

Data on health effects, exposure standards, and research gaps, particularly regarding vulnerable populations like children.

Submitted at *regulations.gov/deregulation*

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My response is based on my personal experience and on peer-reviewed research, government reports, industry data, clinical observations, or other sources.

My comments represent: individual consumer.

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a. My RF exposure has been to cordless phones, mobile phones, Wi-Fi, smart meters and wireless infrastructure. My EMF exposure has been to wiring in buildings and infrastructure.

b. I am 63 years old (born 1963) and, as with most humans, have been exposed to EMF since birth. However, I lived mostly off grid from 1996 until 2004. In 2004 I moved to Santa Cruz, CA and that is when my RF exposure started as a home exposure.

In 2004 I was given a work mobile phone that was on while working a full time position. I was a landscaper working in areas with poor phone service and driving in a truck with 3 or 4 other workers who would be on their phones while we were driving to and from these remote locations.

At that time, I installed a wireless router in my bedroom for my housemates and my use. One housemate tended to stay up all night streaming movies. My bedroom was full of metal furniture. I noticed that I was losing my ability to concentrate as I was listening to a book on tape and after a few months of having the wireless router in my bedroom I could not recall what I heard. I also could not sleep, which had not been typical for me.

Soon after these symptoms I developed a full body ache, creaky joints and found I could roll on my feet causing a popping sensation that I suspect was from nitric oxide buildup.

I had been working full time as a landscaper during the development of these symptoms and rode a bicycle as my transportation. I was very healthy and I had never had these symptoms before.

In 2007 I quit my job landscaping and moved into a full time care giving situation. I no longer had a wireless router in my bedroom and my symptoms went away.

About a month after my move I took a training at a church that met on Wednesday evenings and all day Saturdays. There were cell tower antennas on the building 50 feet away from the room of the training. My symptoms of the full body muscle ache and creaky joints reappeared. On the third Saturday I went for a walk under high power lines supplying UCSC during the lunch break. When I was back in the training room I found I

was confused and could not follow simple tasks. I was able to take notes, but had no recall of what I heard.

I left the training and then found that I could not sleep for 4 days and 4 nights. I pushed myself to exercise, took sleep inducing herbs and other supplements and finally got some sleep on the 5th night. However I now had very bad insomnia and typically only got a few hours of sleep a night. I also had become so sensitized to RF that I would get heated and red in my face if I went anywhere that had WiFi.

At this time I starting researching symptoms of wireless radiation (RF) exposure and I discovered that many people reported similar symptoms to mine. I started avoiding as much RF exposure as I could and did not use WiFi or have a mobile phone.

The house I was living in was approximately 300 feet from a cell tower and after about a year there a large tree that was shielding the house from the RF was cut down I found I could not tolerate living in the house as I was getting headaches in addition to the already present insomnia. I rarely get headaches and could only recall a couple of them prior to this now constant headache. I became very debilitated to the point where I could not remember how to spell "this" after spell check let me know it was misspell

In 2009 I moved again and now had little RF exposure, but I still had the insomnia and hypersensitivity to RF. I purchased RF blocking material and made a sleeping case. This proved to be very healing and I started to tolerate some RF exposure, but was still very sensitized.

I also did a lot of heavy metal detoxing and took herbal supplements such as Ashwaganda and Lion's Mane mushroom. I was still hypersensitive to RF, but my symptoms had eased as I could sleep while using my RF shielding material.

I had to move in 2011 and have had a difficult time finding housing where I could tolerate the RF exposure. This led to my being homeless starting in 2013 and I have been mostly homeless since then. When I have been housed I would try to get at least one night a week out of the house in a place with low RF so that I could tolerate the exposure without developing severe symptoms.

In addition to the RF shielding material for sleeping I made a head wrap of the same material, Swiss Shield Naturel. This has been a huge help in allowing me to have greater RF exposure without debilitating symptoms. This last year, 2025, I purchased wearable magnets that are in soft cloth with Velcro fasteners. This has also been a huge difference as I do not develop severe symptoms from RF exposure. I wear the RF shielding head wrap with the magnets also wrapped around my head while I am home and for the first time I am feeling that I can tolerate living with WiFi and other wireless devices.

I write that I am feeling this way because I have found in the past that if I get a chance to get away from RF exposure for 5 days or more I have realized that I was in fact experiencing debilitating symptoms, but had become accustomed to them as they developed slowly. After 5 days away the symptoms have gone away, which is how I realized that I was having some of the less obvious symptoms of general malaise.

I have never had medical evaluation or treatment as the few doctors that I raised the topic were too dismissive for me to pursue them.

I will reiterate this with the numerical system requested.

- c. Insomnia, headaches, creaky joints, full body muscle ache, brain fog, heated face and head.
- d. adverse health effects first appeared within a few months of placing a WiFi router in my bedroom. They became severe while taking a training located 50 feet from cellular antennas on the building and life threatening immediately after walking under high power lines.
- e. Medical evaluation was sought and dismissed.
- f. Primary step taken was avoidance as much as possible. This meant not going anywhere with WiFi including housing and employment. Consumed herbal supplements such as Ashwaganda and Lion's Mane mushrooms as well as heavy metal detoxing. Used RF shielding material, (Swiss Shield Naturel) for sleeping and as a head wrap. Installed Stetzer and GreenWave dirty electricity filters. Wore magnets in a head band.

All of these steps lessened adverse health effects. However, avoidance is clearly the best method to avoid harm. This has become next to impossible.

g. From AI -

Recent research indicates that exposure to radio frequency electromagnetic fields (RF-EMF) from wireless devices can disrupt sleep architecture and increase the risk of clinical insomnia. A pivotal double-blind, placebo-controlled pilot study published in Frontiers in Public Health found that healthy adults exposed to 2.45 GHz RF-EMF from baby monitors over seven consecutive nights experienced significantly reduced subjective sleep quality and increased brain activity during non-REM sleep. Notably, 27.3% of participants exposed to the radiation scored above the threshold for clinical insomnia risk, whereas this effect was not observed in the sham-exposure group.

<https://sleepreviewmag.com/sleep-health/parameters/quality/study-raises-concerns-wi-fi-device-radiation-sleep-quality/>

<https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2024.1481537/full>

Proposed biological mechanisms for these disruptions include the suppression of melatonin production, which regulates circadian rhythms, and changes in heart rate variability indicating autonomic nervous system stress. While some studies on GSM mobile phone radiation and long-term Wi-Fi router exposure have shown mixed or null results regarding macro-structure sleep parameters (like total sleep time), others document alterations in EEG power spectra (specifically theta, beta, and gamma frequencies) and reduced slow-wave sleep. The consensus suggests that while not all individuals are equally affected, chronic exposure to RF-EMF in real-world settings may contribute to sleep fragmentation and insomnia, particularly in sensitive populations or those with high exposure levels.

<https://airestech.com/blogs/emf-education/emf-and-sleep>

The physics side (well-established)

Faraday-cage principles are solid RF engineering. Conductive materials (silver, copper, nickel mesh or thread woven into fabric) reflect and absorb radio frequency waves. Lab-tested figures:

Shielding type	Typical attenuation
Silver-threaded bed canopy (fully enclosed + floor mat)	30–60 dB (99.9–99.999% reduction)
Silver-threaded curtains / partial wall coverage	20–40 dB
EMF-blocking sleepwear / eye mask	40–60 dB (body-only)

Full shielded room (professional install) 60–80 dB

These figures are measured in accredited labs and are not in dispute. A properly enclosed, grounded canopy around a bed will measurably reduce in-bed Wi-Fi (2.4/5 GHz) exposure to near-zero.

The largest Randomized Control Trial (RCT) is the 60-person elderly study. The 2025 5G study (n=34) is notable for showing that a genetic variant (CACNA1C rs7304986) may moderate the effect — T/C carriers showed EEG changes while T/T carriers did not.

<https://www.sciencedirect.com/science/article/pii/S105381192500343X>

Yes — nitric oxide (NO) is actually one of the best-studied molecular targets in the RF-EMF literature, and there's a fairly consistent mechanistic story, though the studies are all small (mostly animal or cell-culture work).

The proposed mechanism

The most-cited framework (largely from biochemist Martin Pall) is:

RF-EMF → activates voltage-gated calcium channels (VGCCs) → intracellular Ca²⁺ spike → activates nitric oxide synthase (NOS) → NO overproduction → NO reacts with superoxide (O₂⁻) → peroxynitrite (ONOO⁻) → DNA damage, protein oxidation, lipid peroxidation

Peroxynitrite is the actual "toxin" in this chain — NO itself is a normal signaling molecule, but in excess it becomes a reactive nitrogen species (RNS) that's genuinely cytotoxic.

<https://airestech.com/blogs/emf-education/emf-research-landmark-studies-health-evidence>

Key studies showing increased NO

Study	Frequency	Model	Finding
Miura et al. (1993)	RF burst	Rat cerebellum	NO increased; activated NOS; induced vasodilation
Yariktas et al. (2005)	900 MHz after 12 h/day × 30 d exposure	Rat nasal/sinus mucosa	Significant NO increase
Ilhan et al. (2004)	900 MHz	Rat brain	Increased NO + MDA; decreased SOD, GSH-Px
Pilla et al. (2012)	Pulsed RF	Dopaminergic MN9D cells	~3× NO increase within minutes; blocked by NOS inhibitor W-7
Ozgur et al. (2010)	1800 MHz	Guinea pig liver	Increased NO + MDA; decreased SOD, GSH-Px
Esmekaya et al.	900 MHz	Rat liver, lung, heart, kidney	Increased NO + lipid peroxidation across multiple organs
GHz macrophage study (2026)	2.45 GHz	RAW 264.7 macrophages	NO production increased at 48 h; reprogrammed cell death
5G 3.5 GHz skin cells (2025)	3.5 GHz	Human XP6BE fibroblasts	No oxidative stress or NO effect up to 4 W/kg

The "toxin buildup" framing is a bit imprecise — NO and peroxynitrite are transient reactive species, not persistent toxins that accumulate. The concern is chronic oxidative/nitrosative stress from repeated overproduction, not a build-up in the way heavy

metals accumulate.

The 2026 Frontiers review explicitly states: "RF-EMF also affects peptide neurotransmitters such as opioid peptides and increases nitric oxide (NO) levels, causing neuronal dysfunction and neurotoxicity."

<https://pmc.ncbi.nlm.nih.gov/articles/PMC8038719/>

<https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2026.1915745/full>

The NO/peroxynitrite pathway is mechanistically well-suited to produce diffuse muscle aches, and there's a small but notable body of evidence pointing in that direction. However, the human evidence remains weak.

Why NO/peroxynitrite can cause muscle pain

The biochemistry is straightforward:

NO directly activates C-fiber nociceptors in skeletal muscle, producing the sensation of pain (this is one of the proposed mechanisms of DOMS — delayed onset muscle soreness after exercise).

Peroxynitrite (ONOO⁻) — the reaction product of excess NO + superoxide — is a potent hyperalgesia mediator. It upregulates COX-2 → prostaglandin E₂ → pain sensitization, and it phosphorylates NMDA receptors in the spinal cord, driving central sensitization (the amplification loop that makes pain spread and persist).

Pall (2002) in Neuroscience & Biobehavioral Reviews explicitly proposed that elevated NO/peroxynitrite is a common etiology for fibromyalgia, chronic fatigue syndrome, and multiple chemical sensitivity — all of which present with widespread, full-body pain. His model includes six positive feedback loops that keep peroxynitrite elevated once the threshold is crossed.

Direct evidence linking EMF → muscle effects

Study Model Finding

Morabito et al. (2024, Int J Mol Sci)	Mice, ELF-EMF 0.1 mT, 5 weeks	Altered skeletal muscle redox status, upregulated myogenesis markers (Pax7, MyH); partially reversed by NAC antioxidant
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Fibromyalgia/EMF (2020, J Family Med Dis Prev)	80 FMS patients	Microwave users had higher widespread pain index (WPI) and severity scores, but difference was not statistically significant (p = 0.08, 0.06)
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Fibromyalgia/EMF (2022, conference poster)	FMS patients	"Possible pathological link between fibromyalgia and EMF exposure" — excess EMF "could be an underlying or augmenting factor"
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EHS case report (2024, Frontiers)	Single EHS patient	"Generalized systemic pain
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within minutes of exposure"; symptoms included spasms/microspasms in internal tissues

Systematic review (2024, Environ Res) Meta-analysis of 10 human RCT pairs No
or small non-significant effects of RF-EMF on self-reported symptoms

Randomized crossover provocation (2022, Sci Rep) IEI-EMF participants, base station exposure None of the reported symptoms (including muscle aches) were related to actual EMF exposure

The mechanistic chain is:

RF-EMF → VGCC activation → Ca^{2+} influx → NOS activation → NO overproduction → peroxynitrite → COX-2 / prostaglandin E_2 / NMDA central sensitization → diffuse myalgia

Every individual link in that chain is well-established in the pain physiology literature (NO in DOMS, peroxynitrite in hyperalgesia, central sensitization in fibromyalgia). What's missing is a single human study that:

Exposes a group to RF-EMF at realistic levels

Measures NO/peroxynitrite biomarkers (nitrite/nitrate, 3-nitrotyrosine, F2-isoprostanes) in muscle tissue or blood

Correlates those biomarker changes with a validated pain scale (e.g., FIQR, WPI)

The 2024 mouse study is the closest — it shows ELF-EMF (not RF) alters skeletal muscle redox and myogenesis in vivo, and that an antioxidant (NAC) partially reverses it. But it's a pilot, it's ELF (50/60 Hz power-line frequency, not Wi-Fi/phone RF), and it didn't measure pain.

Bottom line

The NO/peroxynitrite pathway is the most plausible mechanistic explanation for how RF-EMF could produce full-body muscle aches, and it's the same pathway implicated in fibromyalgia and DOMS. But no human study has closed the loop from Wi-Fi/phone exposure → elevated NO/peroxynitrite in muscle → measurable pain. If you're experiencing this, the practical question is whether it's the RF-EMF, the sleep disruption (which independently causes myalgia), or a confounding factor — and the only way to test that is the no-cost experiment of eliminating the source for 2–4 weeks and seeing if the aches resolve.

<https://pubmed.ncbi.nlm.nih.gov/22227257/>

<https://www.ovid.com/jnls/pain>

<https://www.sciencedirect.com/science/article/abs/pii/S0306987701913258>

<https://www.preprints.org/manuscript/202408.0378>