and include chronic fatigue, depression, headaches, body aches and pains, ringing in the ears, eye discomfort, skin irritations, unnatural warmth or burning sensation in the face, nausea, dizziness, cardiac palpitations, impaired sleep, memory loss, and confusion [2]. Individuals with severe symptoms may have difficulty in public places and seek relief by minimizing their electricity use or by turning off the power supply in their home. Those with less severe symptoms may associate the daily headache or the excessive fatigue with a stressful lifestyle. One study estimates that two percent of the population may be electrically sensitive [3].

Students or teachers who suffer from electrical sensitivity in a school with computers, energy efficiently lighting, photocopy machines and other electronic equipment are unlikely to do well in their work. Electrical sensitivity of one student at Willow Wood school prompted the present study and the recent commercial availability of the Graham/Stetzer filters made this study possible.

Graham/Stetzer filters are capacitors that remove microsurges on electrical wires within the range of 4 to 100 kHz [4,5]. These microsurges include transients and harmonics of the 60 Hz frequency and consist of variable spikes in the voltage that ride on top of the electrical distribution grid's 60 Hz sine wave. They are produced by computers, television, energy-efficient lighting, dimmer switches, telephones, photocopiers and other electrical appliances. Once generated these microsurges flow along electrical wires. In addition to the microsurges generated within buildings, they can also enter buildings through the power distribution lines or through water and gas pipelines by way of ground current. These high frequency microsurges flowing along the ground and along wires are a form of electrical pollution and are referred to as dirty power or dirty electricity.

In the present study we tested the effect of the Graham/Stetzer filters on the wellbeing of teachers and on the behavior of their students in Willow Wood School, a private school (grades 1 to 12) in Toronto, Canada.

Method

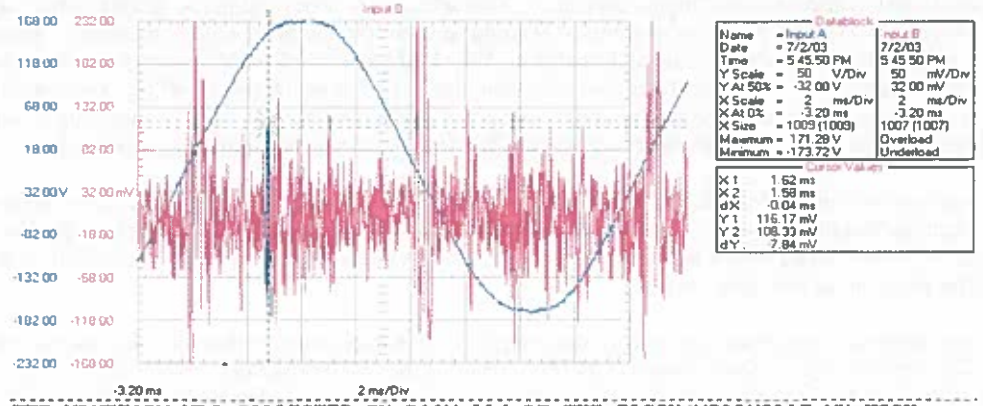
The Principal of Willow Wood agreed to having the Graham/Stetzer filters installed in her school and to participate in a study on the effectiveness of these filters. The study period extended from January 16th through March 3rd 2003. The GS filters were installed from February 4 to 24th inclusive and this provided a 2-week pre-filter and a 1-week post-filter reference period for comparison.

Teachers were asked to complete a questionnaire twice daily (at 11:30 am and 3:30 pm) regarding behaviour of students in their last class and they were asked to complete another questionnaire at the end of the school day regarding their own physical well being and performance. Teacher identity and individual responses to the questionnaire were kept confidential. The questionnaire was designed to test for internal consistency with redundant questions. Participation was voluntary and teachers completed these questionnaires without knowing the nature of the research that was being conducted (single blind study).

Questionnaire data were analyzed separately for each class and for each teacher since students in grades 1 through 6 (elementary school) spend most of their day in the same classroom and hence a reasonable estimate of electromagnetic exposure is possible, while students in both middle school and high school (grades 7 to 12) move to different classrooms each period and are exposed to a much more variable environment. Similarly, some teachers remain in one classroom while others rotate with the courses they teach. Pre- and post-filter data for individual teachers and classes were grouped and the results were compared to periods with the filters in place using a two-tailed t-test at $P \leq 0.05$. The effect of time (pre vs during vs post-filter) was assessed where sufficient data existed.

Power quality was measured weekly in each classroom, in the cafeteria, gym, library, front office and other places where either teachers or students were likely to spend part of their day. Measurements were taken with a Fluke 79 III meter (mV as rms, range to 20 KHz) connected to a Graham Ubiquitous Filter, which removes the 60 Hz sine wave. An example of poor power quality (microsurges) and a 60 Hz sine wave are shown in Fig. 1.

A total of 50 Graham/Stetzer filters (capacitors) were installed in outlets throughout the school on February 4th and left in place until February 24th. The filters are small box-like units (5x4x9 cm) that plug into an outlet. Each classroom had 1 or 2 filters and most of these probably went unnoticed. A school of this size with the number of computers and other office equipment requires approximately 150 GS filters and hence the dirty electricity in the school was reduced but not eliminated (Table 1). Filters improved quality by 50% for frequencies up to 20 kHz. Since these filters are effective for frequencies up to 100 kHz, additional improvements were likely but were not measured.



THE WAVEFORM WAS COLLECTED IN ROOM 114 AT THE ELGIN/MILLVILLE MN HIGH SCHOOL. CHANNEL 1 WAS CONNECTED TO THE 120 VAC UTILITY SUPPLIED POWER RECEPTACLE. CHANNEL 2 WAS CONNECTED TO THE SAME POTENTIAL, EXCEPT THROUGH THE GRAHAM UBIQUITOUS FILTER. (REMOVES THE 60 HERTZ) THE AREA BETWEEN THE CURSORS REPRESENTS A FREQUENCY OF 25 KILO HERTZ. A TEACHER WHO PREVIOUSLY OCCUPIED THE ROOM DIED OF BRAIN TUMORS AND THE TEACHER IN THE ADJOINING ROOM DIED OF LUEKEMIA.

Figure 1. Example of microsurges in a school environment. Data courtesy of Dave Stetzer, Electrical Pollution: RF Frequencies and Your Health. Talk presented at Willow Wood School, January 2004.

Results & Discussion

The Graham/Stetzer filters improved power quality at Willow Wood School by filtering out high frequency transients on indoor wiring. The amplitude of frequencies below 20 kHz were reduced by approximately 50% from an average of 23 mV (range 13-101 mV rms) to 13 mV (range 8-24 mV rms) (Table 1).

Table 1. Dirty electricity monitored weekly in each classroom at Willow Wood School with and without Graham/Stetzer Filters.

Willow Wood School	Sample Size	Dirty Electricity (mV, rms) mean	range	% change
without GS filter	130	23	13 - 101	57%
with GS filter	97	13	8 - 24	

Although the amount of current in a transient is small, it changes rapidly and can generate large electromagnetic fields. These transients are likely to be more biologically active since they produce radio frequency signals that are emitted into the environment and that can penetrate more deeply into tissue than can 60-Hz sine waves [6,7].

Despite the fact that the microsurges were not eliminated within the school, as many as 45% of the teachers reported feeling less tired and less frustrated; 35% felt healthier; 30% were less irritable; 25% had improved mood, more energy and a greater sense of satisfaction with their work while the filters were installed (Figure 2). This was not a placebo effect since the teachers were unaware of the nature of the research that was being conducted.

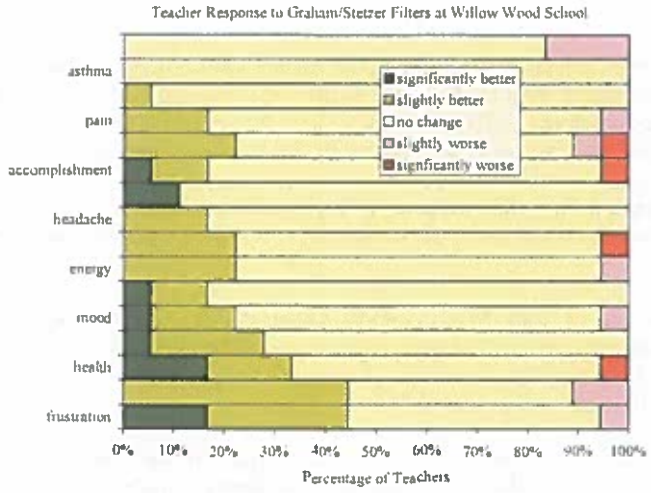


Figure 2. Response of teachers at Willow Wood School to improved power quality with Graham/Stetzer filters.

If the response of the teachers is a sign of electrical sensitivity then as many as 7 to 10 of the 18 teachers (39% to 56%) may have some degree of electrosensitivity based on the data in Table 2. The top candidate showed improvements while the filters were in place in 11 of the 16 questions asked (69%). These data are particularly interesting since the filters were installed during February, a month which people associate with symptoms of seasonal affective disorder (SAD). During the period the filters were installed three teachers showed no response and 2 teachers, both male, had a negative response.

Table 2. Individual teacher response to the Graham/Stetzer filters at Willow Wood School.

	Teacher			Dirty Power		Teacher Response to Graham/Stetzer Filters														Summary					
SYMPTOMS	teacher ID	gender	school	mV with GS Filter	% decrease with GS Filter	frustration	fatigue	health	irritable	mood	unfocussed	energy	satisfaction	headache	coughing	accomplishment	well-being	pain	medication	asthma	flu	significantly better	slightly better	no change	slightly worse	significantly worse	net response
						++	+	+	--	+	0	+	+	+	0	-	+	+	0	0	0						
BETTER (10 teachers (56%)	93	f	O	15	11%	++	+	+	--	+	0	+	+	+	0	-	+	+	0	0	0	13%	56%	31%	0%	0%	69%
	81	f	H	14	46%	0	+	++	0	++	++	+	0	0	++	0	0	0	0	0	0	25%	13%	63%	0%	0%	38%
	16	m	E	14	48%	0	+	++	0	0	+	0	+	0	++	0	0	+	0	0	0	13%	25%	63%	0%	0%	38%
	22	m	E	14	22%	+	0	+	0	0	0	0	+	0	0	++	+	+	0	0	0	6%	31%	63%	0%	0%	38%
	43	f	M	11	60%	+	+	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0%	25%	75%	0%	0%	25%
	56	m	H	9	47%	+	+	0	+	0	0	+	0	0	0	0	0	0	0	0	0	0%	25%	75%	0%	0%	25%
	32	m	M	13-17	21-33%	++	0	0	0	+	0	0	0	0	0	0	+	0	0	0	0	6%	13%	81%	0%	0%	19%
	15	f	M	14	19%	+	+	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0%	19%	81%	0%	0%	19%
	69	f	H	9	47%	+	+	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0%	19%	81%	0%	0%	19%
	53	f	H	12	27%	0	0	++	0	0	0	0	0	0	0	0	0	0	0	0	0	6%	0%	94%	0%	0%	6%
BETTER & WORSE 3 teachers (17%)	65	f	H	12	34%	++	+	0	+	+	0	+	0	0	0	0	0	0	0	+	0	-	6%	31%	56%	6%	0%	31%
	42	m	M	14-17	30-33%	0	0	--	+	0	+	0	0	0	0	0	0	0	0	0	0	0	13%	81%	0%	6%	6%
	62	m	H	9-14	45-47%	0	-	0	0	0	0	0	+	0	0	0	0	-	0	0	-	0%	6%	75%	19%	0%	-13%
NO CHANGE 3 teachers (17%)	21	f	E	12	38%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%	100%	0%	0%	0%
	11	f	E	12	45%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%	100%	0%	0%	0%
	51	f	H	22	7%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%	100%	0%	0%	0%
WORSE 2 teachers (11%)	12	m	E	11	48%	-	-	0	0	-	0	-	0	0	0	0	-	0	0	0	-	0%	0%	63%	38%	0%	-38%
	66	m	H	nd	nd	0	0	0	0	0	0	0	--	0	0	--	--	0	0	0	0	0%	0%	81%	0%	19%	-19%
			++	significantly better		17%	0%	17%	6%	6%	6%	0%	0%	0%	11%	6%	0%	0%	0%	0%	0%	6%						
			+	slightly better		28%	44%	17%	22%	17%	11%	22%	22%	17%	0%	11%	22%	17%	6%	0%	0%		13%				
			0	no change		50%	44%	61%	72%	72%	83%	72%	72%	83%	89%	78%	67%	78%	94%	100%	83%			76%			
			-	slightly worse		6%	11%	0%	0%	6%	0%	6%	0%	0%	0%	0%	6%	6%	0%	0%	17%				3%		
			--	significantly worse		0%	0%	6%	0%	0%	0%	0%	6%	0%	0%	6%	6%	0%	0%	0%	0%					1%	
				net response		39%	33%	28%	28%	17%	17%	17%	17%	17%	11%	11%	11%	11%	6%	0%	-17%						15%

nd no data
m male
f female

H high school
M middle school
E elementary school
O office

Teachers also documented student behaviour (but not student health) in this questionnaire. In the lower school (grades 1 to 6) students spend most of their time in the same classroom. Sixty percent of the classes showed signficant improvements in student behaviour (Table 3). In grades 3 to 6, the time teachers had to spend dealing with disruptions or starting a new lesson was reduced by 2 to 6 minutes per class.

In middle school (represented by grade 7, Table 4), only one class showed statistically significant improvements. In two of the three classes, as much as 5 to 10 minutes were saved each period in unproductive activity while the filters were installed.

In high school (grades 9 to 12, Table 5) as in middle school, students change classrooms each period and hence their exposure to microsurges are likely to be much more varied than the data in Table 5 suggest. Although there were some positive responses (58% showed slight or signfiicant improvements in symptoms) there were also a considerable number of negative responses (39%).

One interesting observation is that the net response (postive minus negative symptoms) decreased with increasing grade level (Table 6). What this suggests is that younger students may be more sensitive than older students to poor power quality. Similar results were observed for childhood leukemia with residential exposure to magnetic fields. Younger children were at greater risk for developing leukemia than older children [8].

The need for teachers to repeat instructions, the ability of students to focus on class work, and active particiation by students in classes are shown in Figure 3 for all grades at Willow Wood School. This figure clearly shows that improved power quality is associated with behaviour that is more conducive to learning in the classroom. It also raises questions about students who may have learning disabilities or those with ADD or ADHD. To what degree are these symptoms associated with or exacerbated by poor power quality in the classroom?

Although Willow Wood is not the first school with Graham/Stetzer filters it is the first one that has been documented scientifically. More studies in schools, particularly elementary schools, are recommended.

Table 3. Response of students in grades 1 to 6 to improved power quality with Graham/Stetzer filters at Willow Wood School.

Lower School		Dirty Power (mV rms)			Student Response to Graham/Stetzer Filters							Summary					
Grade	Room	without G/S filters	with G/S filters	% of original	unproductive time/class (min)	time to start class	time dealing with distruptions	late for class (# students)	need to repeat instructions	students' ability to focus	active student participation	classroom noise	significantly better	slightly better	no change	slightly worse	significantly worse	net response
													++	+	0	-	--	
1&2	A1	24	14	60%	-0.9	-	+	0	+	+	+	++	14%	57%	14%	14%	0%	57%
3	A4	18	12	65%	2.6	+	+	+	++	-	++	+	29%	57%	0%	14%	0%	71%
4	A5	18	14	78%	4.1*	+	++	+	+	+	+	-	14%	71%	0%	14%	0%	71%
5	B7	22	12	55%	2.1	+	+	+	+	-	+	+	0%	86%	0%	14%	0%	71%
6	B6	21	11	52%	5.7	+	+	+	+	+	+	+	0%	100%	0%	0%	0%	100%
	++	significantly better			20%	0%	20%	0%	20%	0%	20%	20%	11%					
	+	slightly better			60%	80%	80%	80%	80%	60%	80%	60%		74%				
	0	no change			0%	0%	0%	20%	0%	0%	0%	0%			3%			
	-	slightly worse			20%	20%	0%	0%	0%	40%	0%	20%				11%		
	--	significantly worse			0%	0%	0%	0%	0%	0%	0%	0%					0%	
		net response			60%	60%	100%	80%	100%	20%	100%	60%						74%

* = statistically significant (P≤0.05)

Table 4. Response of students in grades 7 to improved power quality with Graham/Stetzer filters at Willow Wood School.

Middle School			Dirty Power (mV rms)			Student Response to Graham/Stetzer Filters								Summary					
Grade	Room	Course	without G/S filters	with G/S filters	% of original	unproductive time/class (min)	time to start class	time dealing with distruptions	late for class (# students)	need to repeat instructions	students' ability to focus	active student participation	classroom noise	significantly better	slightly better	no change	slightly worse	significantly worse	net response
														++	+	0	-	--	
7	A2	math	20	13	68%	10	0	+	0	0	-	+	+	0%	43%	43%	14%	0%	29%
7	B4	math	20	14	67%	5.9	0	+	++	+	+	+	-	14%	57%	14%	14%	0%	57%
7	B5	math	28	11	40%	-1.8	-	+	-	-	+	+	-	0%	43%	0%	57%	0%	-14%
		++	significantly better			0%	0%	0%	33%	0%	0%	0%	0%	5%					
		+	slightly better			67%	0%	100%	0%	33%	67%	100%	33%		48%				
		0	no change			0%	67%	0%	33%	33%	0%	0%	0%			19%			
		-	slightly worse			33%	33%	0%	33%	33%	33%	0%	67%				29%		
		--	significantly worse			0%	0%	0%	0%	0%	0%	0%	0%					0%	
			net response			33%	-33%	100%	0%	0%	33%	100%	-33%						24%

A school in the Melrose-Mindoro School District in western Wisconsin had previously been categorized as a "sick" building but attempts to remove mold, which was assumed to be the problem, did nothing to alleviate symptoms among the staff. After installation of the Graham/Stetzer filters both teachers and students had more energy. The school nurse documented these changes [9]. Of the 37 students with inhalers only 3 used them for exercise-induced asthma before physical education classes. Staff with allergies took less medication and students with migraines experienced less pain. Teacher absences for health-related reasons were dramatically reduced after the filters were installed. The increase in modern electronics inside the school and "dirty" power from similar sources outside the school were to blame.

Table 5. Response of high school students to improved power quality with Graham/Stetzer filters at Willow Wood School.

High School				Dirty Power (mV rms)				Student Response to Graham/Stetzer Filters							Summary					
Time	Grade	Room	Course	without G/S filters	with G/S filters	% of original	unproductive time/class (min)	time to start class	time dealing with disruptions	late for class (# students)	need to repeat instructions	students' ability to focus	active student participation	classroom noise	significantly better	slightly better	no change	slightly worse	significantly worse	net response
															++	+	0	-	–	
10:00	9	Annex	Science	nd	nd	nd	0.9	–	+	+	+	+	+	+	0%	86%	0%	0%	14%	71%
10:00	9	S Lab	SNCID	18	9	53%	1.8	++	+	+	+	-	+	-	14%	57%	0%	29%	0%	43%
10:00	11	D2	Law	24	22	93%	0	0	+	+	-	-	-	+	0%	43%	14%	43%	0%	0%
10:00	12	C1	Math	25	14	54%	-4.8	-	–	-	+	-	-	-	0%	14%	0%	71%	14%	-71%
11:30	10	D2	Careers	24	22	93%	1.2	+	+	+	++	-	-	-	14%	43%	0%	43%	0%	14%
11:30	10	D3	Civics	18	12	66%	0.6	+	+	++	-	++	+	+	29%	57%	0%	14%	0%	71%
11:30	11	C Lab	ICS3M	26	14	55%	1.1	++	+	-	-	+	+	++	29%	43%	0%	29%	0%	43%
11:30	11	S Lab	Chemistry	18	9	53%	-1.1	-	-	+	+	--	+	-	0%	43%	0%	43%	14%	-14%
11:30	12	C1	Math	25	14	54%	4.9	++	+	+	-	+	-	+	14%	57%	0%	29%	0%	43%
12:30	10	CIP	Math	nd	nd	nd	-0.8	–	++	-	+	+	+	+	14%	57%	0%	14%	14%	43%
12:30	10	D2	Business	24	22	93%	-0.4	–	-	-	+	++	-	-	14%	14%	0%	57%	14%	-43%
12:30	11	C1	Accounting	25	14	54%	-8.3	-	-	++	++	+	-	+	29%	29%	0%	43%	0%	14%
12:30	12	D3	World Issues	18	12	66%	-0.1	-	0	+	+	+	-	+	0%	57%	14%	29%	0%	29%
3:00	9	Annex	SNCID	nd	nd	nd	12.6	-	++	-	+	+	-	++	29%	29%	0%	43%	0%	14%
3:00	9	S Lab	Science	18	9	53%	4.3	+	+	+	++	+	-	-	14%	57%	0%	29%	0%	43%
3:00	12	A6	Co-op	17	13	77%	-0.8	+	-	0	-	-	+	+	0%	43%	14%	43%	0%	0%
3:00	12	CIP	Math	nd	nd	nd	-0.1	+	-	+	-	+	–	+	0%	57%	0%	29%	14%	14%
			++	significantly better			0%	18%	12%	12%	18%	12%	0%	12%	12%					
			+	slightly better			47%	29%	47%	53%	47%	53%	41%	53%		46%				
			0	no change			6%	6%	6%	6%	0%	0%	0%	0%			3%			
			-	slightly worse			47%	29%	29%	29%	35%	29%	53%	35%				34%		
			–	significantly worse			0%	18%	6%	0%	0%	6%	6%	0%					5%	
				net response			0%	0%	24%	35%	29%	29%	-18%	29%						18%

nd = no data

Table 6. Summary data for students and staff to improved power quality with Graham/Stetzer filters at Willow Wood School.

Willow Wood	Better significantly	Better slightly	no change	Worse slightly	Worse signficiantly	net change
lower school	11%	74%	3%	11%	0%	74%
middle school	5%	48%	19%	29%	0%	24%
high school	12%	46%	3%	34%	5%	18%
teachers	4%	15%	76%	3%	1%	15%
mean	8%	46%	25%	19%	2%	33%

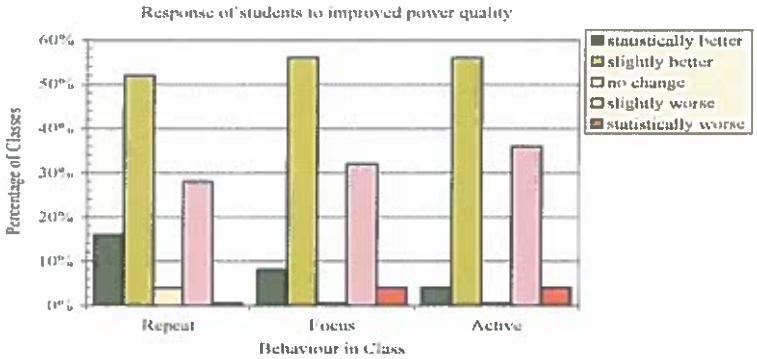


Figure 3. Response of students from grades 1 to 12 at Willow Wood school to improved power quality after installation of Graham/Stetzer filters. Results are based on 25 classes.

Conclusions

These data suggest that poor power quality may be interfering with the education of students, particularly younger students, and the performance of teachers. If the improvements in wellbeing, behaviour and performance that coincided with improved power quality at Willow Wood is a sign of electrical sensitivity then the proportion of electrically sensitive people in the population may be 20-60% than the 2% reported in Sweden [3]. This situation is likely to get worse as we continue to promote the use of computers in the classroom and as we move towards wireless computer and communication technologies that generate radio frequency radiation.

The Graham/Stetzer filters provide one method by which individuals can improve power quality in their home, work, or school environment. They also provide a tool that enables scientists to study the biological effects of poor power quality [10].

Acknowledgements

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Power quality affects teacher wellbeing and student behavior in three Minnesota Schools

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ABSTRACT

BackgroundPoor power quality (dirty electricity) is ubiquitous especially in schools with fluorescent lights and computers. Previous studies have shown a relationship between power quality and student behavior/teacher health.

ObjectivesThe purpose of this study is to determine the ability of power line filters to reduce dirty electricity in a school environment and to document changes in health and behavior among teachers and students.

MethodWe installed Graham Stetzer filters and dummy filters and measured power quality in three Minnesota Schools. Teachers completed a daily questionnaire regarding their health and the behavior of their students for an 8-week period. Teachers were unaware of which filters were installed at any one time (single blind study).

ResultsDirty electricity was reduced by more than 90% in the three schools and during this period teacher health improved as did student behavior in the middle/elementary schools. Headaches, general weakness, dry eyes/mouth, facial flushing, asthma, skin irritations, overall mood including depression and anxiety improved significantly among staff. Of the 44 teachers who participated 64% were better, 30% were worse, and 6% did not change. Behavior of high school students did not improve but elementary/middle school students were more active in class; more responsive, more focused; had fewer health complaints; and had a better overall learning experience.

ConclusionsDirty electricity in schools may be adversely affecting wellbeing of teachers and behavior of their students, especially younger students in middle and elementary school. Power line filters improve power quality and may also protect those who are sensitive to this energy. Work on electric and magnetic field metrics with and without Stetzer filters urgently needs to be carried out to determine just what characteristics of the dirty electricity may be interacting with the people.

1. Introduction

Poor power quality, commonly referred to as dirty electricity, is a growing concern for the electrical utility as it interferes with sensitive electronic equipment leading to malfunctions and costly repairs. Schools with fluorescent lights and electronic equipment in the form of computers, those near high voltage transmission lines and near antennas for wireless communication are prime candidates for poor power quality (Havas 2006b; Vignati and Giuliani 1997).

Another, less well understood, consequence of dirty electricity is ill health for those who have become electrically hypersensitive (EHS). Diabetics with EHS have higher plasma glucose levels and require more medication, when exposed to

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this energy, and people with multiple sclerosis have a worsening of their symptoms (Havas 2006b). The most common complaints among self-proclaimed EHS include chronic fatigue, chronic pain, difficulty sleeping, mood disorders such as anxiety or depression, concentration and memory problems, dizziness, skin irritation, visual disturbances and ringing in the ears (Firstenberg 2001; Havas and Stetzer 2004; Schooneveld and Kuiper 2007).

A study of dirty electricity, in a Toronto school, documented improved health among teachers and improved behavior among students when the dirty electricity was reduced with Graham/Stetzer filters (GS filters) plugged into outlets throughout the school (Havas et al., 2004). These filters short out high frequency transients and harmonics that contribute to poor power quality.

We repeated the study at three schools in Minnesota: an elementary and middle school, in the same building, and a nearby high school.

2. Materials and method

This research was approved by Trent University Ethics Committee and complies with local, state, and national regulations. Teacher participation was voluntary and those who participated could opt out during the study. Teachers provided written consent for us to use the information they provided with the understanding that their identify would not be revealed.

Three schools in Minnesota, an elementary, middle and high school, agreed to participate in a study that monitored and improved power quality and assessed teacher health and student behavior. The middle and elementary schools were in the same building. We did spot measurements of magnetic fields in randomly selected classrooms (using a trifield meter) and found the values to be low (less than 2 mG). Two power quality exposures were tested in each school. One test was with dummy filters that have no effect on power quality and the other was with GS filters that improve power quality. These filters are identical except the dummy filters are internally disconnected. A total of 541 GS filters or 285 dummy filters were installed in the three schools during testing. The protocol was as follows: first two weeks (Jan 31 to Feb 11 2005) with dummy filters, four weeks with GS filters (Feb 14 to Mar 11), and two weeks (Mar 14–25) with dummy filters to minimize seasonal effects on health and behavior. This was a single blind study as teachers were unaware of which filters were installed at any time during the study. While we did not use exactly the same number of real and placebo filters during this study, whether teachers counted the number of filters in their classrooms, along the hallway, in the library, etc. is questionable. We are confident this was a blinded study.

Power quality was monitored with a Microsurge meter that measures high frequency transients and harmonics between 4 to 100 kHz. This meter provides a digital reading from 1 to 1999 of |dv/dt| expressed as GS units with +/−5% accuracy (Graham, 2003). The power quality was measured during the weekend when the dummy and real filters were first installed. Lights were turned on in each room and some computers may have been on but were not in use. Readings obtained are likely to be lower than readings during regular school hours. While this is less than ideal we did not want teachers to know when the filters were exchanged.

Teachers answered a questionnaire related to their health and the behavior of their students at the end of each school day for an 8-week period between January 31 and March 25 2005. For ethical reasons information on the health and behavior of individual students was unavailable and we confined our questionnaire to classroom behavior. Internal checks were used to determine reliability of the responses to the questionnaire with similar questions asked in different ways.

A total of 44 teachers responded frequently enough to the questionnaire to enable statistical analysis providing 685 teacher-days of data. Two-tailed t-tests (dummy vs. GS filters or poor vs. improved power quality) were used for each teacher and for each symptom at the 5% probability level for significant effects and at the 10% level for slight effects. Classroom behavior was assessed the same way. Middle and elementary schools were in the same building and data were combined for analysis. We analyzed data for 14 classes in the middle and elementary school and 17 classes in the high school.

3. Results and discussion

GS filters improved power quality in all three Minnesota schools by more than 90% in the frequency range of 4 to 100 kHz (Table 1). Dirty electricity for all three schools averaged 574 GS units and ranged from 90 to greater than 2000 with dummy filters installed. With GS filters the values ranged from 16 to 150 with an average of 37 GS units. Based on previous studies, values below 50 and ideally below 40 GS units are associated with health benefits for those who are electrically sensitive (Havas, 2006a).

3.1. *Teacher wellbeing*

Teacher health and sense of well being improved with enhanced power quality (Fig. 1). Of the 38 symptoms 79% were better, 13% were worse, and 8% were the same while the GS filters were installed. Headaches, general weakness, dry eye/mouth, facial flushing, depression, mood, dizziness, asthma, pain, skin irritations, clarity of thought, and energy were among the net improvements documented by teachers. Elementary and middle school teachers reported greater improvement (68% of net symptoms) than high school teachers (24% of net symptoms).

A similar study to the one in Minnesota was conducted in a Toronto school for students with learning disabilities from grade 1 to 12 (Havas et al., 2004). Net improvements in teacher wellness were documented for 14 of the 16 symptoms (88%).

In the present study asthma, among teachers, was one of the symptoms that improved as did other respiratory ailments such as runny noise and sinus congestion. Installation of GS filters in a Wisconsin school, experiencing sick-building syndrome, resulted in students with asthma no longer requiring daily use of their inhalers as documented by the school nurse (Havas, 2006a).

Many of the teachers' symptoms that improved are common among people who have developed electrohypersensitivity

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Table 1 – Power quality with real and dummy filters installed in three Minnesota schools

School	Power quality	#rooms	#filters	Dirty electricity (GS units)			Power
				Minimum	Mean	Maximum	% improvement
Elementary	Poor	35	62 (dummy)	147	722	>2000	
	Improved	35	131 (real)	29	41	60	94%
Middle	Poor	30	87 (dummy)	200	563	>2000	
	Improved	28	139 (real)	28	46	150*	92%
High	Poor	36	136 (dummy)	90	438	>2000	
	Improved	37	271 (real)	16	23	40	95%
All	Poor	101	285 (dummy)	90	574	>2000	
	Improved	100	541 (real)	16	37	150*	94%

*Boiler room, large copy machine.

(EHS) (Firstenberg, 2001; Schooneveld and Kuiper, 2007). The symptoms of electrohypersensitivity resemble radiowave sickness, first described among radar workers following World War 2 (Firstenberg, 2001). Electrosensitivity may be severely affecting 3% of the population, who would be unable to work in a school environment with computers and fluorescent lighting and with wireless technology associated with phones and computers (Johansson, 2006). Another 35% of the populations have some of the symptoms of EHS (Philips and Philips, 2006), such as headaches, body aches and pains, fatigue and poor sleep and simply associate these symptoms with either aging or living a stressful lifestyle.

Teachers in this study were ranked based on the amount their symptoms improved (Fig. 1). During the period of enhanced power quality, 64% of the teachers were better, 30% were worse, and 7% were the same resulting in a net improvement among 34% of the teachers overall. This corresponds to the 35% with moderate symptoms of EHS according to Philips and Philips (2006) and is just below the 40% in the Toronto School study (Havas et al., 2004).

Several teachers showed marked improvements ranging from 10% of their symptoms to more than 70%. We believe this relates to the degree of electrosensitivity of the individuals involved.

The teacher who benefited the most is an elementary school teacher. Levels of dirty electricity in her classroom were reduced from 406 to 40 GS units and 27 (71%) of her symptoms improved. She noted that her psoriasis, which had been bothering her for years, completed cleared-up during the study and she did not change any of her medication or skin lotions. Skin irritations following exposure to computer screens, commonly referred to as screen dermatitis, have been extensively studied in Sweden

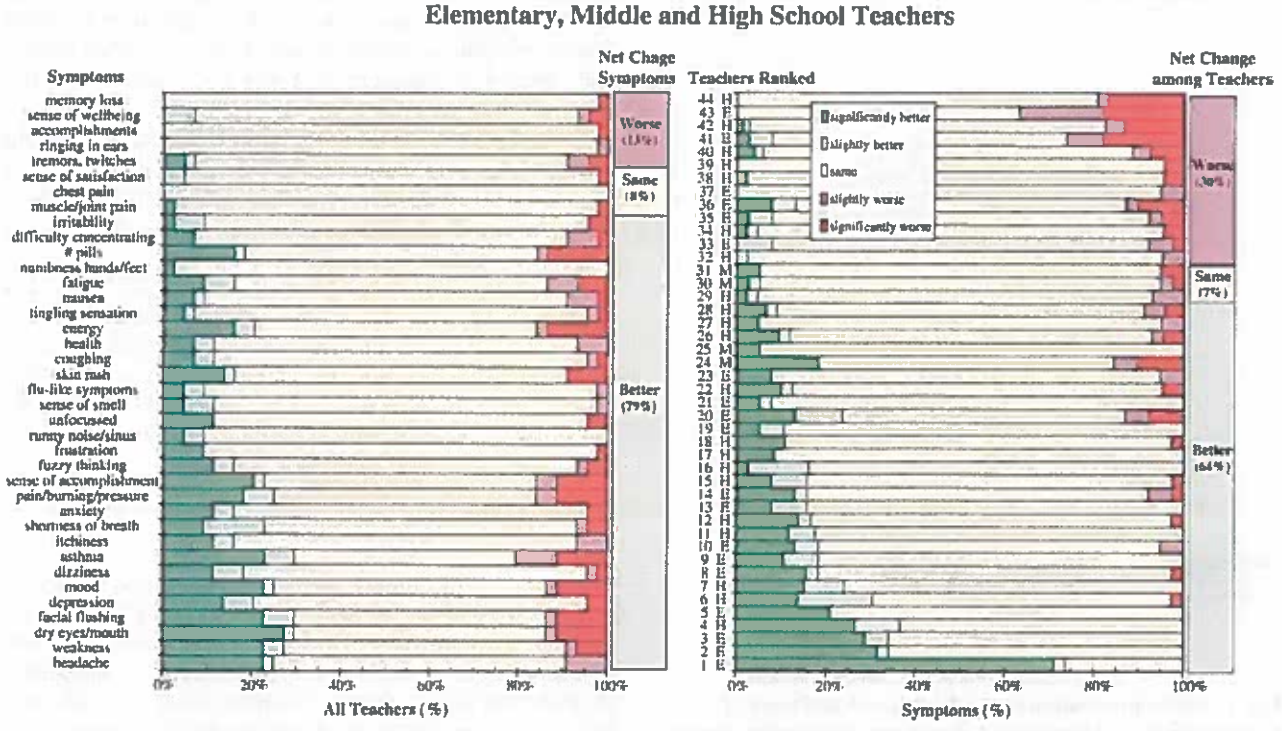

Fig. 1 – Changes in health and wellness symptoms, associated with improved power quality, among teachers in three Minnesota Schools. Note: letter after teacher ranking is for elementary (E), middle (M), and high school (H).

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(Johansson, 2006). Production of mast cells and histamine may be the underlying mechanism for the skin irritations and this seems to differ among people with EHS.

We were unable to lower the dirty electricity in each classroom below the recommended 40 GS units and found that teacher response related to both the original levels of dirty electricity and the values after cleanup. The greater the improvement in power quality the greater was the improvement among teachers (Fig. 2).

The dummy filters, in Fig. 2, represent the ambient levels of dirty electricity and the real filters indicate how much the dirty electricity was reduced in any one classroom. Since we know which teachers taught in which classrooms, we were able to compare their "recovery" with the before and after filter values for power quality.

In classrooms that had values of dirty electricity above 300 GS units and that were reduced to less than 50 GS units with the filters, all the teachers improved. In classrooms where the filters reduced the dirty electricity to above 50 GS units fewer teachers improved (59–82%). In classrooms with the lowest levels of dirty electricity (less than 300), the levels needed to be reduced to less than 30 GS units before all the teachers improved. This demonstrates that the teacher's response was influenced by the original levels of dirty electricity and the values after cleanup.

Other studies have examined the relationship between poor power quality and cancers. Milham and Morgan (submitted for publication) reported a cancer cluster among teachers at La Quinta Middle School in California. Of the 137 teachers, 18 cancers were observed and 6.5 were expected. This 3-fold increase in cancer cases has a 1 in 10,000 possibility of being due to chance. Monitoring of the rooms showed that 13 rooms had high levels of dirty electricity (>2000 GS units) and the teachers who taught in those rooms had a greater risk of developing cancer. Cancer risk for teachers was 1.8 fold if they never taught in those rooms; 5.1 fold if they ever taught in those rooms; and 7.1 fold if they taught in those rooms and had been at the school for more than 10 years. Cancers included melanoma, thyroid, uterine, breast, colon, pancreas, ovary, larynx, lymphoma, and multiple myeloma. In the present study we did not inquire about cancers among staff, but if the conclusions of Milham and Morgan are correct then levels in at least three rooms, with values above 2000 GS units, should be reduced.

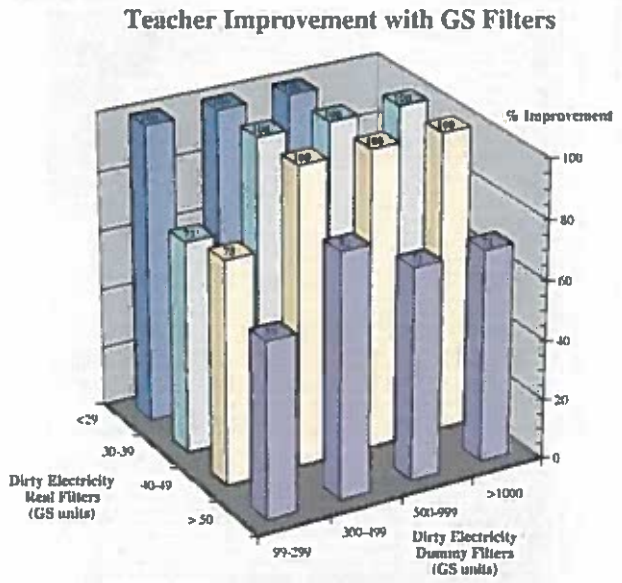

Fig. 2–Net improvement in the health and wellness of teachers in three Minnesota Schools associated with power quality. The real GS filters improved power quality, while the "dummy" filters represented ambient levels.

Interestingly, cancers (Eger et al., 2004; Kundi et al., 2004; Wolf and Wolf, 2004) and symptoms of EHS (Zwamborn et al., 2003; Oberfeld et al., 2004) are the two most common associations with RF exposure from wireless technology including their base stations and antennas.

3.2. *Student behavior*

During this study, the behavior of high schools students did not improve whereas elementary and middle school students did.

3.3. *High school*

Thirty-eight percent of the behavioral traits and 18% of the high school classes were worse overall during the period of enhanced power quality (Fig. 3). One exception was the computer room where student behavior improved for more than 60% of the behavioral traits tested. Interestingly, the results for the Toronto school showed that improvements among high schools students were marginal compared with middle and elementary school students (Havas et al., 2004). This may be due to cell phone use, which is another form of radio frequency exposure that was not controlled in this study, or to the fact that high school students change rooms for their classes and hence a 60-minute exposure in any one class may not be sufficiently long to assess changes in behavior. According to the Principal, 50% of the high school students carry cell phones to class, although they are allowed to use them only in between classes.

In a study of 250 self-proclaimed EHS sufferers, 26% claimed to be bothered by cell phones (Schooneveld and Kuiper, 2007). According to the Stewart Report (2000), children may be more vulnerable to cell phone radiation and should be discouraged from using them for non-essential calls. Here the concern was for developing brain tumors rather than for other less severe but chronic symptoms of EHS.

3.4. *Elementary and middle school*

Behavioral traits among elementary and middle school students were better for 70% of the traits and for 42% of the classrooms overall (Fig. 4). The improvements were not nearly as dramatic as for the Toronto school for learning-disabled students (Havas et al., 2004). Perhaps students with Attention Deficit Disorder (ADD) or Attention Deficit Hyperactivity Disorder (ADHD) are inherently more sensitive to electromagnetic energies.

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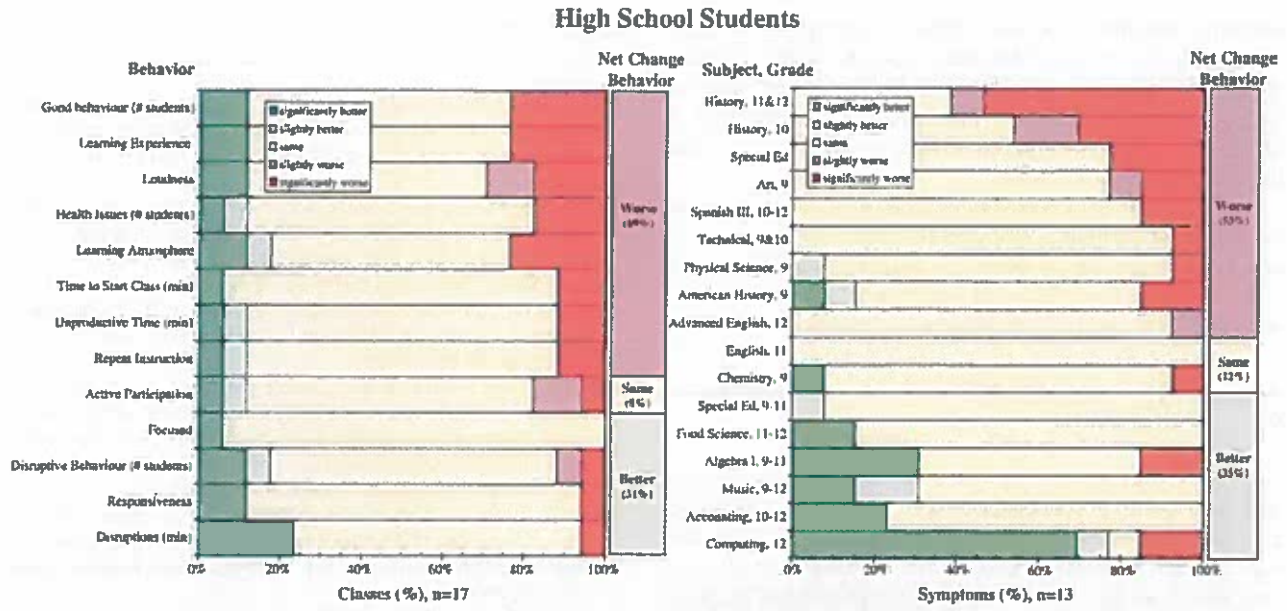
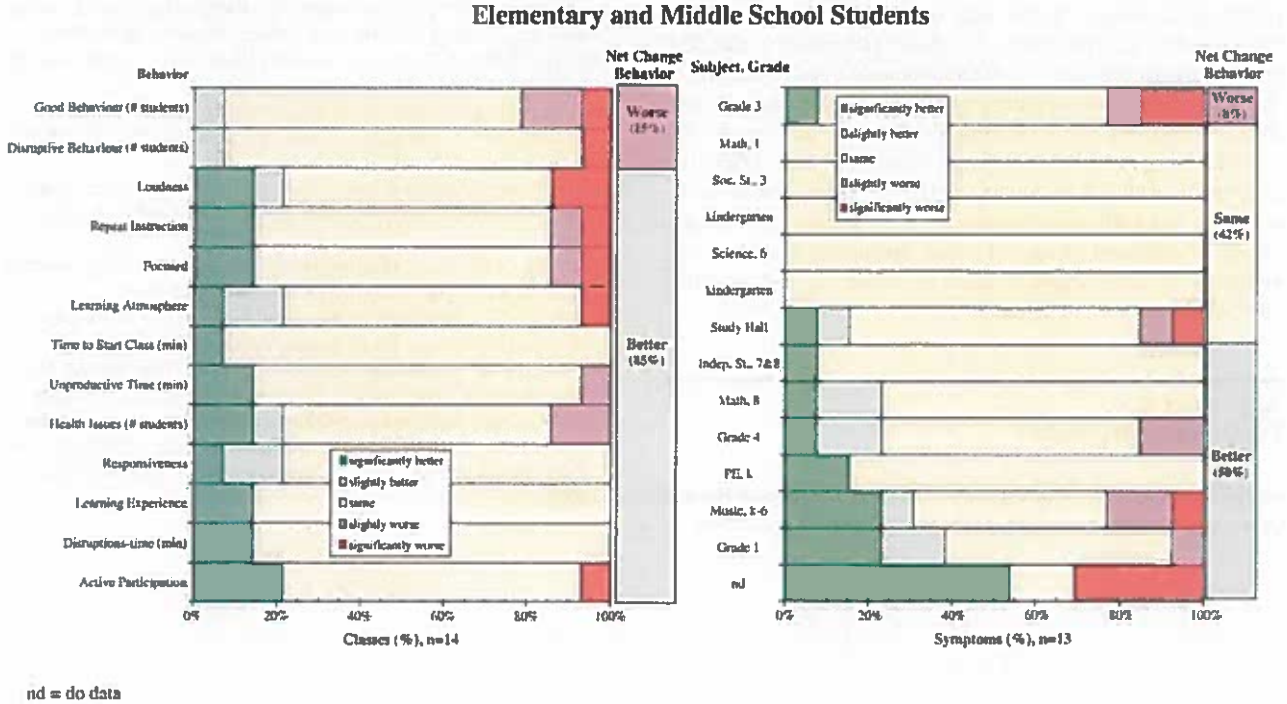


Fig. 3–Behavioral changes in high school students in Minnesota associated with improved power quality.

Teachers reported that students were more actively involved and more responsive during classes. The amount of time it took to start the class and to deal with disruptions was reduced. Students were more focused and required fewer repetitions of instructions and had fewer health complaints. Overall this resulted in an improved learning environment and a better learning experience.

3.5. *High school vs. elementary/middle school*

This different response among the teachers and students in the high school and those in the elementary/middle school may be due to natural variability or, possibly, to other sources of radio frequencies radiation that were not monitored such as wireless computing, within the school, or telecommunication



nd = do data

Fig. 4–Behavioral changes in elementary and middle school students in Minnesota associated with improved power quality. nd=no data.

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antennas, outside the school. Neither building had wireless computing at the time of this study. However, within a radius of 400 m, the Elementary/Middle school had 1 antenna and the high school had 4 (www.antennasearch.com). Monitoring of RF radiation at these schools is advised to confirm or rule out this exposure to RF radiation.

Studies showing increased symptoms of EHS and/or cancers near cell phone antennas cite a critical distance of 300 to 400 m and exposure values far below the existing Federal Communication Commission (FCC) and international guidelines (Oberfeld et al., 2004; Wolf and Wolf, 2004; Zwamborn et al., 2003).

4. Conclusions

Poor power quality or dirty electricity has been implicated with poor health in schools in Ontario, Wisconsin, California, and now Minnesota. Fluorescent lighting and computers are the primary sources of poor power quality but external sources cannot be ruled out. Improving power quality, with GS filters, is accompanied with enhanced teacher wellbeing and improved student behavior in middle and elementary school resulting in a better overall learning experience. The effect of poor power quality on health is a relatively new area of research but one that needs attention, especially in schools where the health and wellbeing of teachers and students are at stake. Work on electric and magnetic field metrics with and without Stetzer filters urgently needs to be carried out to determine just what characteristics of the dirty electricity may be interacting with the people.

Boards of Education have long considered the health effects of air quality, mold, and asbestos and have reduced these in school buildings. Many schools restrict wearing of perfume, to protect those with chemical sensitivities, and have nut-free environments, for those with peanut allergies. School Superintendents and School Boards need to recognize that some people are sensitive to electromagnetic energy and that schools need to be monitored for power quality and for other forms of radio frequency radiation. If levels are high they need to be reduced to ensure a safe environment for both students and staff. More research is required into the health effects of dirty electricity but in the meantime, based on the evidence to date, steps should be taken to reduce dirty electricity exposure in schools.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.scitotenv.2008.04.046.

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Graham/Stetzer Filters Improve Power Quality in Homes and Schools, Reduce Blood Sugar Levels in Diabetics, Multiple Sclerosis Symptoms, and Headaches.

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Summary

Graham/Stetzer filters significantly reduce radio frequency electrical noise on indoor wiring generated by computers, energy efficient lighting, dimmer switches, and entertainment units within the home or workplace and transported into buildings by power lines from neighbouring property. The resultant improvements in power quality in homes and in schools are associated with fewer and less severe headaches, more energy, lower blood sugar levels for diabetics, and improved balance for those with multiple sclerosis. Results are observed within a matter of hours or days. Cases studies for blood sugar, multiple sclerosis, and general wellbeing are presented.

Introduction

Exposure to electromagnetic fields has been associated with an increased incidence of childhood leukaemia and miscarriages with residential exposure and with an increase in adult leukemia, brain cancer, and breast cancer with occupational exposure (see review by Havas 2004). In addition to these serious illnesses, an increasing number of people claim to be electrically sensitive. An estimate of the prevalence of self-reported hypersensitivity to electric or magnetic fields is between 1 and 2 percent in the general Swedish population (Hillert *et al.* 2002). Symptoms include headaches, flu-like symptoms, chronic fatigue, fibromyalgia, poor quality sleep, tightness in the chest, eye discomfort, skin disorders, dizziness, nausea, and difficulty concentrating (Levallois, 2002).

While power frequency (50/60 Hz) electromagnetic fields and particularly the magnetic flux density have been associated with a number of these complaints, it is possible that some of the biological reactions are due to dirty power. Dirty power refers to high frequency transients, harmonics, and other noise on electrical wiring. It can be generated inside buildings by electronic equipment and it can enter the home through wiring from nearby sources including wireless telecommunication antennas connected to the power grid. When the capacity of the primary neutral on distribution lines is exceeded, current runs along the ground and enters homes via grounded water pipes. Wertheimer *et al.* (1995) reported increased cancer risk (OR 3, 95% CI 1.33-6.67) for children in homes with conductive plumbing.

If dirty power is indeed responsible for some of the symptoms mentioned above then removal of dirty power should alleviate these symptoms. Graham/Stetzer Filters are designed to reduce high frequency electrical noise within the range of 4 to 100 kHz on indoor wiring (Graham 2002, 2003). What follows is a summary of the response of individuals who have used Graham Stetzer filters on indoor wiring.

Case Studies

Diabetes

Diabetes is on the increase. In the United States, 16 million people are diagnosed as diabetic and more are suspected of having this disease. Case studies show that blood sugar levels are associated with dirty power on internal wiring as well as radio frequency radiation and that these blood sugar levels can change quickly as one moves from a "dirty" to a "clean" electrical environment.

A 51-year old male, recently diagnosed as diabetic, had higher blood sugar levels when the dirty power exceeded 10 mV (peak to peak) (Figure 1). Ideally blood sugar values should not exceed 200 mg/dL. The blood sugar value of 277 mg/dL at 250 mV (Figure 1 insert) is a real point, not an error. However, since it contributed disproportionately to the correlation co-efficient it was removed. The resultant data still give a significant R^2 value of 0.75. The blood sugar levels for this individual increased when he stood under distribution lines and decreased within 20 minutes in a "clean" environment.

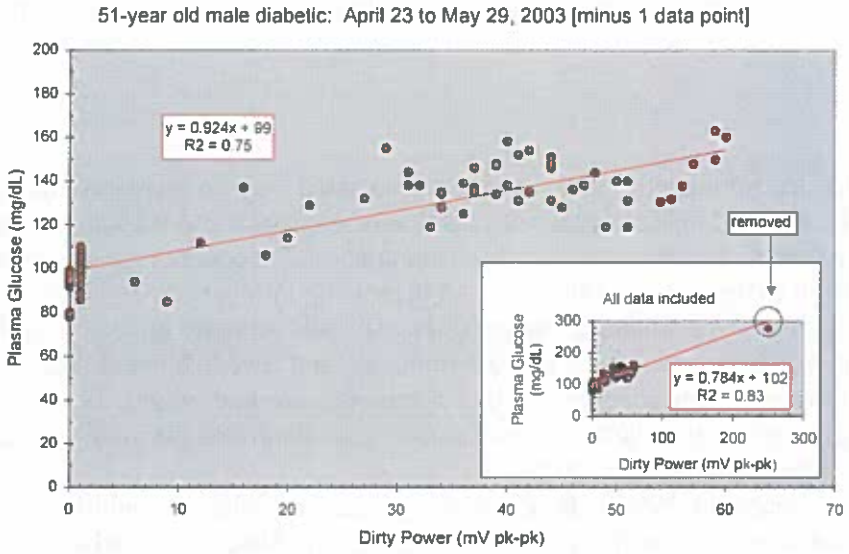

Figure 1. Dirty power and plasma glucose levels for a 51-year old male recently diagnosed as diabetic.

A 57-year old diabetic woman in New York who lives near cell phone antennas has high fasting plasma glucose levels that are associated with the radio frequency radiation in her home (Figure 2). On several occasions she drove from home (10 microW/cm^2) to a clean environment (<1 microW/cm^2) and sat in her car where her blood sugar levels dropped from 225 to 191 mg/dL within 20 minutes. Upon returning home her blood sugar increased within 5 minutes to 195 mg/dL and within 20 minutes to 226 mg/dL while she sat on a chair in her living room. She did not consume any food or medication, nor did she exercise beyond the walk to and from her car. Her symptoms (headache, nausea, and joint pain) disappeared in the car and reappeared when she returned home. She has done this repeatedly and while the values for blood sugar differ the trend is the same.

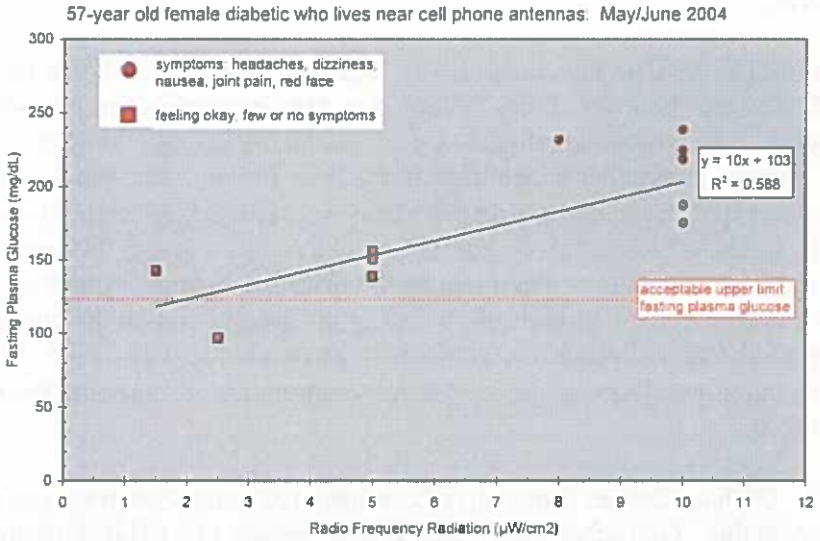

Figure 2. Fasting plasma glucose levels associated with radio frequency radiation from nearby cell phone antenna.

An 80-year old female diabetic had Graham/Stetzer filters installed in her home in Arizona. The dirty power dropped from 800 GS units (on average) to 13 GS units (values <50 units are recommended HSSP 2003). The week prior to the installation her fasting blood sugar levels measured at 7 am averaged 171 (range 152 to 209) mg/dL. After the filters were installed they averaged 119 (range 70 to 168) mg/dL and her intake of insulin (Humlin 70/30) decreased from an average of 36 units per day to 9 units. Fasting plasma glucose above 126 mg/dL is considered diabetic.

Multiple Sclerosis

Three individuals with mild to moderate cases of multiple sclerosis have noticed significant improvements in their symptoms after installation of the Graham/Stetzer filters. One 40-year old man, confined to a wheel chair, was able to run along the beach in Florida with his dog several months after the filters were installed. Two other individuals, one in a wheel chair and one who walked with a cane, were able to walk unsupported within one month of the filter installations.

Of these individuals, a 33-year old female noticed improvement within 24 hours. Twelve filters, installed in her home, reduced the dirty power from an average of 170 to 33 GS units. Her symptoms, prior to the filters being installed, included muscle weakness, muscle pain, difficulty walking, joint stiffness, and joint pain that were major to severe. She also experienced dizziness, restlessness, fatigue, excessive need to urinate, difficulty staying asleep at night and waking up in the morning. Within the first 24 hours she was able to walk around the house without a cane and was able to maintain her balance even when bending over. During the first week after the filters were installed she woke up fewer times during the night, had more energy, and experienced less dizziness.

Part 1 of 8, Additional information found TheBrainCan.com , SolomonSeries.com, and https://www.youtube.com/solomonseries

General Well Being

A family in rural Wisconsin developed severe headaches after some home renovations during the fall of 2002. The children were home schooled and the headaches for all family members seemed to coincide. The mother developed migraines and the younger children experienced headaches that were so severe they would roll on the floor in pain. The father, who worked away from home all day, experienced these headaches only on weekends or during holidays. After they installed the Graham/Stetzer filters their headaches went away and the mother's thyroid problems required less medication. Their headaches returned during spring thaw. Dirty power came into their home from the distribution line along the ground and on the wiring. They have since gone off grid and have disconnected the utility ground at the pole. Two of the children are diabetic and both had lower blood sugar levels and required less insulin after the Graham/Stetzer filters were installed.

School Study #1: Graham/Stetzer filters have been installed in the classrooms of two schools for which data are available. One school, a private school (grades 1 to 12) in Toronto, Canada had 50 filters installed during the winter of 2003 (Havas and Illiatovitch 2004). This reduced, but did not eliminate, the dirty power. Teachers were asked, with no knowledge of the nature of the research (single blind), to complete a questionnaire daily for a 6-week period (3 weeks with and 3 weeks without filters) between January and March 2003. Twenty-two (out of 49 staff) completed the questionnaire enough times to enable statistical analysis.

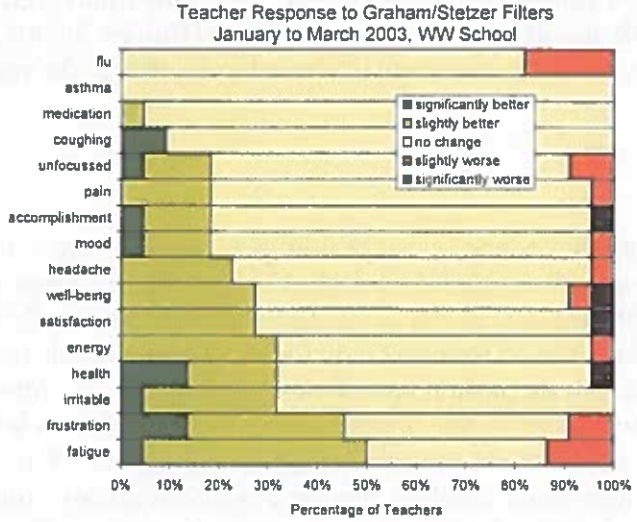

Figure 3. Response of teachers at WW School to improved power quality with Graham/Stetzer filters.

While the filters were installed teachers were less tired, less frustrated, and less irritable with fewer headaches and body pain (Figure 3). They were better able to focus and had better health, improved mood, and greater sense of accomplishments. Of these 22 teachers, 3 teachers (14%) experienced no change in any of the questions asked while the filters were installed. Eleven teachers (50%) showed some improvement in at least one of their symptoms, another 6 teachers (27%) had some symptoms that got better while others got worse, and another 2 teachers (9%) experienced only worsening of their symptoms while filters were installed. Overall, 7 teachers

(32%) experienced statistically significant improvements and only 2 (9%) experienced worsening of their symptoms.

Teachers also documented student behaviour (but not student health) in this questionnaire. The student response was not as clear as that of the teachers. The major difference was that students were less disruptive in the classroom while filters were in place although this may have had some seasonal influence as well. This is a preliminary study that needs to be repeated in other schools.

School Study #2: A school in the Melrose-Mindoro School District in western Wisconsin had previously been categorized as a "sick" building but attempts to remove mold, which was assumed to be the problem, did nothing to alleviate symptoms among the staff. After installation of the Graham/Stetzer filters both teachers and students had more energy. The school nurse documented these changes (www.electricalpollution.com). Of the 37 students with inhalers only 3 used them for exercise-induced asthma before physical education classes. Staff with allergies took less medication and students with migraines experienced less pain. Teacher absences for health-related reasons were dramatically reduced after the filters were installed. The increase in modern electronics inside the school and "dirty" power from similar sources outside the school were to blame.

Conclusions

These results strongly support the contention that blood sugar levels among diabetics, MS symptoms, headaches, and fatigue are associated with dirty power (high frequency electrical noise on electrical wiring). It is possible that some of the cancers associated with high magnetic fields may also be affected by dirty power. The results from these very few case studies are so dramatic that they are worth further investigation. Graham/Stetzer filters enable people to improve power quality in their home and place of work. Ideally manufacturers of electronic equipment (computers, entertainment units, energy efficient lighting, variable speed motors) should filter the noise before it gets onto the wire and power distributors should minimize this dirty power on their lines. They should also increase the capacity of their neutral returns so that less dirty power flows along the ground as ground current. If the Graham/Stetzer filters are as effective as they appear to be in these case studies, then the dirty power in schools, homes, and offices can be reduced until better legislation is in place or existing standards are enforced (IEEE 1992 and HSSP 2003) to minimize the production and distribution of this form of dirty electricity.

Acknowledgements

We would like to thank Kevin Maciejewski and all the people who shared information with us.

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Electromagnetic Hypersensitivity: Biological Effects of Dirty Electricity with Emphasis on Diabetes and Multiple Sclerosis

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Dirty electricity is a ubiquitous pollutant. It flows along wires and radiates from them and involves both extremely low frequency electromagnetic fields and radio frequency radiation. Until recently, dirty electricity has been largely ignored by the scientific community. Recent inventions of metering and filter equipment provide scientists with the tools to measure and reduce dirty electricity on electrical wires. Several case studies and anecdotal reports are presented. Graham/Stetzer (GS) filters have been installed in schools with sick building syndrome and both staff and students reported improved health and more energy. The number of students needing inhalers for asthma was reduced in one school and student behavior associated with ADD/ADHD improved in another school. Blood sugar levels for some diabetics respond to the amount of dirty electricity in their environment. Type 1 diabetics require less insulin and Type 2 diabetics have lower blood sugar levels in an electromagnetically clean environment. Individuals diagnosed with multiple sclerosis have better balance and fewer tremors. Those requiring a cane walked unassisted within a few days to weeks after GS filters were installed in their home. Several disorders, including asthma, ADD/ADHD, diabetes, multiple sclerosis, chronic fatigue, fibromyalgia, are increasing at an alarming rate, as is electromagnetic pollution in the form of dirty electricity, ground current, and radio frequency radiation from wireless devices. The connection between electromagnetic pollution and these disorders needs to be investigated and the percentage of people sensitive to this form of energy needs to be determined.

Keywords Diabetes; Dirty electricity; Electromagnetic hypersensitivity; Multiple sclerosis; Power quality; Radio frequency.

Introduction

Most of the research on the biological effects of nonionizing radiation is done at one of two frequency ranges: extremely low frequency (ELF) associated with electricity (50/60 Hz) and radio frequency (RF) associated with wireless telecommunication

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devices (800 MHz to 2.5 GHz range). An intermediate frequency range, at the low end of the RF spectrum (kHz), flows along and radiates from wires (dirty electricity) and thus has characteristics of the two major types of electromagnetic pollution mentioned above. Scientists doing research on the biological effects of power line frequencies seldom measure this frequency range and thus ignore the effects it might have on health.

Recent advances in filtering technology (Graham/Stetzer or GS filters) and measuring equipment (microsurge meter) enable scientists to test for dirty electricity and to reduce it on indoor wires. In this article, case studies are presented of individuals who have benefited after the dirty electricity in their environment was reduced. This technology provides scientists with the tools to monitor, reduce, and experiment with a frequency range that, until now, has been largely ignored and it may help those who suffer from symptoms of electromagnetic hypersensitivity (EHS).

Dirty Electricity

Poor power quality, also known as dirty electricity, has been a concern for the electric utility for decades. Dirty electricity refers to electromagnetic energy that flows along a conductor and deviates from a pure 60-Hz sine wave (Figure 1). It has both harmonic and non harmonic (transient) components and emerged as a problem in the late 1970s with the increasing use of electronic devices that produce nonlinear loads. Karl Stahlkopf, a vice president of the Electric Power Research Institute (EPRI), estimates that dirty power costs U.S. industry between $4 and $6 billion a year, and that it is likely to get worse before it can be mitigated. EPRI expects that 70% of all electricity produced within the U.S. will flow through electronic devices by 2002, compared with 30% in 1999 (Fortune, 1999).

Dirty electricity is ubiquitous. It is generated by electronic equipment such as computers, plasma televisions, energy efficient appliances, dimmer switches, as

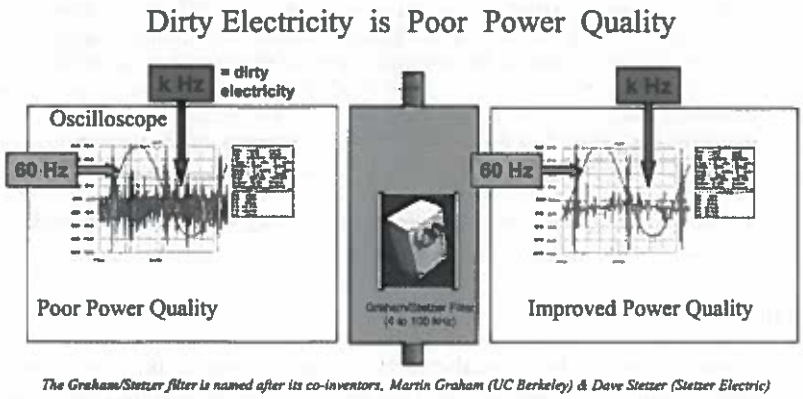

Figure 1. Visual display of dirty electricity (kHz range) and 60 Hz power frequency without (left) and with (right) Graham/Stetzer filters. A 2-channel Fluke 199 Scopemeter was attached to a ubiquitous filter to separate the 60 Hz frequency from the dirty electricity (Graham, 2000). The improved power quality has fewer spikes and smaller amplitude for the high frequency transients. The GS filters have no effect on the 60 Hz sine wave.

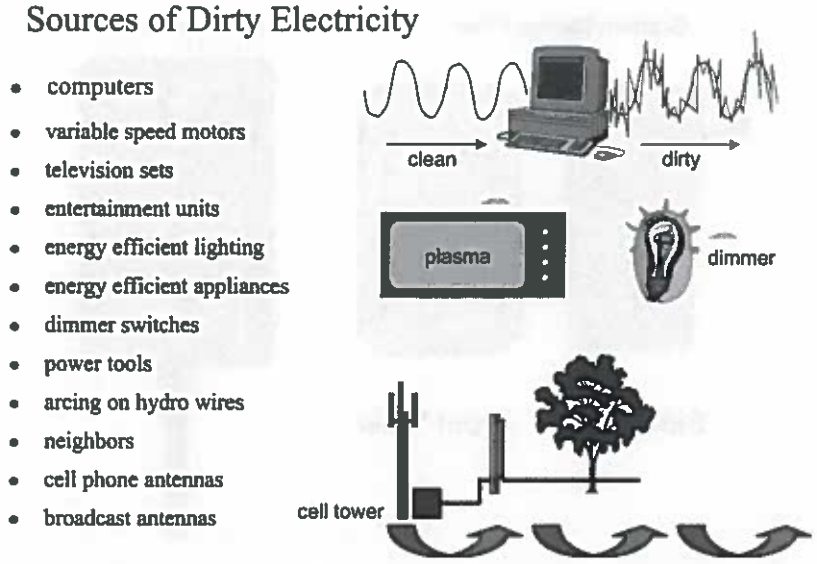

Figure 2. Sources of dirty electricity include electronic equipment and appliances, arcing on wires, and unfiltered cell phone and broadcast frequencies from nearby antennas.

well as arcing on electrical conductors caused by loose wires or contact with trees (Figure 2). Dirty electricity is thus produced within buildings but can also enter buildings from neighbors who share the same transformer. Mobile or broadcast antennas, if not properly filtered, can also contribute to high frequencies on electrical wires in nearby buildings.

The IEEE 519-1992 recommends installing filters to control harmonic distortions on power lines. With 5 kV and higher voltage distribution lines the IEEE identifies voltage notching, which produces both harmonic and nonharmonic frequencies in the radio frequency (RF) range and, as such, can introduce harmful effects associated with spurious RF. Industry uses large capacitors to protect sensitive equipment from power surges, especially in production line work, where malfunctions and down time are costly. Until now filters have not been available for in home use.

Professor Martin Graham from UC Berkeley and power quality expert, Dave Stetzer, President of Stetzer Electric in Wisconsin, have designed a filter that can be used inside buildings to clean the power that enters the building as well as the dirty electricity generated within the building. The Graham/Stetzer (GS) filter is a compact unit that plugs into an electrical outlet (Figure 3). It contains an electrical capacitor that shorts-out the high frequency transients on the circuit and is most effective when placed close to the appliance generating the dirty electricity. The GS filter has optimum filtering capacity between 4 and 100 kHz (Graham, 2000, 2002).

In Russia, the safety guidelines for electric and magnetic field exposure are frequency specific. For frequencies between 5 Hz and 2 kHz, the guideline is 25 V/m for electric fields and 0.25 μT (2.5 mG) for magnetic fields. For frequencies between 2 and 400 kHz, the guidelines are lower by a factor of 10. Since energy is proportional to frequency, the energy is 1,000 times higher at 60 kHz than it is at 60 Hz.

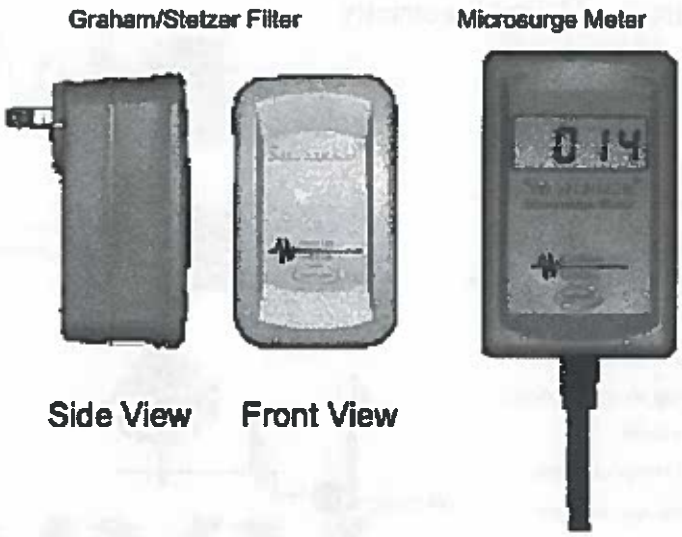

Figure 3. Equipment used to reduce and monitor dirty electricity inside buildings: the Graham/Stetzer filter and the microsurge meter.

The microsurge meter (Figure 3), also designed by Graham and Stetzer, measures the energy associated with dirty electricity in GS units with a range from 1 to 1999 and an accuracy of ±5% (Graham, 2003). The Health Department of the Republic of Kazakhstan (2003) has stated that any reading on the microsurge meter exceeding 50 is unacceptable and steps must be taken to lower such readings. Experience with this meter suggests that values below 30 GS units are undesirable and that extremely sensitive individuals may not see any benefits until the values are at or below 20 GS units. In some extremely dirty environments it is not possible to achieve such low values.

In the following, a number of case studies are presented.

Case Studies

GS filters have been placed in homes, offices, and schools. People report having better sleep, more energy, and less pain. They document cognitive improvements in memory and concentration. Symptoms of radio wave sickness or electrical hypersensitivity (Table 1) are often reduced or eliminated in the filtered environment.

GS filters placed in one Wisconsin school that had sick building syndrome, significantly improved power quality. Shortly after the filters were installed, the health and energy level of staff and students began to improve. According to the District Nurse, of the 37 students in the school who used inhalers on a daily basis, only 3 required inhalers and only for exercise-induced asthma after the filters were in place (Sbraggia, 2002).

GS filters were placed in a Toronto school and approximately 50% of the teachers documented improvements in energy, performance, mood, and/or health in a single blind study (Havas et al., 2004). Student behavior, especially at the elementary level, also improved. The symptoms that changed were ones we associate

Table 1
Symptoms of radio wave sickness first documented among radar workers during the Second World War resemble those now associated with electromagnetic hypersensitivity

Symptoms of radio wave sickness* (Firstenberg, 2001)
Neurological: Headaches, dizziness, nausea, difficulty concentrating, memory loss, irritability, depression, anxiety, insomnia, fatigue, weakness, tremors, muscle spasms, numbness, tingling, altered reflexes, muscle and joint paint, leg/foot pain, "flu-like" symptoms, fever. More severe reactions can include seizures, paralysis, psychosis, and stroke.
Cardiac: Palpitations, arrhythmias, pain or pressure in the chest, low or high blood pressure, slow or fast heart rate, shortness of breath.
Respiratory: Sinusitis, bronchitis, pneumonia, asthma.
Dermatological: Skin rash, itching, burning, facial flushing.
Ophthalmologic: Pain or burning in the eyes, pressure in/behind the eyes, deteriorating vision, floaters, cataracts.
Others: Digestive problems, abdominal pain, enlarged thyroid, testicular/ovarian pain, dryness of lips, tongue, mouth, eyes, great thirst, dehydration, nosebleeds, internal bleeding, altered sugar metabolism, immune abnormalities, redistribution of metals within the body, hair loss, pain in the teeth, deteriorating fillings, impaired sense of smell, ringing in the ears.

*Note: These symptoms resemble symptoms associated with electrical hypersensitivity.

with attention deficit disorder (ADD) and attention deficit hyperactivity disorder (ADHD). This begs the question, "How much of the increase in ADD/ADHD among young people is due to electromagnetic pollution and poor electromagnetic hygiene?"

People with situational tinnitus (ringing in the ears that is present only in certain environments, often where RF is present) have documented improvements as well after the filters were installed in their home, as have those individuals who are otherwise healthy (Havas and Stetzer, 2004). Two diseases we seldom associate with electromagnetic hypersensitivity are diabetes and multiple sclerosis (MS). What follows are case studies that document the response to dirty electricity of diabetics and those with MS.

Diabetes

Two case studies are presented. (1) A 51-year old male with Type 2 diabetes who does not take medication and (2) an 80-year old female with Type 1 diabetes who takes insulin twice a day. A 51-year old male with Type 2 diabetes monitored dirty electricity in his environment and his blood sugar levels randomly throughout the day for approximately one month in 2003. The microsurge meter was not yet available to measure dirty electricity so he used a Protek 506 Digital Multimeter and measured the peak-to-peak voltage. His blood sugar levels were positively correlated with the amount of dirty electricity in his environment (Figure 4). One day he was

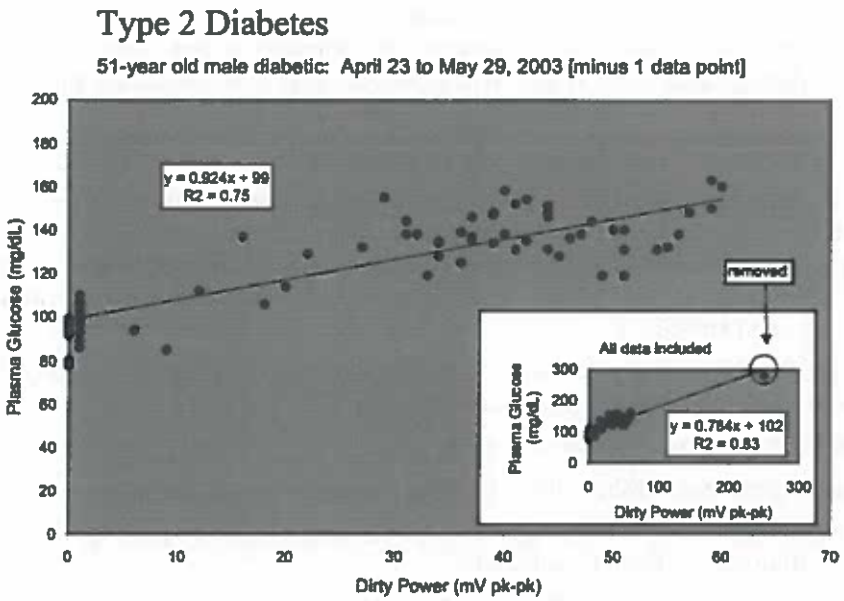

Figure 4. Fifty-one year old male with Type 2 diabetes. His plasma glucose levels correlate with the dirty electricity in his environment. Insert shows exposure on one day to a very high level of dirty electricity and this is reflected in elevated blood sugar.

exposed to very high levels of dirty electricity and this was reflected in exceptionally high levels of blood sugar. He noticed that his blood sugar levels remained low when he was in his truck away from power lines and antennas and when he was in a wilderness setting. In an electromagnetically dirty environment his blood sugar levels would increase within minutes.

An 80-year old female with Type 1 diabetes, who monitors her blood sugar twice daily—once in the morning upon awakening (fasting plasma glucose) and once in the evening before supper—had her home in Arizona filtered by an electrician. He was able to reduce the dirty electricity in her home from an average of 800 GS units to 13 GS units. As soon as the dirty electricity in her home was reduced, her blood sugar began to drop. Her average fasting plasma glucose levels without the filters was 171 mg/dL and this dropped to an average of 119 with the filters (Figure 5). During this period her insulin injections were reduced from a daily average of 36 units to 9 units.

Her evening plasma glucose did not change after the filters were installed in her home but they did change on days she spent away from home. Levels were particularly high after spending time in a casino. Casinos are likely to have high levels of dirty electricity but stress may also have contributed to higher levels of blood sugar (Hinkle and Wolf, 1950).

Multiple Sclerosis

One teacher in the Wisconsin school that was filtered had been diagnosed with multiple sclerosis (MS). She was extremely tired, had double vision, had cognitive

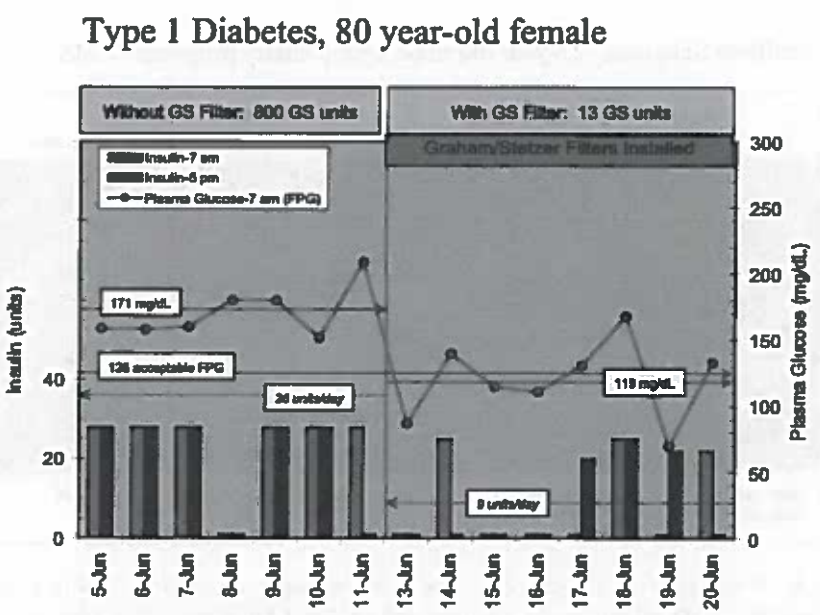

Figure 5. Eighty-year old female with Type 1 diabetes, who takes insulin twice daily. Fasting plasma glucose levels and insulin injections with and without Graham/Stetzer filters are shown.

difficulties and could not remember the names of the students in her 4th grade class. Her health would improve during the summer but her symptoms returned in September. She assumed her problems were mold-related but her symptoms did not improve after the mold was removed from the school. Once the school was filtered her symptoms disappeared. Similar stories prompted studies with people who had MS.

Havas began to work with people diagnosed with MS, who had difficulty walking and who used canes or walkers. The first person she worked with noticed improvements within 24 h. At that stage Havas assumed this was a powerful placebo effect but the subject's symptoms continued to improve weekly and regressed only during wet weather, which had always been a problem for this subject. Several other people with MS were able to walk unassisted after a few days to weeks with the GS filters and Havas began to videotape those who gave her permission to do so.

One of those individuals is a 27-year old male who had been diagnosed with primary progressive MS two years earlier. He walked with a cane or did "wall walking" at home (holding onto the wall or furniture for balance). He had tremors, was exceptionally tired, and was beginning to have difficulty swallowing. Three days after 16 GS filters were placed in his home his symptoms began to disappear. The dirty electricity in his home was reduced from 135–410 GS units to 32–38 GS units. He assumed his body was recovering spontaneously but he had been diagnosed with progressive MS and not relapsing/remitting MS, so spontaneous recovery was unlikely in his case.

A week after the filters were installed in his home he had enough energy to go shopping with his father. He did not take his cane because he had not needed it, but

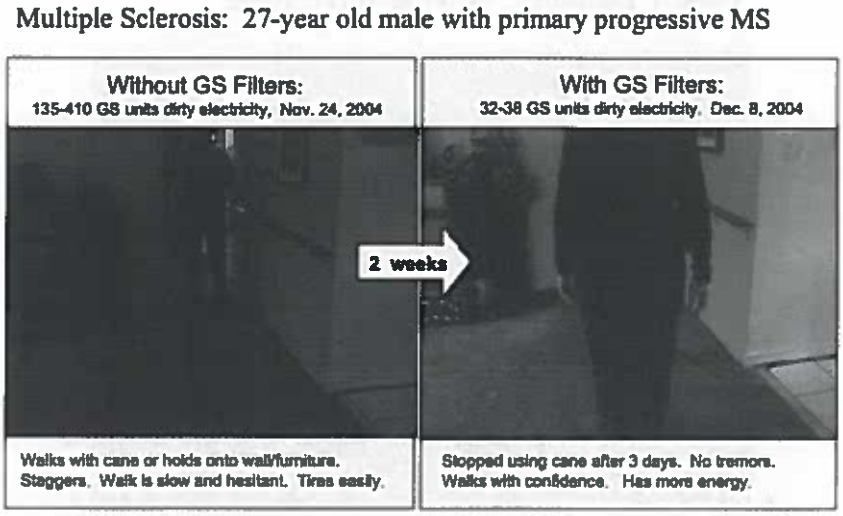

Figure 6. Video-clip of 27-year old male with primary progressive multiple sclerosis, diagnosed two years earlier. In the video on left (without Graham/Stetzer filters), he walks slowly and is hesitant. In the video on the right (two weeks after Graham/Stetzer filters were installed in his home), he walks with confidence and is well coordinated.

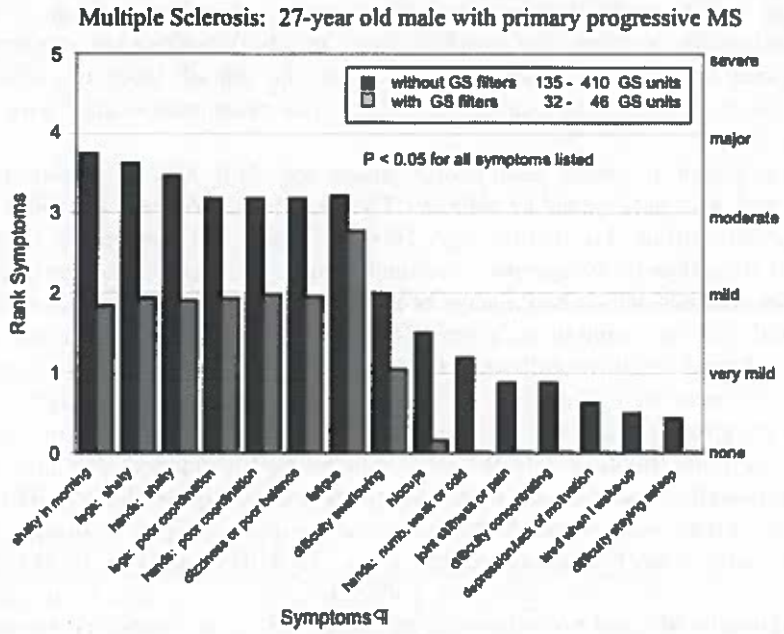

Figure 7. Symptoms of 27-year old male with primary progressive multiple sclerosis with and without Graham/Stetzer filters in his home.

after a couple of hours in the store his symptoms reappeared and he had difficulty walking to the car. His tremors began to subside three hours after arriving home. This experience has been repeated on several occasions and he now knows that if he goes into an environment with dirty electricity his MS symptoms reappear.

Figure 6 is taken from a video before the filters were installed in his home and two weeks later. Prior to the filters his walk was stilted and slow. He staggered and resembled the gait of someone who was intoxicated. Two weeks after the filters were installed his walk was normal with no signs of MS. During this period he began to put on weight, was sleeping better, and had fewer tremors and more energy (Figure 7).

Some other observations that are notable is that his mother had been suffering from hot flashes at night associated with menopause and these came to an end after the filters were installed and his father experienced several episodes of vertigo weekly and these became less frequent.

Conclusions

These case studies and anecdotal reports suggest that dirty electricity is biologically active. Once dirty electricity is reduced, people's health improves. For some it is reflected in more normal blood sugar levels, for others symptoms of MS are reduced, and for still others tinnitus disappears and behavior resembling ADD/ADHD improves. Since dirty electricity is becoming ubiquitous large fractions of the population are being exposed to this pollutant and some are being adversely affected.

Diabetes, multiple sclerosis, ADD/ADHD, asthma chronic fatigue, and fibromyalgia are all increasing in the population and the reasons for this increase are poorly understood. Dirty electricity may be one of the contributors to these illnesses.

According to Philips and Philips (2006) 3% of the population has electromagnetic hypersensitivity (EHS) and 35% have symptoms of EHS. If these percentages apply to diabetics then as many as 5–60 million diabetics worldwide may be responding to the poor power quality in their environment (Wild et al., 2004). Evidence from laboratory studies documents that insulin release and insulin-binding capacity to receptors cells is reduced by electromagnetic fields (Li et al., 2005; Sakurai et al., 2004). It is further known that stress increases blood sugar levels in diabetics and that exposure to electromagnetic energy induces stress proteins at various frequencies (Blank and Goodman, 2004; Hinkle and Wolf, 1950).

Dirty electricity can now be monitored with meters and reduced with filters, providing scientists with the tools needed for research. What is presented here is a handful of studies, many preliminary, with dramatic results. This area warrants further investigation to determine the mechanisms involved and the percentage of the population affected.

Conflict of Interest

Please note that the author has no vested interest, financial or otherwise, in the commercial devices discussed in this article.

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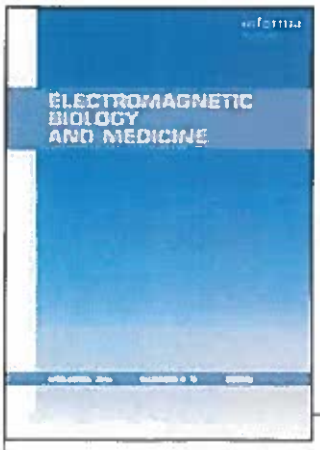

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Dirty Electricity Elevates Blood Sugar Among Electrically Sensitive Diabetics and May Explain Brittle Diabetes

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Dirty Electricity Elevates Blood Sugar Among Electrically Sensitive Diabetics and May Explain Brittle Diabetes

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Transient electromagnetic fields (dirty electricity), in the kilohertz range on electrical wiring, may be contributing to elevated blood sugar levels among diabetics and pre-diabetics. By closely following plasma glucose levels in four Type 1 and Type 2 diabetics, we find that they responded directly to the amount of dirty electricity in their environment. In an electromagnetically clean environment, Type 1 diabetics require less insulin and Type 2 diabetics have lower levels of plasma glucose. Dirty electricity, generated by electronic equipment and wireless devices, is ubiquitous in the environment. Exercise on a treadmill, which produces dirty electricity, increases plasma glucose. These findings may explain why brittle diabetics have difficulty regulating blood sugar. Based on estimates of people who suffer from symptoms of electrical hypersensitivity (3–35%), as many as 5–60 million diabetics worldwide may be affected. Exposure to electromagnetic pollution in its various forms may account for higher plasma glucose levels and may contribute to the misdiagnosis of diabetes. Reducing exposure to electromagnetic pollution by avoidance or with specially designed GS filters may enable some diabetics to better regulate their blood sugar with less medication and borderline or pre-diabetics to remain non diabetic longer.

Keywords Radio frequency; Transients; Dirty electricity; Power quality; Plasma glucose; Blood sugar; Insulin; GS filters; Electrohypersensitivity; Brittle diabetes; Type 3 diabetes; Type 2 diabetes; Type 1 diabetes.

Introduction

Diabetes mellitus is increasing globally. According to the World Health Organization, in 1985 the global population of diabetics was 30 million (0.6% of the world population). This increased to 171 million (2.8% of the global population) by 2000, and it is expected to more than double to 366 million (4.5% of the global population) by 2030 (Wild et al., 2004; U.S. Census Bureau, 2005). Doctors attribute this rise in diabetes to poor diet and limited exercise, resulting in obesity, and seldom look for causes other than lifestyle and genetics.

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This article presents a paradigm shift in the way we think about diabetes. In addition to Type 1 diabetics, who produce insufficient insulin, and Type 2 diabetics, who are unable to effectively use the insulin they produce, a third type of diabetes may be environmentally exacerbated or induced by exposure to electromagnetic frequencies.

Our increasing reliance on electronic devices and wireless technology is contributing to an unprecedented increase in our exposure to a broad range of electromagnetic frequencies, in urban and rural environments and in both developed and developing countries. This energy is generated within the home by computers, plasma televisions, energy efficient lighting and appliances, dimmer switches, cordless phones, and wireless routers, and it can enter the home and work environment from nearby cell phone and broadcast antennas as well as through ground current.

Although the position of most international health authorities, including the World Health Organization, is that this form of energy is benign as long as levels remain below guidelines, an increasing number of scientific studies report biological and health effects associated with electromagnetic pollution well below these guidelines (Sage and Carpenter, 2007). Epidemiological studies have documented increased risks for childhood leukemia associated with residential magnetic fields exposure (Ahlbom et al., 2000), greater risk for various cancers with occupational exposure to low-frequency electric and magnetic fields (Havas, 2000), miscarriages (Li et al., 2002), Lou Gehrig's disease (Neutra et al., 2002), brain tumors associated with cell phone use (Kundi et al., 2004), as well as cancers and symptoms of electrical hypersensitivity (EHS) for people living near cell phone and broadcast antennas (Altpeter et al., 1995; Michelozzi et al., 2002). Laboratory studies report increased proliferation of human breast cancer cells (Liburdy et al., 1993), single- and double-strand DNA breaks (Lai and Singh, 2005), increased permeability of the blood brain barrier (Royal Society of Canada, 1999), changes in calcium flux (Blackman et al., 1985), and changes in ornithine decarboxylase activity (Salford et al., 1994).

In this article, changes in plasma glucose, in response to electromagnetic pollution, for numerous measurements on four subjects—two with Type 1 diabetes taking insulin and two non medicated with Type 2 diabetes—are described. They include men and women, ranging in age from 12–80, as well as individuals recently diagnosed and those living with the disease for decades.

Case 1: 51-Year Old Male with Type 2 Diabetes

A 51-year old male with Type 2 diabetes, taking no medication, monitored his plasma glucose levels from April 24 to May 30, 2003. He also monitored the dirty electricity in his home using a Protek 506 Digital Multimeter connected to a ubiquitous filter (Graham, 2000) to remove the 60-Hz signal and its harmonics. Measurements were taken in the morning and randomly throughout the day. Low or no readings of dirty electricity were taken in an electromagnetic clean environment far from power lines and cell phone antennas (Fig. 1 upper graph). Three years later, the microsurge meter became available and Case 1 monitored his blood sugar levels once more (Fig. 1 lower graph). This meter provides a digital readout of the absolute changing voltage as a function of time ($|dv/dt|$, expressed as GS units) for the frequency range 4–100 kHz and with an accuracy of $\pm$ 5% (Graham, 2003).

Figure 1 shows a positive correlation between dirty electricity and plasma glucose levels taken randomly during the day (upper graph) and first thing in the morning (lower graph). His elevated plasma glucose is unrelated to eating. Working

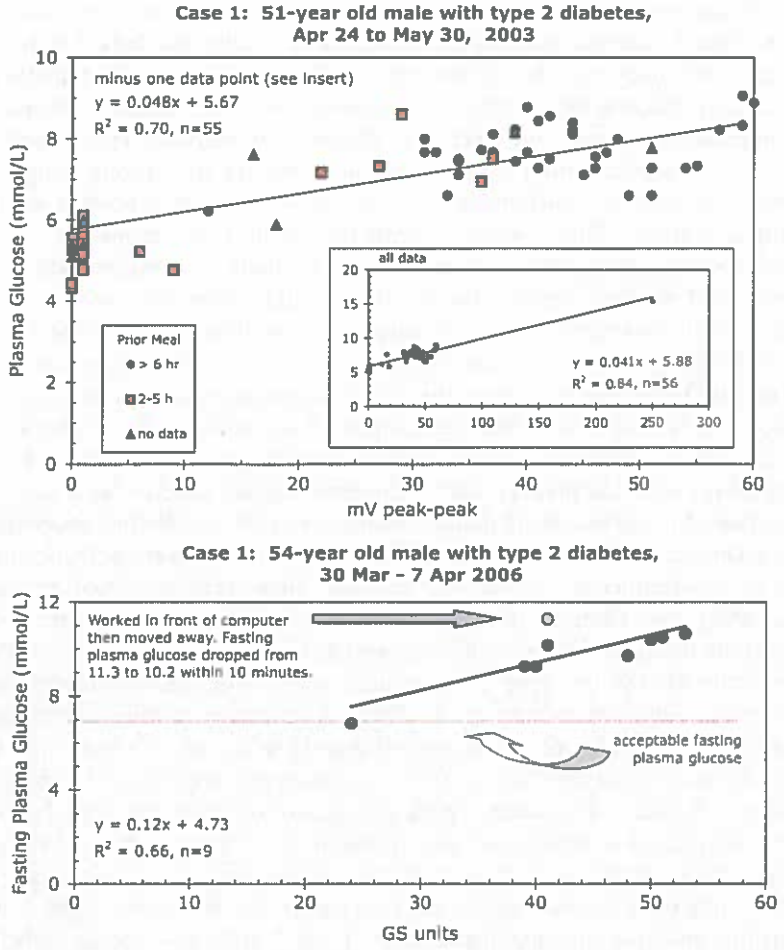

Figure 1. Case 1: *Upper chart*: Plasma glucose levels of a 51-year old male with Type 2 diabetes exposed to different levels of power quality. Insert shows the entire data set with one very high plasma glucose reading that was recorded during a period of high exposure to dirty electricity. *Lower chart*: Three years later, fasting plasma glucose levels correspond to power quality measured in GS units. Time spent in front of computer resulted in higher plasma glucose levels that dropped 1.1 mmol/L [19.8 mg/dL] 10 min after moving away from computer. Note that we have scaled both plots the say way in Fig. 1.

on a computer increases blood sugar, but these values decrease as much as 0.11 mmol/L* [2 mg/dL] per minute after moving away from the computer. Blood viscosity decreased as his plasma glucose levels dropped.

Case 1 also documented rapid changes in blood sugar as he moved from a medical clinic (environment with dirty electricity), to his parked vehicle (no dirty electricity), and back to the medical clinic. His blood sugar levels changed significantly within 20 min. His endocrinologist classified him as *pre-diabetic* when his blood sugar was tested immediately upon entering the medical clinic and as a *Type 2 diabetic* after a 20-min wait in the medical clinic. Measurement of blood sugar needs

*Multiply by 18 to convert to mg/dL.

to be done in an electromagnetically clean environment to prevent misdiagnosis and to accurately determine the severity of the disease.

Case 2: 57-Year Old Female with Type 2 Diabetes

A 57-year old female with Type 2 diabetes takes no medication and controls her plasma glucose with exercise and a hypoglycemic diet. When she exercised by walking for 20–30 min at a mall after hours, her blood sugar levels dropped from a mean of 11.8 to 7.2 mmol/L [212 to 130 mg/dL] ($p = 0.045$). When she walked on a treadmill, her blood sugar levels increased from 10 to 11.7 mmol/L [180 to 211 mg/dL] ($p = 0.058$) (Fig. 2). Treadmills have variable speed motors and produce dirty electricity.

Doctors recommend exercise for patients with diabetes. However, if that exercise is done in an electromagnetically dirty environment, and if the patient is sensitive to this form of energy, it may increase stress on the body and elevate levels of plasma glucose, as in Case 2.

This subject also measured her plasma glucose as she moved from an environment with dirty electricity to one that was clean, and back again. Her blood sugar in the dirty environment was 12.5 mmol/L [225 mg/dL] and within 20 min in the clean environment dropped to 10.6 mmol/L [191 mg/dL]. Within 5 min after returning to the dirty environment, her blood sugar rose to 10.8 mmol/L [194 mg/dL] and 15 min later to 12.6 mmol/L [227 mg/dL]. She did not eat or exercise during this period. Her elevated plasma glucose levels were associated with headaches, nausea, and joint pain in her home, where she was exposed to both dirty electricity and radio frequency radiation from nearby cell phone antennas. These exposures and symptoms were absent in the clean environment.

Case 3: 80-Year Old Female with Type 1 Diabetes

An 80-year old female with Type 1 diabetes, who takes insulin (Humulin® 70/30) twice daily, documented her blood sugar levels before breakfast and before dinner

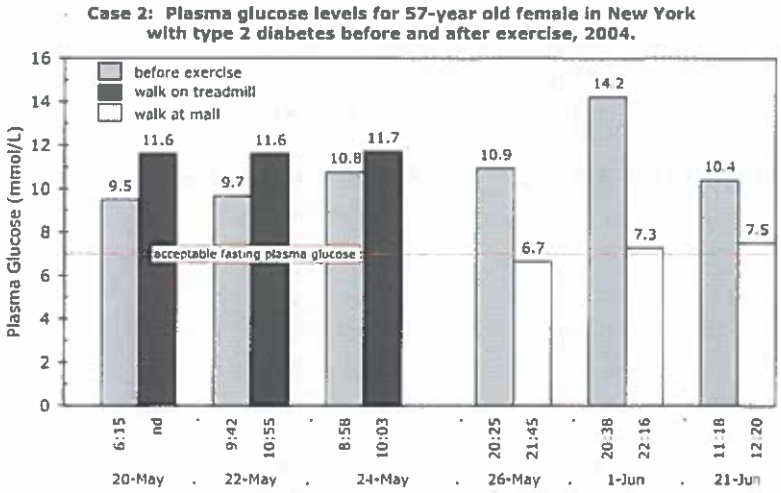

Figure 2. Case 2: Plasma glucose levels for a 57-year old female in New York with Type 2 diabetes, before and after walking for 20–30 min on a treadmill in her home and after hours at a mall.

for one week. On June 12, 2004, the dirty electricity in her home was reduced from an average of 1,550 GS units (range: 600 to > 2,000) to 13 GS units (range 11 to 22) with Graham/Stetzer filters (GS filters). These filters provide a short to high frequency, and, thus, reduce transients on electrical wiring with an optimal filtering capacity between 4 and 100 kHz (Graham, 2000, 2002, 2003). They are similar to capacitors installed by industry to protect sensitive electronic equipment from power surges and to adjust the power factor. GS units measure the energy associated with dirty electricity (amplitude and frequency) and are a function of changing voltage with time (dv/dt). Dirty electricity can be measured using an oscilloscope or multimeter set for peak-to-peak voltage or a Microsurge meter that provides a digital readout (GS units) and is easily used by non professionals.

Case 3 had mean fasting plasma glucose of 9.5 mmol/L [171 mg/dL] without the GS filters and 6.6 mmol/L [119 mg/dL] with the GS filters ($p = 0.02$) (Table 1). Her evening blood sugar did not change appreciable during this period, although it did differ on days she was away from home. She was able to more than halve her insulin intake ($p = 0.03$) once the GS filters reduced the dirty electricity in her home (Table 1).

Table 1

Case 3: Plasma glucose levels and daily insulin injections (Humulin® 70/30) for an 80-year old woman with Type 1 diabetes before and while GS filters were installed in her home in Arizona

	Plasma Glucose (mg/dL)		
Date 2004	Morning (7 am)	Evening (5 pm)	Daily Insulin (units)
Without GS Filters: Dirty Electricity 1,550 GS units			
June 5	158	239●	56
June 6	158	167	56
June 7	160	113●	56
June 8	180	104	0
June 9	180	144	56
June 10	151	76	56
June 11	116	229	28
Mean (sd)	171 (20)	153 (63)	44 (22)
With GS Filters: Dirty Electricity 13 GS units (installed June 12)			
June 13	86	194	0
June 14	140	94	25
June 15	115	178	0
June 16	112	135	15
June 17	131	175	20
June 18	167	250●	50
June 19	70	169	22
June 20	133	126	22
Mean (sd)	119 (31)	166 (49)	19 (16)
2-tailed *t*-test	$p = 0.002$**	$p = 0.69$	$p = 0.03$*

●Subject was away from home during the day.

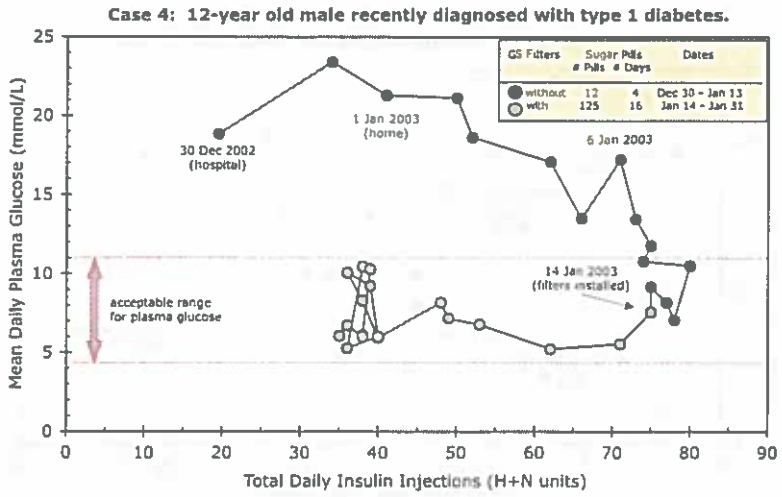

Figure 3. Case 4: Sequence of mean daily plasma glucose levels and total daily insulin injections for 12-year old male with Type 1 diabetes who was admitted to hospital in December 2002 and returned home on January 1, 2003. On January 14, 2003, GS filters were installed in his home to improve power quality.

Case 4: 12-Year Old Male with Type 1 Diabetes

A mother and her 5 children, who were all home schooled, began to develop intermittent, excruciating headaches during the fall of 2002 in rural Wisconsin, shortly after they had a new septic system installed. The headaches continued and a power quality expert measured high levels of dirty electricity and ground current, possibly attributable to the septic system installation.

In December 2002, one child, a 12-year old male, was hospitalized and diagnosed with Type 1 diabetes. His younger sister had been living with diabetes since the age of 3 months and was one of the youngest children diagnosed with diabetes in the United States.

On January 14, 2003, the family installed GS filters to help alleviate their symptoms of electrical hypersensitivity. The headaches disappeared and the family's health began to improve. Shortly after the GS filters were installed, the mother had great difficulty controlling her son's blood sugar. She couldn't reduce the amount of insulin fast enough to keep it within an acceptable range and needed to give him sugar pills to prevent hypoglycemia (Fig. 3). He was taking a combination of Humalog® (H-insulin, a short-acting insulin) and Humulin® NRT (N-insulin, a long-lasting insulin).[1] During this period, her daughter's blood sugar levels began to drop as well.

Doctors attribute the short-term improvement in blood sugar to the "honeymoon period", which is observed among some diabetics shortly after diagnosis and lasts from weeks to months and occasionally for years (Bernstein, 2003). The honeymoon period cannot explain the response of the subject's sister, who had been living with Type 1 diabetes for years, and who also had lower plasma glucose levels

[1]Both the short-acting Humalog® (H-insulin) and the long-lasting Humulin® NPH (N-insulin) are produced by Eli Lilly.

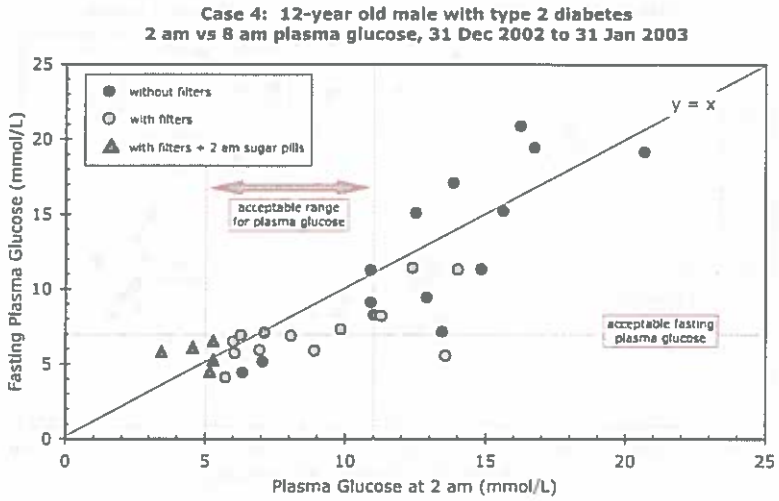

Figure 4. Case 4: Fasting (8 am) and 2 am plasma glucose levels for 12-year old male with Type 1 diabetes with and without GS filters. NOTE: Sugar pills were administered at 2 am for 5 d to prevent hypoglycemia while filters were installed.

and difficulty regulating her insulin within an acceptable range after the GS filters were installed and the dirty electricity was reduced.

Case 4 had higher levels of plasma glucose at 8 am (fasting) than at 2 am on some days before the GS filters were installed. This was not observed with the filters, except when sugar pills were taken at 2 am to deliberately increase blood sugar (Fig. 4). In Wisconsin, dirty electricity often increases in the middle of the night, beginning at 2–3 am and lasting from minutes to hours, as the electric utility makes changes in its system.

Discussion

These results show that plasma glucose levels, in the Type 1 and Type 2 diabetic cases reported, respond to electromagnetic pollution in the form of radio frequencies in the kHz range associated with indoor wiring (dirty electricity). Type 1 diabetics require less insulin in an electromagnetically clean environment and blood sugar levels for Type 2 diabetics increase with increasing exposure to dirty electricity.

In May 2006, a long-term health care facility in Ontario, Canada installed GS filters to reduce dirty electricity. Of the five diabetic residents, for whom data were available, two (aged 87 and 88) were insulin-dependent Type 1 diabetics. Both had significantly lower fasting plasma glucose levels ($p < 0.01$) after the GS filters were installed. Their insulin intake did not change during this period and nursing staff had to give them orange juice on several occasions to prevent hypoglycemia. The levels of plasma glucose of the remaining three, who were Type 2 diabetics, did not change during this period.

The GS filters, used in this study have been tested at the Yoyogi Natural Clinic in Japan (Sogabe, 2006). Three people participated in the study. Three hours after eating, their blood sugar was 6.3, 7.7, 17.9 mmol/L [113, 139, and 322 mg/dL] in an

environment with more than 2,000 GS units of dirty electricity. GS filters reduced the dirty electricity to 30–35 GS units and, within 30 min, their plasma became less viscous and their blood sugar dropped to 5.6, 6.1, 16.1 mmol/L [101, 110, 290 mg/dL], respectively.

The person with the highest plasma glucose levels was a 28-year old male with Type 2 diabetes and fasting plasma glucose levels of 16.7 mmol/L [300 mg/dL]. Despite taking 250 mg of Glycoran®, 3 times a day, and 12 mg of Amaryl®, spread throughout the day, he still had difficultly regulating his blood sugar. Three days after installing 4 GS filters in his home, his blood sugar dropped to 6.9 mmol/L [124 mg/dL] and he was feeling well. He had been unable to achieve such low values with medication alone.

In this study, we classify diabetics whose blood sugar responds to electromagnetic pollution as Type 3 diabetics. In contrast to true Type 1 diabetics who produce insufficient insulin and true Type 2 diabetics who are unable to effectively use the insulin they produce, Type 3 diabetics are responding to environmental triggers that affect blood sugar readings and blood viscosity. These individuals may be better able to regulate plasma glucose by controlling their exposure to frequencies in the low RF range, and thus differ from true Type 1 and Type 2 diabetics whose blood sugar is not affected by this type of electromagnetic exposure.

The increase in blood viscosity with increasing exposure to dirty electricity is a critical observation. If this turns out to be the case among electrosensitive individuals, it may explain the symptoms of headaches, chest pain, higher blood pressure, blurred vision, and fatigue.

The percentage of diabetics who are likely to be affected by electromagnetic energy is unknown, but if the values are similar to those suffering from symptoms of electromagnetic hypersensitivity (EHS), 3–35% of the population (Philips and Philips, 2006), then globally between 5 and 60 million existing diabetics may have Type 3 diabetes as described in this study.

There is a growing body of *in vivo*, *in vitro*, and epidemiological evidence, which suggests a relationship between plasma glucose levels, insulin secretion, and exposure to electromagnetic energy at frequencies both lower and higher than the ones we tested in this study.

Altpeter et al. (1995) reported that for people living within a 2 km radius of a short-wave transmitter, in Schwarzenburg, Switzerland, the odds ratio (OR) for diabetes was 1.93 when compared with a population further away. There was a significant linear correlation ($R^2 = 0.99$) between daily median RF exposure and incidence of diabetes. The highest RF readings, recorded in the nearest zone (51 mA/m), were well below the International Radiation Protection Agency's 1988 guidelines of 73 mA/m. Those living near the transmitter also had difficulty falling and staying asleep, were restless, experienced weakness and fatigue, and had both limb and joint pain with statistically significant odds ratios between 2.5 and 3.5. These symptoms are typical of radio wave sickness or electrical hypersensitivity (Firstenberg, 2001). Failure of the transmitter for a 3-d period was associated with improved sleep and, hence, these reactions are biological not psychological.

Beale et al. (2001) reported that the prevalence of chronic illness, asthma, and Type 2 diabetes was linearly related to 50-Hz magnetic field exposure for adults living near transmission lines. For Type 2 diabetes, the crude OR was 8.3 (95% CI 1 to 177), but the OR adjusted for possible confounders (age and ethnicity) was reduced to 6.5 and was not statistically significant ($p > 0.05$). Epidemiological

studies of power lines tend to focus on cancers, rather than diabetes, and, hence, limited information of this type is available.

Litovitz et al. (1994) exposed diabetic subjects to 60-Hz magnetic fields between 0.2–1 μT (2–10 mG) and noticed that blood glucose levels increased above 0.6 μT. No statistical tests were reported and no attempt was made to measure frequencies other than 60 Hz. Magnetic flux densities above 0.6 μT are realistic near transmission lines and overlap with the range documented in the Beale study (2001).

Jolley et al. (1982) exposed islets of Langerhans from rabbits to low-frequency pulsed magnetic fields and noted a reduction in insulin release during glucose stimulation compared with controls ($p < 0.002$). Similarly, Navakatikyan et al. (1994) exposed rats to 50-Hz magnetic fields for 23 h per day for 11 days at 10, 50, and 250 μT. Serum insulin levels decreased at the middle- and high-flux densities, which the authors associated with stress.

Sakurai et al. (2004) measured insulin secretion from an islet derived insulinoma cell line, RIN-m, exposed to low-frequency magnetic fields of 5 mT compared with sham exposure of less than 0.5 μT. Insulin secretion was reduced by approximately 30% when exposed to low-frequency magnetic fields compared to sham exposure. The authors conclude: "it might be desirable for diabetic patients who have insufficient insulin secretion from pancreatic islets to avoid exposure to ELFMF". The magnetic flux density was exceptionally high in this experiment and is unlikely to be encountered in normal daily life. Studies of the incipient level of electromagnetic exposure, at which insulin secretion is reduced, would be useful.

Li et al. (2005) exposed hepatocytes *in vitro* to 50 Hz pulsed electric fields (0.7 V/m) and noted a conformation change in the insulin molecule and an 87% reduction in the binding capacity of insulin to its receptors compared with controls.

Stress often increases plasma glucose levels in diabetics (Hinkle and Wolf, 1950; Jolley et al., 1982). Studies with laboratory animals and *in vitro* studies with human cells show both low-frequency electromagnetic fields and non thermal RF radiation stimulates production of stress proteins, and that the biochemical reactions are the same over a range of frequencies and intensities (Blank and Goodman, 2004). Release of insulin is strongly inhibited by the stress hormone norepinephrine, which leads to increased blood glucose levels during stress. Rajendra et al. (2004) found elevated levels of norepinephrine in the brain of fertilized chick eggs on day 15 following exposure to 5, 50, and 100 μT. The "stress response" to electromagnetic energy may provide, yet, another mechanism that could explain Type 3 diabetes.

Reduced insulin secretion and reduced binding capacity of insulin to its receptors may explain the elevated levels of plasma glucose in Type 3 diabetics exposed to electromagnetic fields. More research on mechanisms is needed.

Conclusions

In addition to lifestyle and genetics, the environment appears to be another factor contributing to high levels of blood sugar. This concept presents a possible paradigm shift in the way we think about diabetes and the consequences may be far reaching. As a result, we have labeled environmental diabetes as Type 3 diabetes.

We recognize that there is, as yet, no accepted definition of Type 3 diabetes and that our definition may be in conflict with others that have been suggested including a combination of Type 1 and Type 2, gestational diabetes, and that Alzheimer's Disease is a form of diabetes (Steen et al., 2005; de la Monte et al., 2006).

What we describe here is a totally different type in the sense it has an environmental trigger. Doctors have long suspected an environmental component but it has not been until now that one has been found.

The increasing exposure and ubiquitous nature of electromagnetic pollution may be contributing to the increasing incidence of this disease and the escalating cost of medical care. Diagnosis of diabetes needs to be done in an electromagnetically clean environment to prevent misdiagnosis, and to properly assess the severity of this disorder. Most medical centers have electronic equipment and use fluorescent lights that produce dirty electricity, which is likely to cause abnormally high blood sugar readings for those with a combination of diabetes and electrohypersensitivity (Type 3 diabetes). Dirty electricity may also explain why brittle diabetics have difficulty controlling their blood sugar levels.

Type 3 diabetes, as described in this study, is an emerging disease. Unlike true Type 1 and Type 2 diabetics whose blood sugar is not affected by dirty electricity, Type 3 diabetics may be better able to regulate their blood sugar with less medication, and those diagnosed as borderline or pre-diabetic may remain non diabetic longer by reducing their exposure to electromagnetic energy. The GS filters and the microsurge meter provide the tools needed for scientific investigation of dirty electricity and may help diabetics regulate their blood sugar by improving power quality in their home, school, and work environment. Minimizing exposure to radio frequencies (kHz to GHz), flowing along the ground or through the air, also needs to be addressed. Large-scale studies are needed in controlled settings to determine the percentage of the population with Type 3 diabetes.

These results are dramatic and warrant further investigation. If they are representative of what is happening worldwide, then electromagnetic pollution is adversely affecting the lives of millions of people.

Conflict of Interest

Please note that the author has no vested interest, financial or otherwise, in the commercial devices mentioned in this article.

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Dirty Electricity and Electrical Hypersensitivity: Five Case Studies

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Abstract

Deteriorating power quality is becoming increasingly common in developed countries. Poor power quality, also known as dirty electricity, refers to a combination of harmonics and transients generated primarily by electronic devices and by non-linear loads. We have assumed, until recently, that this form of energy is not biologically active. However, when Graham/Stetzer™ filters were installed in homes and schools, symptoms associated with electrical hypersensitivity (such as chronic fatigue, depression, headaches, body aches and pains, ringing in the ears, dizziness, impaired sleep, memory loss, and confusion) were reduced. Five case studies are presented that include one healthy individual; one person with electrical hypersensitivity; another with diabetes; and a person with multiple sclerosis. Results for 18 teachers and their classes at a school in Toronto are also presented. These individuals experienced major to moderate improvements in their health and wellbeing after Graham/Stetzer filters improved power quality in their home or work environment. The results suggest that poor power quality may be contributing to electrical hypersensitivity and that as much as 50% of the population may be hypersensitive; children may be more sensitive than adults and dirty electricity in schools may be interfering with education and possibly contributing to disruptive behavior associated with attention deficit disorder (ADD); dirty electricity may elevate plasma glucose levels among diabetics, and exacerbate symptoms for those with multiple sclerosis and tinnitus. Graham/Stetzer filters and meters enable individuals to monitor and improve power quality in buildings and they provide scientists with a tool for studying the effects of dirty electricity. For the first time we can progress from simply documenting electrical hypersensitivity to alleviating some of the symptoms. These results are dramatic and warrant further investigation. If they are representative of what is happening worldwide, then dirty electricity is adversely affecting the lives of millions of people.

Key words: ADD, ADHD, electrical hypersensitivity, EHS, dirty electricity, diabetes, Graham/Stetzer filter, multiple sclerosis, MS, power quality, tinnitus, Stetzerizer

Introduction

We are living in an increasingly complex electrical environment and are inundated daily with electromagnetic frequencies ranging from less than 20 Hz (electric trains) to greater than 1 billion Hz (wireless telecommunication). Most of these frequencies are man-made and were not present until the invention and subsequent commercialization of electricity (early 1900s), radio (1920s), radar (1940s), television (1950s), computers (1970s), and cell phones (1980s). Whether, and at what intensities, these frequencies have biological effects has been a subject of scientific debate for decades.

The present paper is restricted to the electromagnetic spectrum associated with the distribution of electricity and the poor power quality that results from electronic devices that generate high frequencies and transients that ride on top of a normal 50/60 Hz sine wave. Graham/Stetzer filters are able to improve power quality by reducing microsurges [refer to website for definition, www.stetzerelectric.com] in the frequency range of 4 to 100 kHz on electrical wiring. This paper documents the response of individuals to the removal of dirty electricity in their home or work environment. Five case studies are presented. They include a healthy individual; a person who has symptoms of electrical hypersensitivity; a person with multiple sclerosis; one with diabetes; and the response of 18 teachers and their students to improved power quality in their school.

Dirty Electricity

Since the introduction of electricity and the rapid growth in our use of electronic devices the quality of electrical power flowing along conductors (wires) within the home and workplace has been deteriorating. The public became aware of poor power quality, also known as dirty electricity, when home computers became popular. These computers would periodically "malfunction" and these malfunctions were associated with power surges on the electrical wiring. Surge suppressors are now commonly used as a consequence of poor power quality to protect sensitive electronic equipment.

In most homes today the 50 or 60 Hz sine wave, when viewed with an oscilloscope, is often distorted by microsurges or high frequency harmonics and transients (Figure 1). Computers, television, dimmer switches, and energy efficient lighting and appliances within the home and arcing on distribution lines, caused by contact with tree branches, as well as non-linear loads on power lines contribute to dirty electricity. Even the 25 MHz burst of energy every 1.5 seconds from strobe lights (without an RF choke) on cell phone towers has been measured on the ground and on wires more than 5 km away.

We have learned to protect sensitive electronic equipment with surge suppressors and have assumed, until recently, that this form of energy is not biologically active. Evidence suggests otherwise.

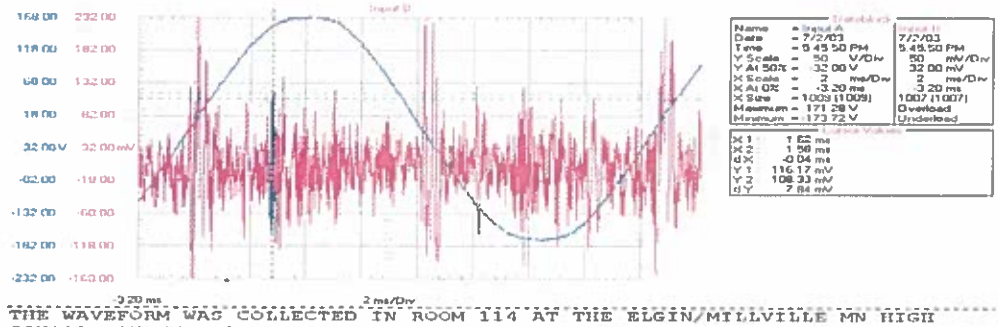
Capacitors smooth out high frequency noise on electrical wires. Graham/Stetzer filters[1] were designed to reduce microsurges on indoor wiring and they work most effectively within the frequency range of 4 to 100 kHz.

Various models have been designed to predict the flow of electromagnetic energy around and through living organisms. According to the Cornell Cow Model (Reines et al. 2000), at frequencies below 1 kHz 80% of the energy is dissipated on the skin and 20% is dissipated internally; and at frequencies above 2 kHz all the energy is dissipated internally. A similar human electrical model (Reilly 1992) predicts that 75% of the energy is dissipated internally at lower frequencies and all is dissipated internally at higher frequencies. The frequency transition points tend to vary based on the path of the current, the wetness of the skin etc. The G/S filters, therefore, remove frequencies that are most likely to be internalized. The Republic of Kazakhstan has Sanitary Norms that state that a person should not be exposed to more than 25 V/m under 2 kHz and no more than 2.5 V/m between 2-400 kHz. The same is

[1] G/S filters are capacitors that reduce the amplitude of harmonics and transients on indoor wiring.

true for the magnetic component, which goes from 250 nT to 25 nT for the same frequencies (HSSP 2003)

(a) Before G/S filters were installed



(b) With G/S Filters installed

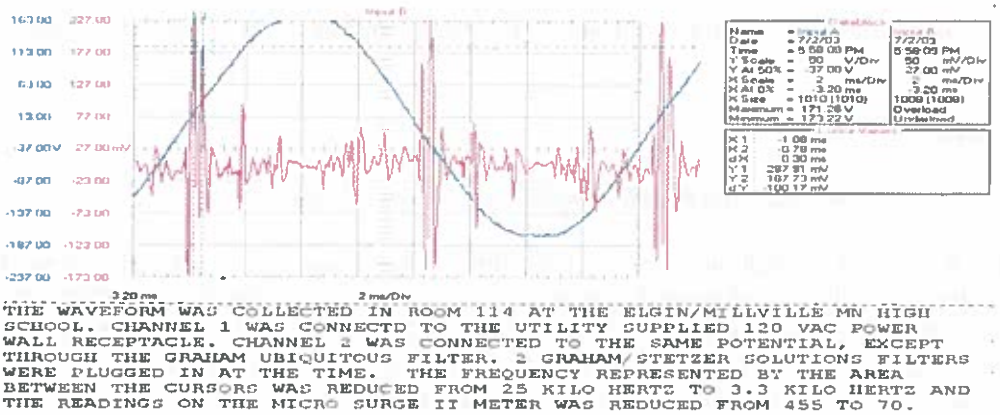
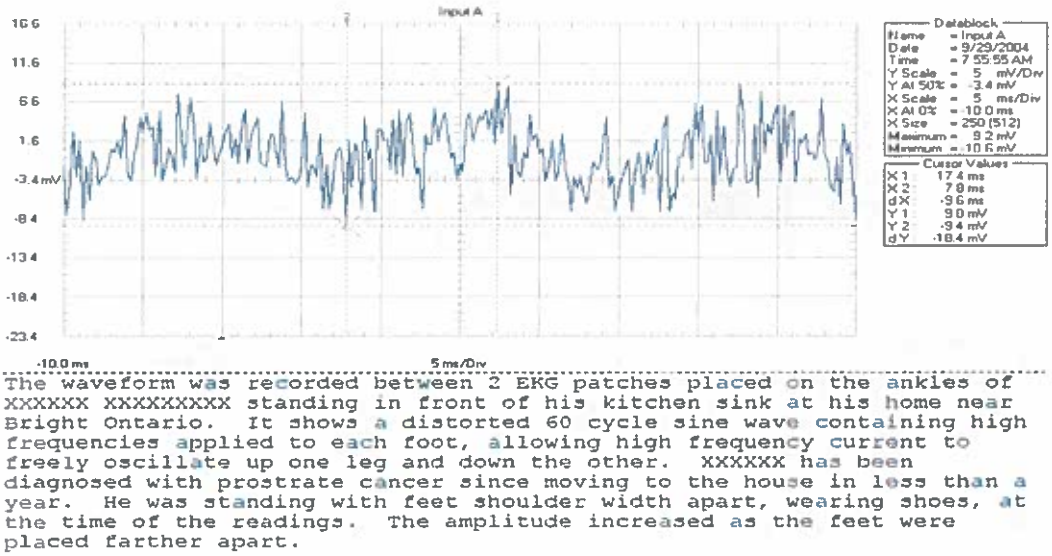


Figure 1. An oscilloscope waveform showing the 60-Hz (blue) sine wave (channel 1) and the high frequency (pink) microsurges (channel 2) on indoor wiring at a school in Minnesota. Top graph (a) is without Graham/Stetzer filters and bottom graph (b) is with Graham/Stetzer filters installed.

It should be noted that high frequency currents tend to become ground currents (Hughes 2004) and an object that is in contact with the ground becomes part of the circuit, as shown in Figure 2 for a man standing in his kitchen with EKG patches on his ankles. The 60-Hz sine wave is distorted with high frequency microsurges that travel up one leg and down the other.

In summary, high frequency microsurges (dirty electricity), generated by, among other things, electronic devices, travel along the electrical distribution grid (wires inside buildings and between buildings) and along the ground. Conducting objects, including living organisms, in contact with the ground become part of the circuit. Frequencies above 2 kHz are likely to penetrate living organisms, while those below 1 kHz dissipate externally

(heating the skin). Graham/Stetzer filters reduce the amplitude of microsurges on indoor wiring and thus reduce the frequencies most likely to be biologically active.



The waveform was recorded between 2 EKG patches placed on the ankles of XXXXXX XXXXXXXXX standing in front of his kitchen sink at his home near Bright Ontario. It shows a distorted 60 cycle sine wave containing high frequencies applied to each foot, allowing high frequency current to freely oscillate up one leg and down the other. XXXXXX has been diagnosed with prostrate cancer since moving to the house in less than a year. He was standing with feet shoulder width apart, wearing shoes, at the time of the readings. The amplitude increased as the feet were placed farther apart.

Figure 2. Oscilloscope waveform on the ankles of a man standing in his kitchen in Ontario.

Case Studies:

Case #1: 51-year old female, no health complaints; Ontario, Canada

A healthy 51-year old female installed the G/S filters in her home and in her office at work. She completed a wellness questionnaire daily for 1 week prior to installation of the filters and for 4 weeks after filters were installed (Sept 6 to Oct 10, 2004). The rectifier, in light dimmer switches, chops the sine wave and generates microsurges that travel along electrical wiring. For this reason, readings[2] of the dirty electricity were taken in her home with and without the dimmers on (Table 1). The dirty electricity in her home reached a peak at 470 GS units (see www.stetzerelectric.com for definition of GS units) with dimmer switches off and 1130 GS units with them on. Graham/Stetzer filters reduced values from an average of 300 to 40 GS units with dimmer switch off and from 440 to 70 GS units with dinner switch on. Values should be less than 50 and, for optimum effectiveness, less than 30 GS units (HSSP 2003). She also installed 4 filters in her office at work but was able to reduce the dirty electricity from 400 to only 100 GS units since microsurges were coming from neighboring offices. In situations like this, G/S filters need to be installed in neighboring offices as well. Ideally an entire building should be filtered to optimize power quality. During the period of the study she spent most of her time at home and approximately 6 hours at work each weekday.

Although this person considered herself healthy and ranked herself high on the wellness questionnaire, she did notice changes after the filters were installed. Her sleep improved immediately (this is a common response) and she began to have vivid dreams. If she woke up in the middle of the night she would return to sleep quickly. Although she did not

[2] Readings were taken with a Stetzerizer™ Microsurge Meter (Model GS-M300-A, www.stetzerizer.com).

consider herself anxious, she noticed that she was calmer and had more energy after the filters were installed. She had less head "pressure", stiffness, and muscle pain (Figure 3). She also noticed that she no longer had cold extremities at night (see Case Study #4).

Table 1. Power quality in the home or workplace of each of the case studies.

Case	Details	Dirty Electricity (GS units) Without Filters Mean	Without Filters Range	With G/S Filters Mean	With G/S Filters Range
#1: Healthy	Home: Dimmer Switches off	300	190-470	40	30-50
	Home: Dimmer Switches on	440	190-1130	70	30-290
	Office	400		100	
#2: EHS[1]	Home	~900	300-1900	~20	13-30
#3: MS[2]	Home	170		30	
#4: Diabetes	Home	800	160 - > 2000	13	10-15
#5: School[3]	School	23	13-101	13	8-24

[1] EHS: electrical hypersensitivity
[2] MS: multiple sclerosis
[3] values for school are in mV (rms) for frequencies up to 20 kHz. Measurements were taken with a Fluke 79 III meter connected to a Graham Ubiquitous Filter, which removes the 60-Hz sine wave.

She wanted to participate in this study because her recently deceased husband, who was suffering from mercury poisoning, felt "discomfort" in certain rooms of the house. When we measured the dirty electricity in her home, the high values corresponded to rooms in which he felt unwell. She wanted to know if her wellbeing was affected by the poor power quality in her home. These results suggest that it was and raise the question, "Is she electrically hypersensitive?"

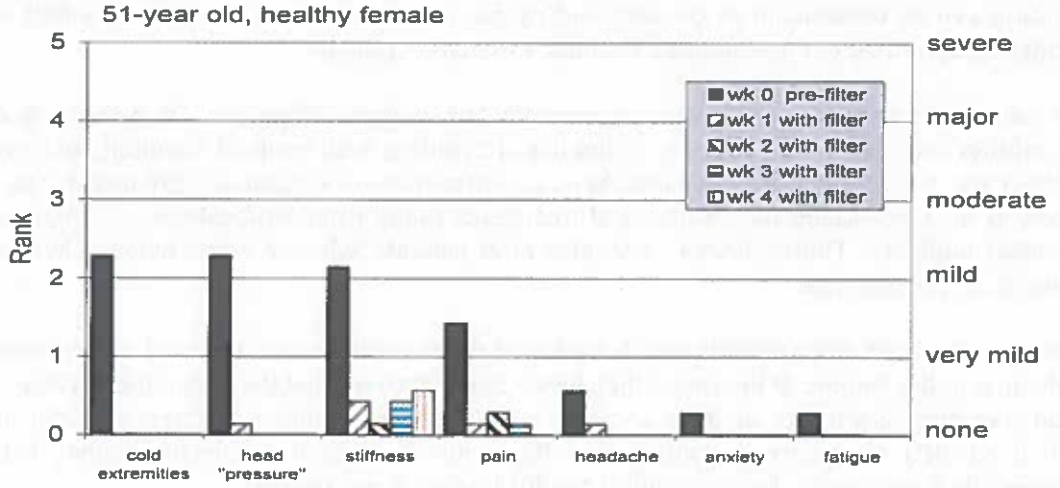


Figure 3. The response of a healthy 51-year old female to G/S filters, Sept/Oct 2004

Case #2: 42-year old male; EHS symptoms include disturbed sleep, headaches, painful teeth and gums, ringing in ears, fatigue and irritability; Barbados

A 42-year old male experienced ringing in his ears (tinnitus), painful teeth and gums, and headaches behind his eyes for which he took over-the-counter medication weekly. He slept poorly and was tired and irritable during the day. These symptoms are consistent with electrical hypersensitivity (Levallois 2002), although he did not use this term. His symptoms

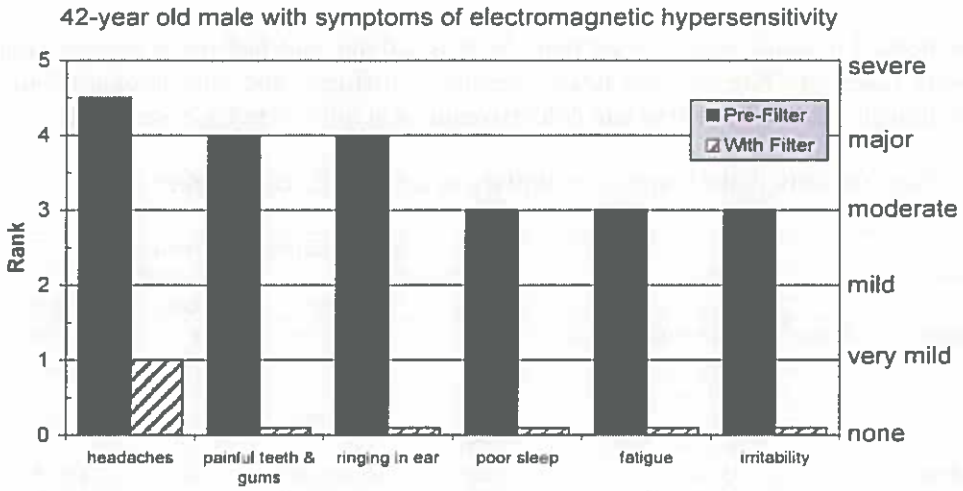


Figure 4. Response of a 42-year old male who was experiencing symptoms of electromagnetic hypersensitivity to G/S filters, May to September 2004.

began 4 years ago and in May 2004 he installed G/S filters in his home. Readings in his home dropped from an average of approximately 900 to 20 GS units (Table 1). His sleep improved immediately (similar to Case #1) and all his other symptoms have disappeared (Figure 4). Since the filters were installed (seven months ago) he can recall having only two headaches.

Tinnitus, one of his symptoms, is the medical term for the perception of sound in one or both ears or in the head when no external sound is present. It is often referred to as "ringing in the ears," although some people hear buzzing, hissing, roaring, clicking, chirping or whistling. Tinnitus can be intermittent or constant and its perceived volume can range from subtle to shattering according to the American Tinnitus Association (2004).

An estimated 1 out of every 5 people experiences some degree of tinnitus. Of the more than 50 million Americans who experience tinnitus, 12 million seek medical attention, and two million are so seriously debilitated that they cannot function on a "normal," day-to-day basis. There is no known cure for tinnitus and treatments range from biofeedback, to drugs, to cochlear implants. Family doctors may also refer patients, who have no obvious physical damage, to psychiatrists.

Several individuals with tinnitus who have tested the G/S filters have reported a significant reduction in the volume of the sound they hear. Some have noticed that when the buzzing is loud, the dirty electricity in their home is high. If some tinnitus sufferers are able to perceived dirty electricity as "noise" then the removal of the dirty electricity may help alleviate their symptoms. The mechanism for this hearing is not known.

The human auditory response to pulses of radio frequency energy, referred to as RF hearing, is well established for frequencies in the MHz range (2.4 –10,000 MHz) (Elder and Chou 2003). Evidence supports a heating effect, whereby audible sounds are produced by rapid thermal expansion of tissue resulting in a clicking, buzzing, or chirping sound. For this reason, the hearing phenomenon depends on the dimensions of the head and on the energy in a single pulse and not on average power density. In our study, exposure was to frequencies in the kHz range that are not associated with a heating phenomenon, so it is possible that some other mechanism is involved in producing the sounds heard.

Case #3: 43-year old female with multiple sclerosis; Ontario, Canada

Graham/Stetzer filters were installed in the home of a 43-year old woman, who has had MS for 8 years. She walked with a cane and did "wall-walking" in her home. "Wall-walking" refers to a person using the wall or furniture to help maintain balance. Readings in her home decreased from an average of 170 to 30 GS units after 13 filters were placed into receptacles in various rooms of her house (Table 1).

Figure 5 shows her response during a 6-week period with the G/S filters installed and a 1-week pre-filter period. Within 24 hours her sense of balance improved and she was able to walk a short distance carrying objects in both hands without assistance (no cane or wall-walking). Within 1 week joint stiffness, joint pain, and muscle weakness decreased significantly and she had less difficulty walking (Figure 5). Within 2 weeks she was able to walk without ankle support and was able to bend forward without losing her balance. She had less muscle weakness and was not as dizzy (Figure 5). Swelling in her hands and feet decreased and her extremities were not as cold (similar to Case #1). The quality of her sleep improved and her level of fatigue decreased (data not shown). This subject is very sensitive to changes in temperature and humidity. During weeks 3 to 6, this part of Ontario received record precipitation and all of her symptoms worsened but were not as severe as her pre-filter symptoms. This subject continues to improve, although her rate of improvement is not as rapid as it was during the first two weeks after the filters were installed.

Symptoms of multiple sclerosis vary between individuals depending on what part of the brain/nervous system is affected. Symptoms include cognitive dysfunction (including problems with memory, attention, and problem-solving); dizziness and vertigo; difficulty walking and/or balance or coordination problems; bladder and bowel dysfunction; depression; fatigue; numbness in extremities; pain; vision problems; hearing loss; speech and swallowing disorders (National Multiple Sclerosis Society, 2004).

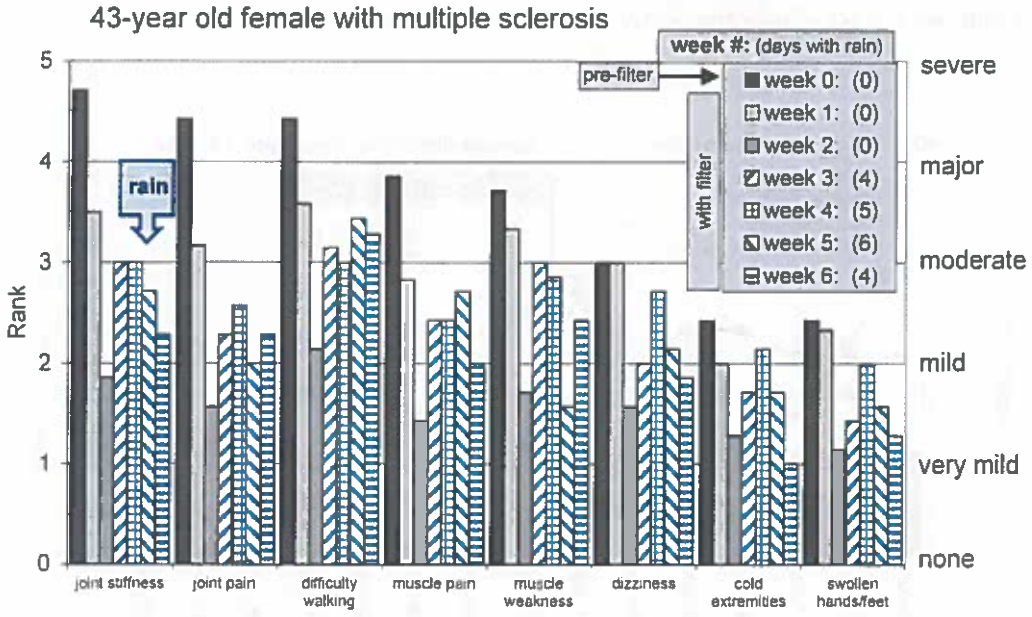


Figure 5. Response of a 43-year old female with multiple sclerosis to Graham Stetzer filters, June/July 2004.

Symptoms can change rapidly and unpredictably. Many people with MS are sensitive to hot or cold conditions and to wet/humid weather. An exacerbation (also known as an attack, a relapse, or a flare) is a sudden worsening of MS symptoms. Temporary improvements are also known to occur and for this reason, one case study showing an improvement may simply have coincided with a normal/temporary remission of this disease. So far, at least 5 people with MS have reported improvements following the installation of G/S filters. More studies are currently underway.

Case #4: 80-year old female with diabetes; Arizona, USA

Graham/Stetzer filters were installed in the home of an 80-year old female with diabetes on June 12, 2004. Her home had very high values for dirty electricity (800 GS units on average with values above 2000 in some rooms) and these dropped significantly to no greater than 15 GS units (Table 1). Because she was diabetic and taking insulin, she regularly monitored her blood sugar levels. Before the filters were installed this subject's fasting plasma glucose (FPG) levels taken at 7 am each morning before breakfast ranged from 152 to 209 with a average of 171 mg/dL (9.4 mmoles/L) (Figure 6). According to the America Diabetes Association a person with a fasting blood glucose level of 126 mg/dL or higher is considered to be diabetic. A fasting blood glucose level between 100 and 125 mg/dL signals pre-diabetes.

The day after filters were installed in her home, this subjects fasting plasma glucose was 87 mg/dL (well below the diabetic range) and she did not take her morning insulin (Figure 6). During the first week her FPG ranged from 87 to 168 and averaged 119 mg/dL (6.5 mmoles/L). Her average daily insulin intake (Humlin 70/30) decreased from 36 to 9 units within the first week. The filters had no effect on her plasma glucose measured at 5 pm. On days that this subject visited shopping malls and casinos, places that are likely to have poor power quality, her evening plasma glucose levels increased significantly (above 250 mg/dL or 14 mmoles/L) (see Havas and Stetzer 2004 for details and more examples).

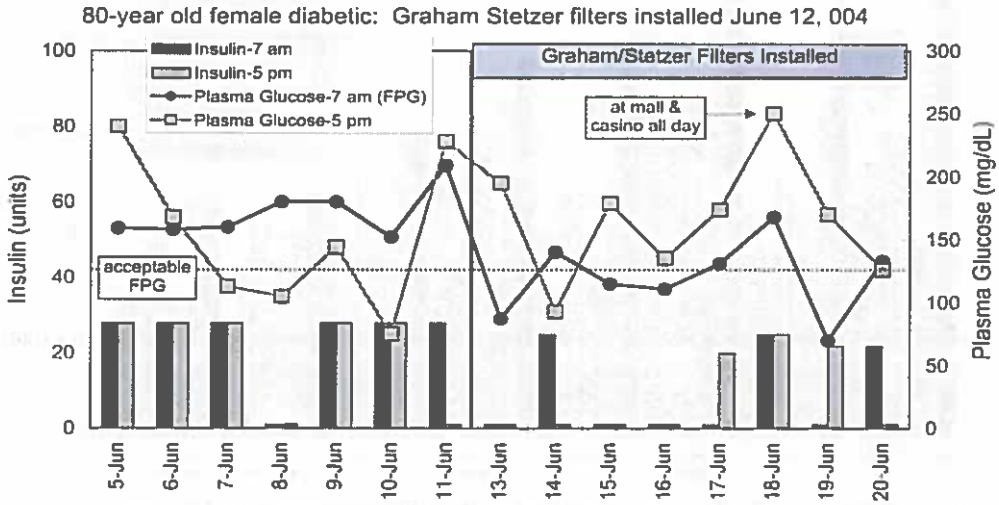


Figure 6. Response of an 80-year old female with diabetes to G/S fitlers installed in her home, June 2004.

In addition to Case #4, we have worked with individuals who have both type 1 and type 2 diabetes and those who are pre-diabetic and have found that blood sugar levels can change rapidly (within a matter of 20 minutes or so for some individuals) as they move from an environment that is electrically dirty to one that is electrically clean (and back again). The percentage of the diabetic population that responds to dirty electricity and to RFR needs to be determined.

Diabetes is on the increase. According to the World Health Organization (2004) in 1985 there were 30 million diabetics worldwide; by 1995 the number increased to 135 million and by 2000 to 177 million. The WHO estimates that by 2025 there will be 300 million diabetics globally. Four million deaths each year (9% of the global total) are attributed to diabetes. Lifestyle (lack of exercise) as well as genetics and environmental factors play a role.

Three types of diabetes have been diagnosed: *Type 1 diabetes* (also known as childhood onset diabetes) results from the body's failure to produce insulin. This is the common form for children and accounts for 5 to 10% of all diabetics. *Type 2 diabetes* (adult onset diabetes) results from insulin resistance (a condition in which the body fails to properly use insulin), combined with relative insulin deficiency and is usually diagnosed in adults. Type 2 diabetes accounts for 90 to 95% of diabetics. Gestational diabetes is a temporary condition that affects approximately 4% of pregnant woman and accounts for 135, 000 cases in the US each year. A forth classification is pre-diabetes, a condition that occurs when a person's blood glucose levels are higher than normal but not high enough for a diagnosis of type 2 diabetes. An estimated 41 million Americans are likely to be pre-diabetic, in addition to the 18 million (6% of the population) with diabetes of which only 13 million have been diagnosed with this disease (American Diabetic Association, 2004).

Based on our studies we would like to suggest that, in addition to *Type 1* and *Type 2* diabetes, there is a *Type 3* diabetes that may be attributed to poor power quality. This form of pollution may be contributing to the rapid growth of this disease and affecting the large number of people who have difficulty controlling their blood sugar with medication (brittle diabetics) and the increasing number who are classified as "pre-diabetic" according to the American Diabetes Association and.

Case #5: Willow Wood School, Toronto, Canada

A study conducted at Willow Wood School in Toronto (January/March 2003) demonstrated that teachers and students responded to improved power quality. This was a single blind study that lasted 6 weeks (3 weeks with filters and 3 weeks without) (see Havas et al. 2004 for details). The Stetzerizer™ microsurge meter was not yet available when this study was done so the power quality was measured with a Fluke 79 III meter connected to a Graham Ubiquitous Filter (to remove 60-Hz frequencies) and values are expressed as mV (rms) rather than GS units (Table 1). The fluke meter measures frequencies up to 20 kHz while the G/S filter removes frequencies up to 100 kHz, hence the Fluke meter underestimates what was actually removed.

Fifty filters were installed in Willow Wood School and the dirty electricity (for frequencies up to 20 kHz) was reduced by 43% from 23 mV (range 13-101 mV) to 13 mV (range 8-24 mV) (Table 1). A school of this size requires 150 filters or more to reduce the microsurges

produced by computers, photocopy machines, fluorescent lightly etc. Even though values were not as low as recommended, significant improvements were noted among teachers and in some classes.

While G/S filters were installed at Willow Wood School, teachers were less tired, less frustrated, less irritable (Figure 7). They had less pain and fewer headaches. They had a greater sense of satisfaction and accomplishment. If these improvements are a sign of electrical hypersensitivity, then 55% of the teachers at WW School may be electrically hypersensitive. This is a much larger percentage than the two percent for self-reported EHS as documented by Hillert et al. (2002). Our results are similar to those reported by Arnetz et al. (1997, as cited in Levallois 1999) for 133 employees of an insurance company who all worked in the same building. More than 50% of those who worked with computers reported that they had health symptoms induced by VDU-related work. The checklist of symptoms were typical of EHS and included musculoskeletal, respiratory, dermatological, gastrointestinal, neurological and memory problems.

If teaches in Willow Wood School were asked if they were electrically hypersensitive, very few would have answered in the affirmative. Indeed, after the study when we presented our results to the teachers, we learned that the concept of electrical hypersensitive was new to them.

Student behavior at Willow Wood School also improved while the filters were installed, especially in grades 1 to 6 as compared with middle school (grades 7-9) and high school (grades 10-12) (see Havas et al. 2004). Students were more active and were better able to focus on their lessons (Figure 8). There was less "inappropriate" classroom noise and class time was used more productively. Teaches spent less time dealing with disruptions or repeating instructions.

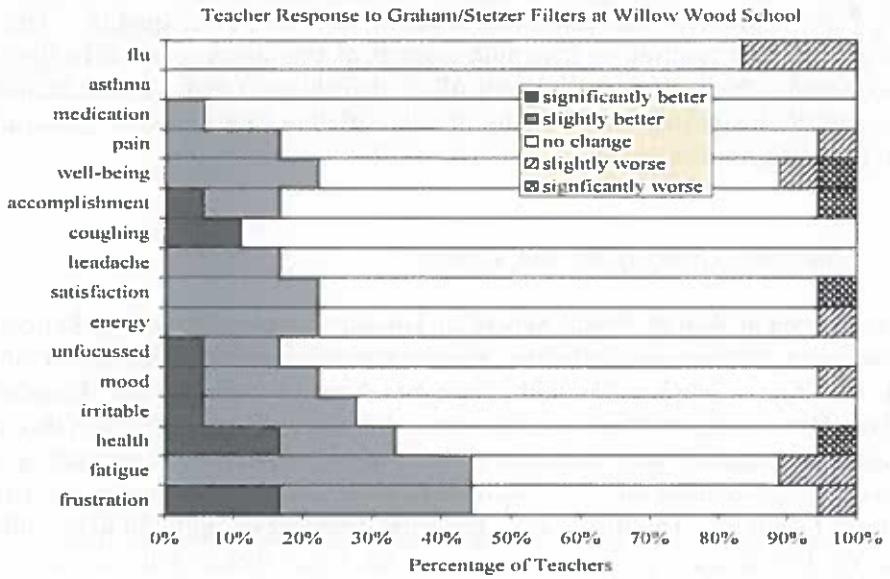


Figure 7. Teacher response to G/S Filters in Willow Wood School. Results are based on 18 teachers, 10 females and 8 males.

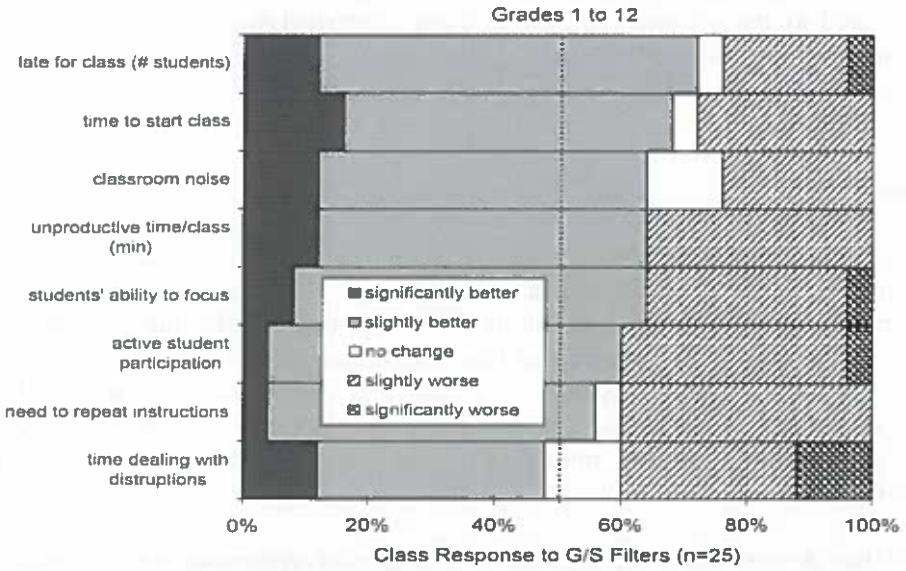


Figure 8. Student response to G/S Filters at Willow Wood School, January/March 2003. Results are based on 25 classes.

Our results suggest that dirty electricity may be interfering with teacher performance and student education. Other schools that have installed G/S filters have also reported improvements among their students and staff. At one school, Melrose-Mindoro in Wisconsin, the District Nurse (Char Sbraggia, R.N.) reported that after the G/S filters were installed teachers were less tired and students also seemed to have more energy. Several staff with allergies were taking less medication since they were experiencing fewer symptoms. But perhaps the most striking result was for students with asthma. Of the 37 students using inhalers, only three continue to use them and only for exercise-induced asthma before their physical education classes (www.electricalpollution.com). At Willow Wood School we had no reported cases of asthma among teachers and did not obtain health information about students.

More and more children are being diagnosed with and medicated for attention deficit disorder (ADD) and attention deficit hyperactivity disorder (ADHD). ADD is the most commonly diagnosed behavioral disorder of childhood. Estimates of its prevalence range from 2% to 18% of school-aged children depending on type of diagnosed (University of Maryland Medicine 2002). In the US, the diagnosis of ADHD in children increased from 950 thousand children in 1990 to 2.4 million by 1996. Attention Deficit Disorder is a neurobiological condition characterized by developmentally inappropriate level of attention, concentration, activity, distractibility, and impulsivity (University of Maryland Medicine 2002).

Some of the symptoms associated with these disabilities (such as inability to focus, disruptive classroom behavior, need for repeated instructions, inability to actively participate in lessons) are the symptoms that were reduced after the G/S filters were installed, which raises questions about the relationship between ADD and power quality. Children are exposed to more dirty electricity because they are now spending more time then ever in front of computers (at home and at school) and television sets and have, for the first time, ready access to cell phones (radio frequency radiation). Both computers and television sets

generate electromagnetic frequencies within the kHz and MHz range and these frequencies are not filtered at the set and thus travel along electrical wiring[3]. Studies testing the relationship between ADD/ADHD and dirty electricity (and radio frequency radiation) are urgently needed.

Conclusions

In this study we demonstrate that Graham/Stetzer filters can improve power quality by reducing the amplitude of harmonics and transients on electrical wiring in buildings; that dirty electricity flows along the ground and interacts with conducting objects (including people) in contact with the ground; and that when this form of energy is removed some symptoms that have been classified as electrical hypersensitivity can be alleviated. Furthermore we demonstrate that symptoms for diseases, not normally associated with electrical hypersensitivity such as multiple sclerosis and diabetes, can also be reduced when power quality is improved.

Instead of just documenting the symptoms of electrical hypersensitivity we now have a method by which these symptoms can be alleviated. Graham/Stetzer filters and microsurge meters enable individuals to monitor and improve power quality in buildings and they provide scientists with a tool for studying the effects of dirty electricity.

These results bring into question the definition of "electrical hypersensitivity". Is a person electrically hypersensitive if his/her health improves when dirty electricity is removed? We suggest that individuals are electrically hypersensitive if their symptoms change when some component of the electromagnetic environment is either increased (provocation studies) or decreased (hygiene studies). What components of the electromagnetic spectrum are bioactive and at what intensities remains to be tested. Our results strongly suggest that transients are biologically active within the frequency range of 4 to 100 kHz and at intensities currently found in homes and schools.

We present five dissimilar cases studies, but we have data for an additional six diabetics and are currently studying the response of more than 20 subjects with MS. To date we have had only one person with MS has not improved after installation of G/S filters.

The results from the cases studies are so dramatic that they warrant further investigation. They suggest that: (1) poor power quality may be contributing to electrical hypersensitivity; (2) a much larger population than originally assumed may be electrically hypersensitive (50% vs. 2%); (3) children may be more sensitive than adults; (4) dirty electricity in schools may be interfering with education and (5) possibly contributing to disruptive behavior associated with attention deficit disorder (ADD); (6) dirty electricity may elevate plasma glucose levels among some diabetics and it may exacerbate the symptoms for those suffering from (8) tinnitus and (9) multiple sclerosis. If these results are representative of what is happening in countries worldwide, then dirty electricity is adversely affecting the lives of millions of people.

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[3] The microsurges generated by a TV or computer in one room have been measured with the Stetzerizer™ microsurge meter at the electrical receptacle that is on the same circuit in another room.

Acknowledgements

We would like to thank all the people who participated in the studies. We would also like to thank Art Hughes for providing technical information and Martin Graham for designing the Graham/Stetzer filter and the Stetzerizer™ microsurge meter.

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www.stetzerelectric.com provides definitions and more details of the meters and filters.

International Scientific Conference on Childhood Leukaemia, London, 6th-10th September 2004.

Graham/Stetzer Filters Improve Power Quality in Homes and Schools; Reduce Blood Sugar Levels Among Diabetics, Multiple Sclerosis Symptoms, and Symptoms Associated with Electrical Hypersensitivity.

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Summary

Graham/Stetzer filters improve power quality by reducing radio frequency electrical noise, referred to as dirty electricity, on indoor wiring. Dirty electricity can be generated by energy efficient lighting, dimmer switches, entertainment units, and computers within the home or workplace and it can be transported into buildings by power lines from neighbouring property. The resultant improvements in power quality in homes and schools are associated with fewer and less severe headaches, more energy, lower blood sugar levels for diabetics, and improved balance and more energy for those with multiple sclerosis. Results are observed within a matter of hours or days.

Conclusions

These results strongly support the contention that symptoms associated with electrical hypersensitivity (headaches, fatigue, irritability, confusion) as well as high blood sugar levels among diabetics and some MS symptoms are associated with dirty electricity (high frequency electrical noise on electrical wiring). The results from these very few cases studies are so dramatic that they warrant further investigation. Some cancers, associated with high magnetic fields may also be affected by dirty power. Graham/Stetzer filters enable people to improve power quality in their home and work environment and scientists to study the effects of dirty electricity.

Dirty Electricity

What is it?

Figure 1. Harmonics

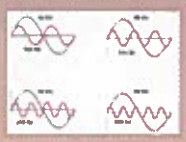


Figure 2. Transients

Dirty power consists of harmonics, multiples of the primary frequency (50/60 Hz), and transients, spikes in voltage that ride on top of the electrical distribution grid's 50/60 Hz sine wave. The microsurges that result are shown in pink in Figures 3 & 4. The blue sine wave is the 60 Hz power frequency. Graham/Stetzer Filters reduce microsurges within the frequency range 4 to 100 kHz.

Figure 3. Waveform without G/S Filters

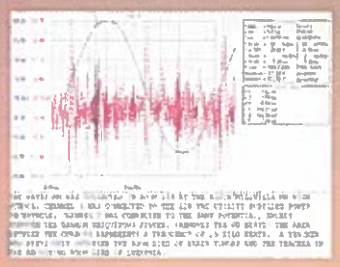


Figure 4. Waveform with G/S Filters

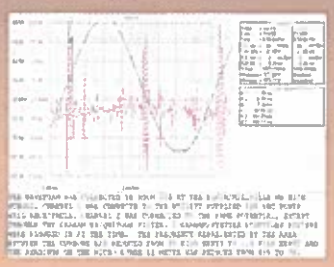


Figure 5. Graham/Stetzer Filters

Where does it come from?

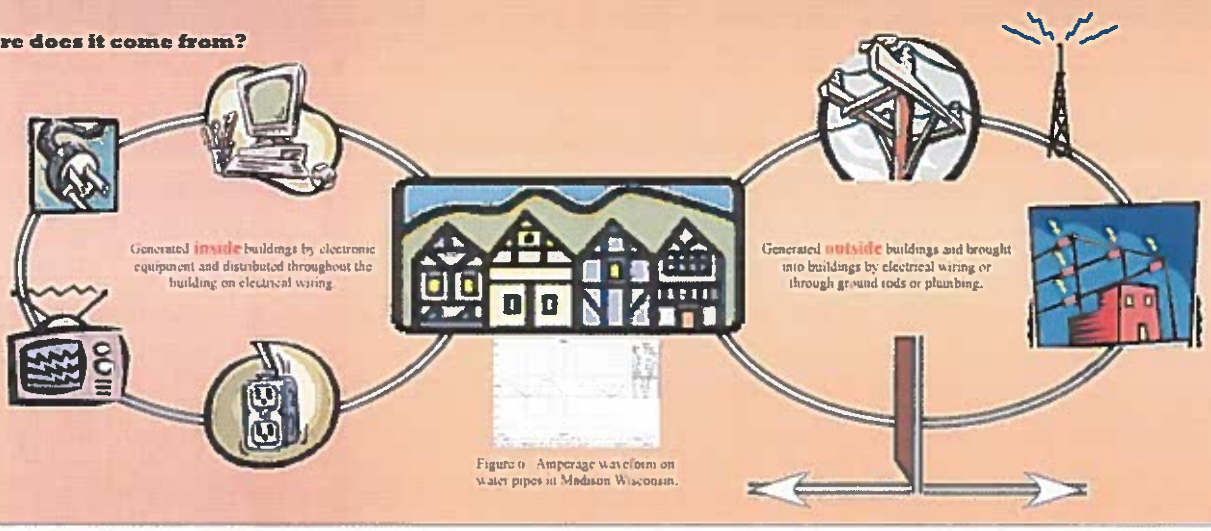


Figure 6. Amperage waveform on water pipes in Madison Wisconsin.

Diabetes

Diabetes is on the increase. In the United States, 16 million people are diagnosed as diabetic and more are suspected of having this disease. Case studies show that blood sugar levels are associated with dirty power on internal wiring as well as radio frequency radiation from nearby cell phone antennas and that these blood sugar levels can change quickly as one moves from a "dirty" to a "clean" electrical environment.

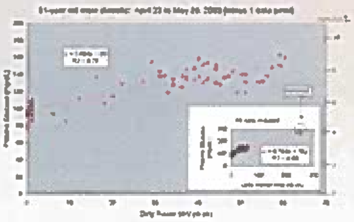


Figure 7. A 51-year old male diabetic exposed to dirty electricity in his home. Plasma glucose levels increase with dirty power. The high blood sugar value (277 mg/dL) at 250 mV (insert) is a real number, not an error. However, since it contributed disproportionately to the correlation coefficient it was removed. The resultant correlation is statistically significant.

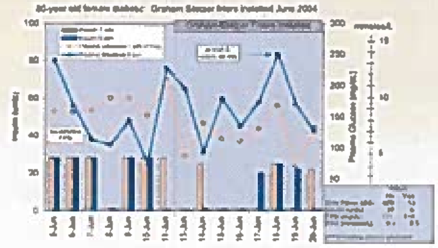


Figure 9. An 80-year old female diabetic exposed to dirty electricity in her home. Graham/Stetzer filters were installed on June 12, 2004 and the microsurges on indoor wiring decreased from 800 to 13 GS units. Her fasting plasma glucose dropped from 171 mg/dL (9.4 mmoles/L) without filters to 119 mg/dL (6.5 mmoles/L) with filters and her average daily insulin intake (Humlin 70/30) decreased from 36 to 9 units respectively. Results were noticed within one day. [Note: GS refers to Graham/Stetzer units and is a function of amplitude and frequency of microsurges on indoor wiring.]

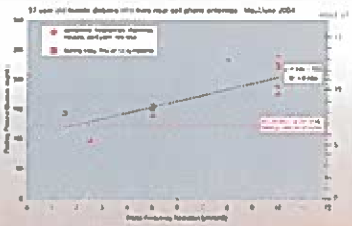


Figure 8. A 57-year old female diabetic exposed to radio frequency radiation (RFR) in her home from nearby cell phone antennas. Fasting plasma glucose levels increase with RFR. High RFR is associated with headaches, nausea, joint pain, dizziness and facial flushing. Twenty minutes in a "clean" environment lowers her blood sugar levels 30 mg/dL (1.7 mmoles/L).

Multiple Sclerosis

Response of a 43-year old woman who has had MS for 8 years to Graham/Stetzer filters installed in her home. Filters decreased microsurges from 170 to 33 GS units. Within 24-hours her sense of balance improved and she was able to walk without a cane. Within 2 weeks she was able to walk without ankle support. Her symptoms became worse during humid weather but she recovered rapidly with the filters installed.

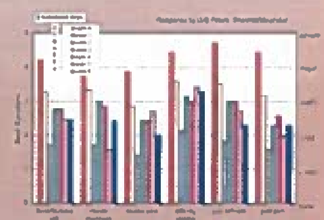


Figure 10. [illegible]

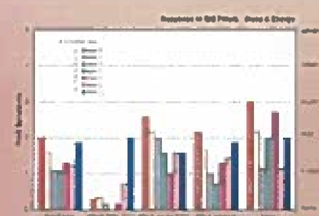


Figure 12. MS patient experienced less fatigue while filters were installed especially during dry weather. She woke up fewer times during the night and had less difficulty waking up in the morning.

Figure 11. MS patient experienced less dizziness, reduced swelling and improved circulation of hands and feet with G-S filters.

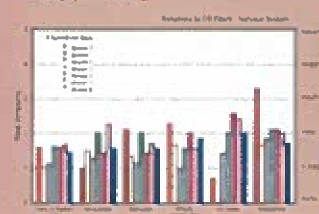


Figure 13. Improvements were noticed in concentration, restlessness and depression. MS patient was more moody and experienced more nervousness when filters were installed.

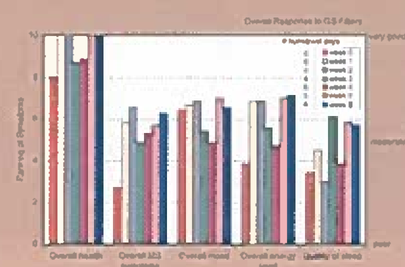
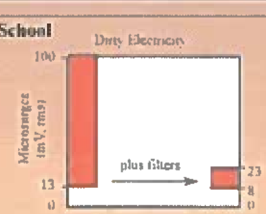


Figure 14. While filters were installed MS patient experienced improvements in overall health, sleep quality, energy level and MS symptoms. Improvements were noticed within 1 week.

Electrical Hypersensitivity

Student behaviour and teacher well being improved while Graham/Stetzer filters were installed in Willow Wood School. This was a single blind study. Data collected during a 6-week period, 3 weeks with filters and 3 weeks without. Response was greatest among younger students in elementary school, suggesting that they might be more electrically sensitive than middle and high school students.

School

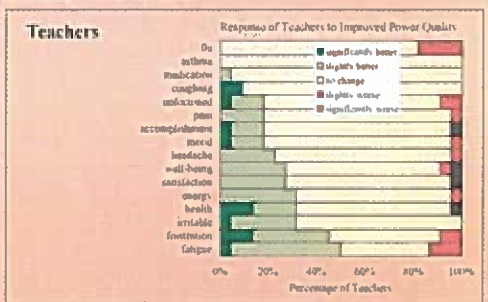


Graham/Stetzer Filters

Figure 15. 4[illegible]% decrease in dirty electricity (≤20 kHz) with 50 G-S filters installed.

Figure 16. Teachers were less tired, less frustrated, less irritable. They had fewer headaches and less pain. They had more energy, better health, greater accomplishments and sense of well-being and were more focused while filters were installed.

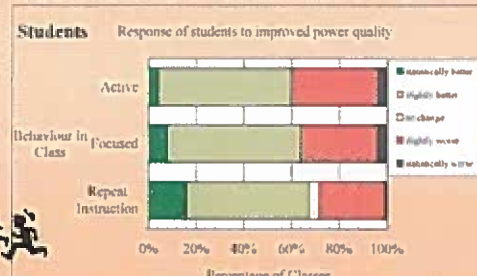
Teachers



Willow Wood School, Toronto, Canada

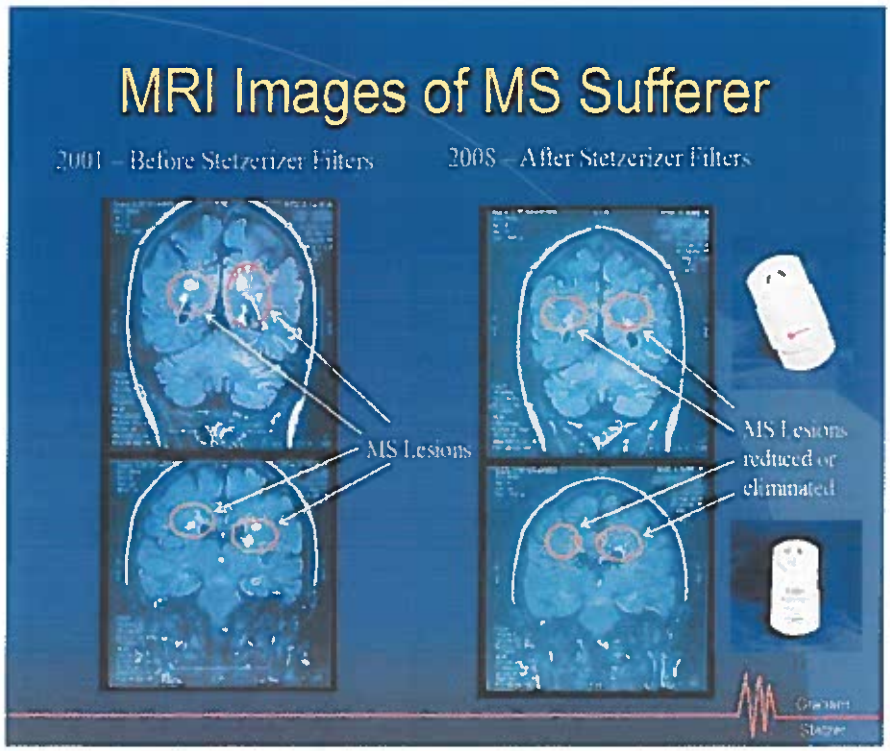
Figure 17. Students were more actively involved in their lessons and were more focused while the filters were installed. They required fewer repetition of instructions. On average 4 minutes were saved dealing with disruptions in each class. Results were most pronounced in elementary school (grades 1 to 6).

Students



MRI Brain Scans of patient diagnosed with Remitting-Relapsing - Multiple Sclerosis before and after Graham-Stetzer (STETZERiZER) filters (fig.1) installed.

www.site.stetzerizeraustralasia.com



Stephen Hall. Age 51
St. Leonards. NSW, 2065
Australia November. 2001
(0411372210)

Diagnosed: Remitting-Relapsing Multiple Sclerosis 11/2001.

MRI Scans.
Royal North Shore Hospital. Sydney. Australia;
Consulting Specialist:
DR ROBERT W. JOHNSTON

49 DORA STREET HURSTVILLE, 2220 Phone : 02 9579 3544 Fax : 02 9570 9854 FRENCHS FOREST, 2086 Phone : 02 8011 0676 Fax : 02 8011 0675 Specialty : **Neurologist**. "Reduction in size and prominence of plaques…patient claims reduction due to lowered EM Fields…"

Symptoms: Pain and numbness in limbs, dizziness (vomiting), fatigue, inability to walk, inability to focus, lack of appetite and unable to digest food, headaches, dropping of foot when able to walk and falling over. Depression. Poor sleep patterns due to pain and numbness in limbs. Spasticity in limbs. Result was general poor quality of health and wellbeing.

After moving residence to St. Leonards, 600-680 GS units measured by the STETZERiZER® Microsurge Meter (daytime) was recorded. GS Units should be under 25 and symptoms were worsening.

Dwelling is close to 3 Television Stations, radio station and railway line, and various mobile phone installations (on high rise). Wi-Fi internet was being used in many adjoining apartments.

RECOVERY and REMISSION: 2007-2008

Graham Stetzer Filters were added to power outlets in around **2007,** GS units reading of **25-30** on Stetzerizer Meter (Fig.2 sample). Many symptoms began to disappear overnight. Gained more strength and composure as days and months progressed. Ability to walk, think clearer, improved strength to stand, walk, talk and less pain in feet and hands.

Blood Glucose Levels
A Study of Correlation Factors

Introduction

This study examines data collected from April 23 to May 29 for a 51-year old male resident of Blair, WI, Dave Stetzer. The study examines R^2 factors derived from scatter plots of various combinations of two variables.

This study, while focused on one person, also includes the results from three other individuals.

The premise of the investigation began when it was serendipitously observed that being in a location where relatively large **peak** values of high frequency transients that existed on 60 Hz electrical wiring was apparently raising blood glucose levels. Interestingly, when RMS values of dirty power were used, there was almost no effect on blood glucose levels.

We have come to call these high frequency transients, "dirty power".

"Dirty power" is also referred to as "transients", "noise" or "stray voltage" and similar terms. Clean power is when the electricity we use is solely in the form of a 60 Hz sinusoidal voltage and current without high frequency components. Dirty power refers to high frequency (>10 KHz) components riding on this sinusoidal wave. Dirty power is a component of the 60 Hz power to which, in our modern electrified world, we are all exposed, in varying degrees. For a complexity of reasons, it is particularly pronounced in Wisconsin, Michigan and Minnesota.

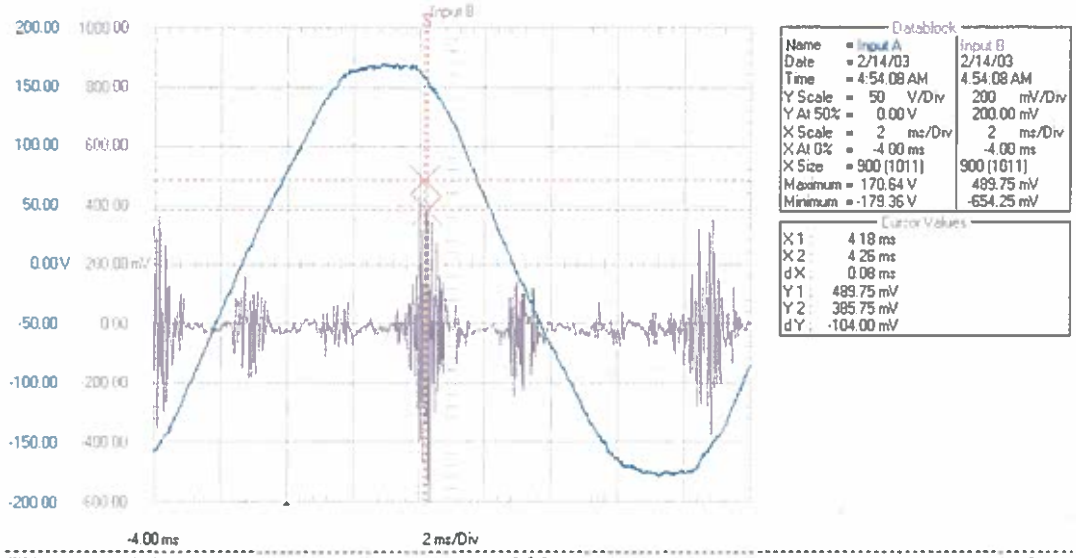
The graph on the next page is an illustration of both "typical " power (the blue line is the 60 Hz power, including dirty power components—notice the jaggedly lines on the top and bottom, and a picture of the extracted "dirty power" (the pink extremely variable line), which is actually the jaggedly sections of the blue line magnified, and sans the 60 Hz power. The Appendix to this report shows: the filter used to remove the 60 Hz. Basically it is a high pass filter that attenuates frequencies below 10 KHz.

Measurement of dirty power peak-peak values, used in the various scatter plots can be seen in this graph as the highest levels of the pink curves. For example, near the middle of the graphs is a set of cursors (dotted lines, vertical and horizontal) where the measured peak-to-peak value of the dirty power is 104.00 mV (dY in the box labeled "Cursor Values".

Lloyd Morgan
510 841-4362

Part 1 of 8, Additional information found TheBrainCan.com , SolomonSeries.com, and https://www.youtube.com/solomonseries

Blood Glucose Levels
A Study of Correlation Factors



THE WAVEFORM WAS COLLECTED IN ROOM 101 OF THE BRIGHTON SCHOOL. CHANNEL 1 WAS CONNECTED TO THE UTILITY SUPPLIED 120 VAC POWER. CHANNEL 2 WAS CONNECTED TO THE SAME POTENTIAL EXCEPT THROUGH THE GRAHAM UBIQUITOUS FILTER. THE AREA BETWEEN THE CURSORS REPRESENT A FREQUENCY OF 12.5 KILO HERTZ. NO GRAHAM/STETZER SOLLUTIONS FILTERS WERE BEING UTILIZED AT THE TIME. THE AMPLITUDE OF THE BURST SHOWN IS 489 MV.

This picture of dirty power was taken from an oscilloscope in a classroom at Brighten School, Brighten, WI. It is typical of what is seen all over Wisconsin.

The cause of this dirty power comes from the myriad electrical gadgets and equipment we use. Recent changes in the technology have resulted in these gadgets and equipment not drawing their power needs continuously, as they did previously, but intermittently at a high frequency. Home light dimmer switches are but one example. Such "non-linear" drawing of power is reflected back onto the electrical power system. The gadgets our neighbors and we use generate such electrical "dirt" as do certain types of variable speed motors. The "dirt" is also generated by the electrical utilities when they switch their distribution from one circuit to another.

Blood Glucose and Dirty Power: A set of scatter plots and the R^2 factor for each.

The following scatter plots were produced:

1) Blood glucose Vs dirty power (full data set)
2) Blood glucose Vs dirty power (single outlier removed)
3) Blood glucose Vs time of day
4) Dirty power Vs time of day

Dave Stetzer was diagnosed as diabetic. Yet, removed from higher levels of dirty power, he can eat a large bowl of ice cream and a piece of pie without having any appreciable change in his blood glucose levels. However, even without eating, when in higher levels of dirty power, his blood sugar is sharply elevated.

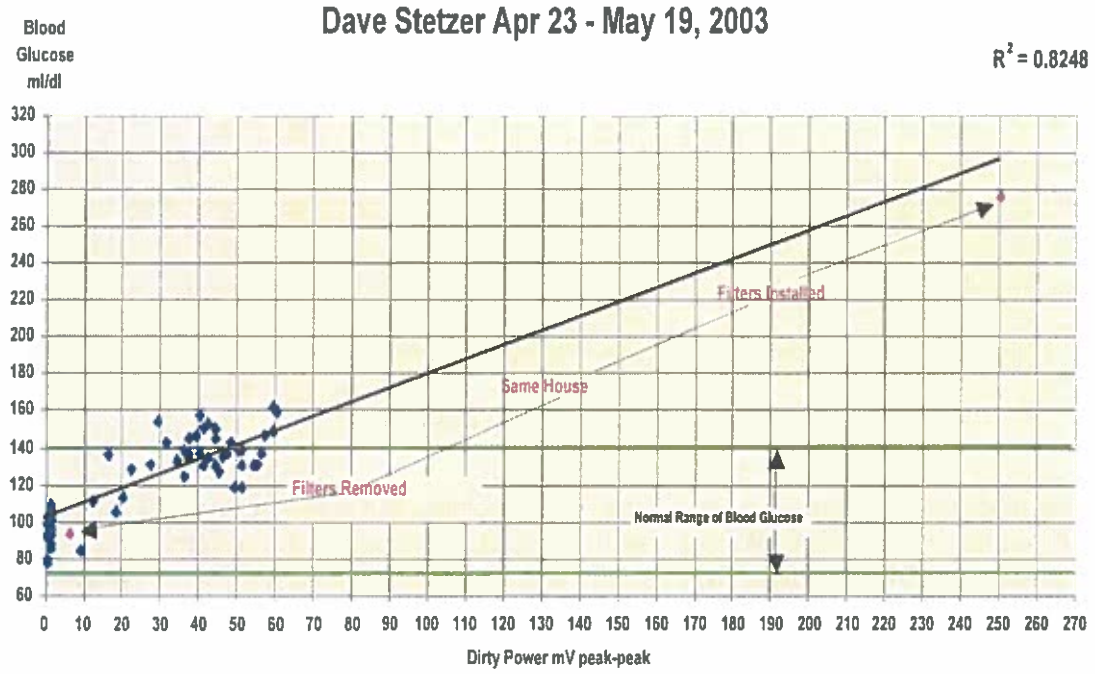
Part 1 of 8, Additional information found TheBrainCan.com , SolomonSeries.com, and https://www.youtube.com/solomonseries

Blood Glucose Levels
A Study of Correlation Factors

Dave is taking no medicines at this time to control his diabetes diagnoses nor is he otherwise controlling his diet or exercising because of his diabetes diagnoses. On his doctor's advice, he did take glucophage XR tablets beginning April 24th through April 29th. He discontinued taking them because they had no effect.

Below are a set of graphs that show the effect of dirty power on Dave Stetzer's blood glucose levels.

Figure 1
Blood glucose Vs Dirty Power (full data set)



While we can see in this scatter plot that the R^2 factor is large (0.82), there is a single "outlier" data point. The "outlier" and a companion data point are shown in pink. These are 2 measurements, taken 2 hours and 45 minutes apart, in the same house. One hours and 45 minutes prior to removing filters that substantially reduce the dirty power levels, a bacon cheeseburger and a bowl of vegetable beef soup was consumed. The lower left data point is where filters are installed that removes most of the dirty power. The upper left is where these same filters have been removed.

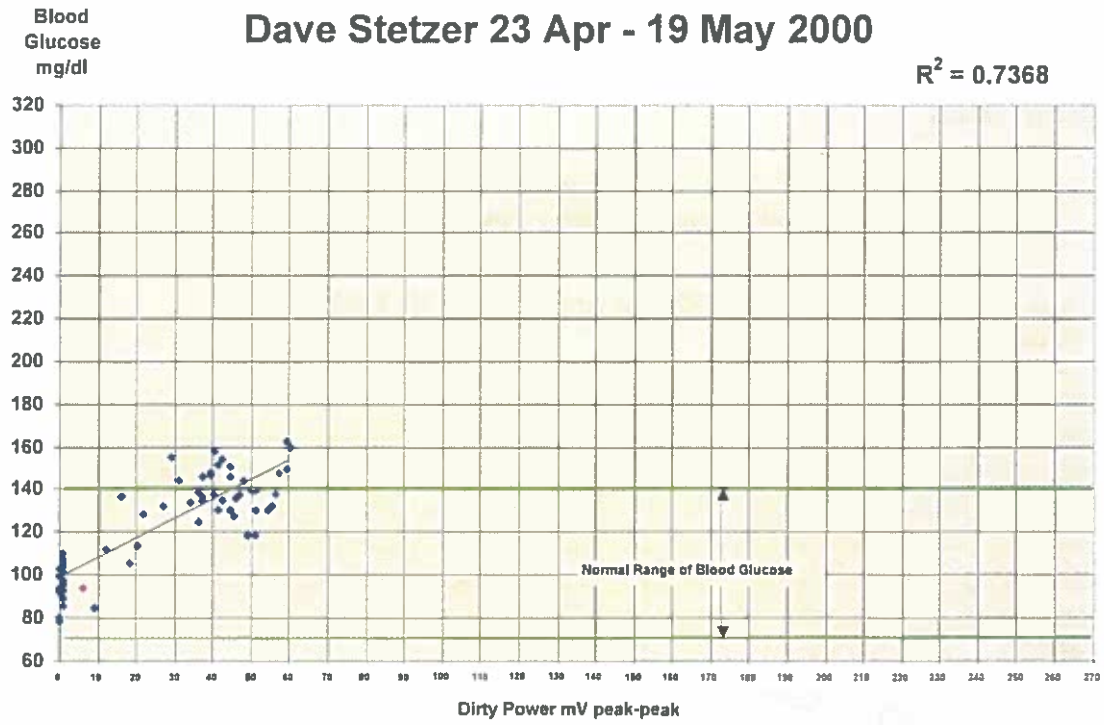
This "outlier" data point is real data, but it does raise the question, what would be the correlation factor if the upper right outlier data point were not there?

The next scatter plot is the exact same set of data, except that the "outlier" is removed.

Part 1 of 8, Additional information found TheBrainCan.com , SolomonSeries.com, and https://www.youtube.com/solomonseries

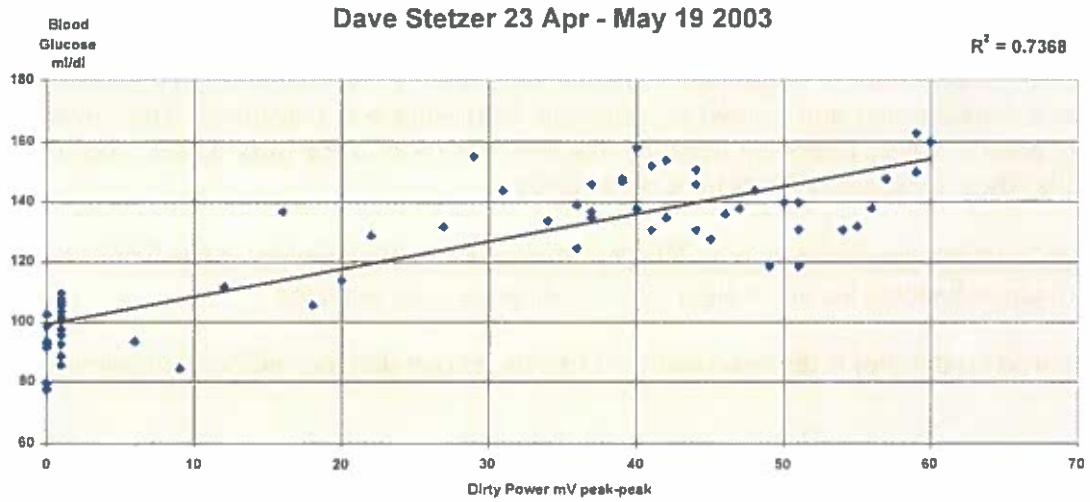
Blood Glucose Levels
A Study of Correlation Factors

Figure 2
Blood glucose Vs dirty power (single outlier removed)



This plot is to the same scale as Figure 1 and includes the exact same set of data except the "outlier" is removed. We see that the R^2 factor has been reduced from 0.82 to a still respectable 0.74. The next figure is the same plot except that the Blood Glucose and Dirty Power scales have changed.

Figure 3
Blood glucose Vs dirty power (single outlier removed & scale change)



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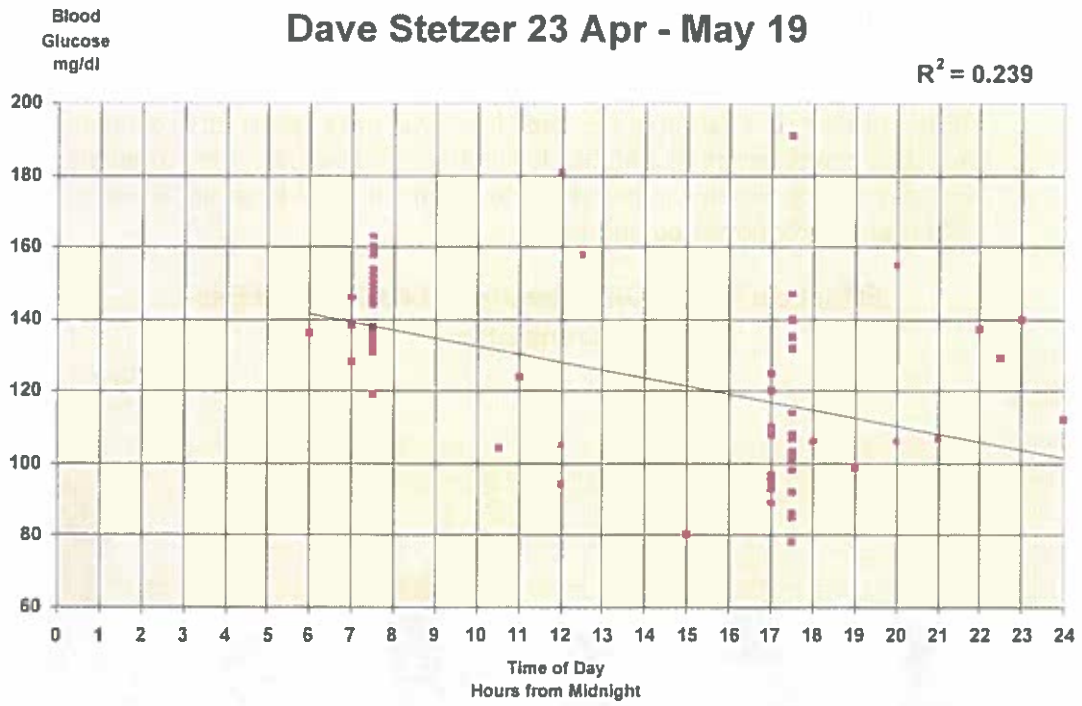
Blood Glucose Levels
A Study of Correlation Factors

Are there some factors, other than dirty power, giving this apparent correlation? We will look at Blood Glucose levels Vs Time of Day.

Figure 4
Blood Glucose Levels Vs Time of Day



The R^2 factor is small when blood glucose is compared to time of day (0.24). Indeed it is difficult to explain why the correlation factor can be so high when we look at blood glucose Vs dirty power and so low when we look at blood glucose Vs time of day, without concluding that dirty power has a profound effect on blood glucose levels.

When partial correlations are examined to remove any time of day effect, the R^2 value is 0.61. The statistical significance is strong ($p < 0.001$).

Is the Blood Glucose Meter Affected by Dirty Power?
The glucose meter used to take these measurements is an ACCU-CHEK Advantage. This meter, for calibration, requires a numeric number found with each set of strips, to be entered into the meter. We did the following test to determine if the glucose meter is itself affected by dirty power.

Dave measured his blood glucose levels in a dirty power environment as he would normally. The reading was 138 mg/dl on the blood glucose meter. Then he put another

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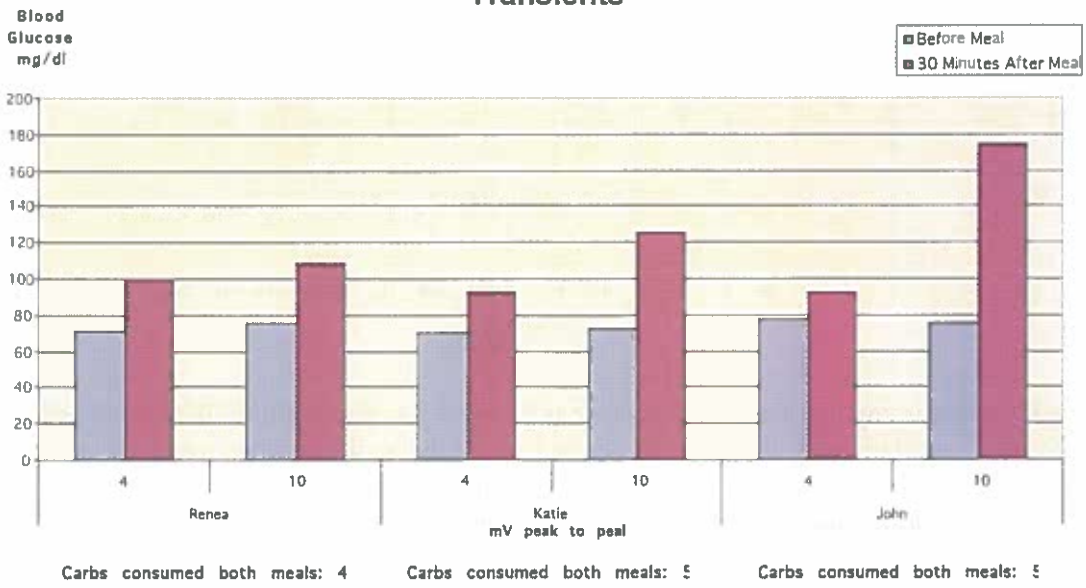
strip in the meter, wrapped the meter in aluminum foil (the foils isolates the meter from all electric and electromagnetic fields), put blood on the strip, and set it on an AC cord plugged in to the wall receptacle (in order to maximize the electric field). The reading was 135 mg/dl. The levels on the dirty power meter were 30 mV during this time. It would appear that the high frequency transient electric fields have very little or no effect on the glucose meter.

Three Other Individuals

All of the above data is for a single individual, Dave Stetzer. The chart below shows the effect of dirty power levels on three individuals. None of these people are diabetic. There are 4 sets of measurements:

1. Before eating in a low-level (4 mV) dirty power environment.
2. Thirty minutes after eating in the same low-level dirty power environment.
3. Next day, before eating in a higher-level (10 mV) dirty power environment.
4. Next day, thirty minutes after eating the identical meal from the day before, in a higher-level dirty power environment.

Effect on Blood Glucose and 60 Hz Peak to Peak Transients



We can see that blood glucose is consistently elevated (reddish-brown bar) when the dirty power is elevated. This elevation of blood glucose with dirty power elevation is far more pronounced after eating (reddish-brown bar) than before eating.

The table on the next page illustrates this numerically:

Blood Glucose Levels
A Study of Correlation Factors

	Dirty Power mV pk-pk	Blood Glucose Before Meal	Blood Glucose 30 Minutes After Meal	Carbs at both Meals	% blood glucose change after eating	% blood glucose change with higher dirty power	
						Before Meal	After Meal
Renea	4	71	99	40	39.4%	7.0%	10.1%
	10	76	109		43.4%		
Katie	4	70	93	50	32.9%	2.9%	35.5%
	10	72	126		75.0%		
John	4	78	93	53	19.2%	-2.6%	88.2%
	10	76	175		130.3%		
				Average at low dirty power	30.5%		
				Average at high dirty power	82.9%		
				Average	53.0%	2.4%	44.6%

There are several results to note:

- Increases in blood sugar 30 minutes after eating the same food, on average more increases 2.7 fold (30.5% to 82.9%), when the peak values of dirty power changes from 4 mV to 10 mV.
- Though too small a sample to draw a general conclusion, one person, Renea's, blood glucose is only slightly effected (10%) while the other two are strongly affected (36% and 88%).
- Prior to eating there is almost no effect on blood glucose levels when the dirty power level changes (average of 2.4%).
- After eating, when exposed to a 10 mV peak-peak dirty power electric field, John's 175 mg/dl blood glucose level is sufficiently high to suggest he has diabetes.

It is our supposition that not everyone is sensitive to peak values of dirty power. It is our hypothesis that there is an allergic type of reaction that some people have and others do not. Further, we have observed that those who become sensitive, over time become hypersensitive, not unlike some known allergies (e.g., bee stings).

Conclusion

The data presented strongly suggests that Dave Stetzer's blood glucose is changed by exposure to dirty power. Further, for 2 out of 3 individuals blood glucose is also changed by dirty power.

We believe that this data is sufficient to warrant a formal study to determine if exposure to dirty power electric fields does in fact raise blood glucose levels in sensitive people. We do not believe that all people are sensitive to dirty power anymore than all people are sensitive to pollen, cat dander and other allergenic agents.

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