

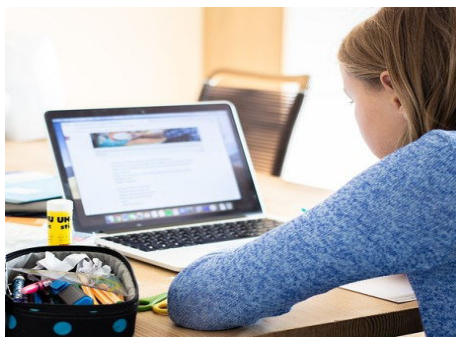
EMR and Health

Report on electromagnetic radiation, health and well-being

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Digital Tech and Education

New research shows digital device use impairs learning and cognition



Digital technology is everywhere in education: in classrooms, in students' pockets, on their laps, in their ears, in their homes.

Does that mean it's benefiting their learning?

Not according to Professor Tom Butler from the University College in Cork in Ireland.

In his recent paper that reviews the latest research in neuroscience, cognitive psychology and education Professor Butler says, 'It is now apparent that Digital Technology has a "dark side" with negative consequences for society that often outweigh the benefits that it brings.'

This is concerning, given that children and teens are spending so long – up to 12 hours a day – on digital devices, at school, at home, and everywhere else they go. Moreover, they are often exposed to multiple devices at once.

Professor Butler explains that there are many reasons why digital technology is harmful – and not just for learning.

Sleep problems

All screens contain LEDs [light-emitting diodes] that emit artificial light frequencies that disrupt the body's circadian rhythms and interfere with sleep. This can have negative consequences for the user, as sleep is important for memory and learning – as well as for health.

Butler says that 'short-term sleep deprivation ... affects cognition, vigilance, mood, behaviour, ability to learn, immune function, and general performance. Moreover, epidemiological studies associate poor sleep with long-term outcomes such as diabetes, obesity, depression, hypertension, and general mortality from all causes.' Lack of sleep has also been linked to substance abuse in teens.

Vision problems

Digital device use also has negative effects on vision. According to Butler, 'LED and CD screen design features such as refresh rate, luminance contrast levels, fluctuating light, backlighting, and contrast contribute to eye strain and visual fatigue'

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– this has become known as computer vision syndrome.’ It can negatively affect legibility and comprehension and even contribute to the loss of retinal cells and macular degeneration.

Keys vs pens

Butler says that it’s pens, pencils and paper – not keys and keyboards – that give the best results when it comes to learning and remembering – and he provides the evidence.

- There are intellectual benefits from physically writing letters and words. According to Butler, ‘The act of writing plays a pivotal role in learning. Typing keys on a keyboard does not have the same effect. Writing and typing involve different cognitive-neurological processes and outcomes in terms of neural circuitry.’
- Multiple studies have found that university students perform better in exams when they take notes by hand rather than using a laptop.
- Students who use computers in class learn less well and disrupt the learning of others.
- People learn better when reading from paper rather than online texts. The reading of digital texts tends to result in more superficial processing and reduced comprehension.

Attention problems

The use of digital devices adversely affects attention and learning.

When students use digital devices in classrooms, it doesn’t mean they’re learning. Butler refers to studies showing that digital devices increase student distraction and says that students who use them are more likely to be off-task during lectures – perhaps checking their phones or scrolling on the internet. Multitasking, in other words.

‘Multi-tasking is epidemic in the digital age,’ he says. However, the human brain is not built to multi-task efficiently and only 2% of the population can actually do it. Although people might think they’re multi-tasking efficiently, each time a person switches from one activity to another, they’re paying a price in cognition.

Effects on the brain

Alarmingly, Butler says that using digital devices can negatively affect brain function. As we’ve seen it can impair memory and cognition, but it can also affect brain chemistry, contribute to psychological problems and affect general well-being.

Multi-tasking on digital devices increases the production of cortisol (a stress hormone) and adrenaline (a fight-or-flight hormone). ‘This is a potent chemical cocktail that can overstimulate a student’s brain, reduce clarity of thought, and produce muddled thinking,’ Butler says.

The distracting nature of technology appeals to the prefrontal cortex of the brain that is attracted to novelty and reward. Butler quotes D J Levitin who says, “We answer the phone, look up something on the internet, check our email, send an SMS, and each of these things tweaks the novelty-seeking, reward-seeking centres of the brain, causing a burst of endogenous opioids (no wonder it feels so good!), all to the detriment of our staying on task.”

Brain plasticity (adaptability) means that negative behaviours like these can physically rewire the brain’s circuitry, thus entrenching the behaviours.

And causing addiction.

‘high levels of ST [screen time] is now considered an independent risk factor in heart disease, poor development outcomes among children, adult disease, and untimely death.’

Internet addiction is a huge problem, with studies showing that up to 50% of students are affected. Butler cites evidence showing that 'pathological internet use' is linked with depression and ADHD. Further, he says that 'high levels of ST [screen time] is now considered an independent risk factor in heart disease, poor development outcomes among children, adult disease, and untimely death.'

Learning outcomes

Digital technologies have been widely used in classrooms for many years. But where are the benefits?

Butler believes they are minimal. 'Digital Technology applications may develop very narrow, non-transferable, cognitive and/or motor skills in children at the expense of more important reading, mathematical skills, interpersonal and problem-solving skills,' he says.

He reveals that many executives from large companies such as Microsoft, Google, Amazon and Intel send their children to Waldorf Schools where children are discouraged from using Digital Technology at home or school before the age of 12.

Even though educators often cite studies showing the advantages of digital technology for education, Butler says that many of those are deeply flawed or have not been peer-reviewed.

What should we do?

Butler shares the view that children under 12 should not be using screen-based technologies at school.

He says, 'Given what neuroscientists have discovered about the dysfunctional and addictive effects of screen-based applications on the human brain, providing children and adolescents with smartphones or tablets is akin to giving them a cannabis plant with lots of fertilizer.'

He has some further recommendations for parents and educators such as:

- avoiding the use of tablets and laptops at home and school
- using screen-based devices for no more than an hour each evening
- avoiding the use of e-books
- where e-books must be used, using those with reflected (rather than LED) lighting
- using paper and pen in class
- educating students about the problems of digital technology.

Butler says that this evidence should let educators pause for thought.

Let's hope that they think hard and long and respond to the problems that are impairing the learning and well-being of our children and potentially compromising their futures.

Butler, T. (2024, March 29). A Critical Review of Digital Technology in Education: A Pause for Thought in 2024. SocArXiv <https://doi.org/10.31235/osf.io/5q8vg>





Mobile phones and the foetus

Does a pregnant mum's mobile phone use affect her unborn child?

According to researchers from Turkey, the answer is yes.

In the first study of its kind, Gülsüm Özen and team studied a group of 67 healthy women and their babies for evidence of oxidative stress.

'Oxidative stress occurs when the balance between the production of free oxygen radicals and their elimination by antioxidants is disrupted. Oxygen free radicals are toxic biological substances that cause lipid, protein, carbohydrate oxidation, and DNA damage,' the authors said.

There are a number of reasons why oxidative stress in pregnancy could be a problem, the authors explain. Firstly, pregnant women have higher levels of oxidative stress than non-pregnant women. Secondly, procedures performed on newborn babies – such as resuscitation and ventilation – can generate free radicals and, thirdly, newborns don't have a developed antioxidant system.

In their study, the researchers obtained information about the women's mobile phone use during pregnancy, including where they kept their phones and how many phones were in the household.

They found that 'The average mobile phone usage time of mothers was 7 years, daily phone talk time was 30 minutes, and daily internet usage time was 60 minutes.'

When each baby was born, the team took a blood sample from the umbilical cord and analysed it for markers of oxidative stress.

They found that oxidative stress was, in fact, related to mobile phone radiation, a sobering thought in today's digital world.

The authors offered some precautionary advice.

'The lack of certainty about the health problems caused by the use of mobile phones and related radiation does not necessarily indicate the absence of risks,' they said. 'The principle of "avoidance" should be adopted for known risky situations and "precautionary" for suspicious and unknown situations.'

'The principle of "avoidance" should be adopted for known risky situations and "precautionary" for suspicious and unknown situations'

Oxidative stress is not the only problem to be caused by wireless radiation. The authors point out that this radiation has been classified as a Class 2B ('possible') carcinogen by the International Agency for Research on Cancer and say: 'In studies on the side effects of EMFs on health, it has been shown EMF has been associated with many diseases such as Alzheimer's disease, autism, blood-brain barrier damage, brain tumors, depression, suicide, DNA damage, fatigue, headache and migraine, heart diseases, hormonal imbalance, joint pain, upper respiratory tract infections, immune system disorders, high blood pressure, learning difficulties, leukemia, loss of concentration, decreased sperm count, miscarriages, Parkinson's disease, sleep disorders and insomnia.'

Özen G, Kahvecioğlu D, Bulut İ, Erel Ö, Neşelioğlu S, Üstün Y, Taşar MA. Effect of Mobile Phone Usage During Pregnancy on Total Oxidant and Antioxidant Levels in Cord Blood. J Behcet Uz Child Hosp 2023;13(3):177-184; https://jag.journalagent.com/behcetuz/pdfs/BUCHD_13_3_177_184.pdf

More bad news for sperm

Guys, would you like to look after your sperm?

What about your kids' sperm?

In a paper published earlier this month, researchers from Iran showed that mobile phone radiation does damage sperm and explained why this is critical for fertility.

Not only is infertility increasing, with 8-12% of couples currently affected, but sperm damage can even affect the reproductive health of a man's children!

From a review of relevant studies, the researchers showed that mobile phone radiation can damage male fertility in a number of ways. Firstly, they say, radiation that's absorbed into the body can be transformed into heat, potentially damaging DNA, cells and epithelia of the seminiferous tubules that comprise the bulk of the testes.

Secondly, even without elevating temperatures, it can cause damage through mechanisms such as 'oxidative stress, alterations in sperm membrane potential, signaling pathways, and changes in sperm proliferation and apoptosis,' Koohestanidehaghi and colleagues say.

What sort of damage are we talking about?

'Several studies have explored the impact of EMW [electromagnetic waves] (860 to 915 MHz) on testicular structure. The findings from these studies suggest a reduction in the diameter of the seminiferous tubules and the thickness of the epithelium, as well as a decrease in the weight of the testicular organs,' the authors said.

Additionally, some studies have found that mobile phone radiation can affect sperm function. 'These studies have reported that exposure to waves is linked with a decrease in sperm count, motility, viability, and morphology. Most notably, they have found an increase in sperm chromatin damage and apoptosis [cell death].'

And that's not all.

Research has also shown that mobile phone radiation can affect Leydig cells, which are the main source of testosterone and are extremely sensitive to this exposure. 'EMW can influence the function of Leydig cells by reducing hormone secretion, which in turn leads to changes in cell proliferation during spermatogenesis.'

The authors explain how mobile phone radiation can damage DNA.

'EMW can induce oxidative stress, which subsequently leads to disorders such as reduced mobility, morphological changes, acrosome disturbances, and ultimately, damage to the nucleus and genetic material. This oxidative damage to DNA can result in the breakdown of both single-stranded and double-stranded DNA structures, culminating in fragmentation. If the DNA is not repaired and the damage accumulates, the sperm may undergo apoptosis [cell death],' they say.

What can be done?

The authors recommend 'it is advisable to limit daily exposure to these sources to prevent irreversible damage caused by EMWs.'

Koohestanidehaghi, Yeganeh, Khalili, Mohammad Ali, Dehghanpour, Fatemeh, Seify, Mohammad, Detrimental impact of cell phone radiation on sperm DNA integrity, Clin Exp Reprod Med. 2024;51(1):13-19. Published online January 24, 2024, DOI: <https://doi.org/10.5653/cerm.2023.06121>

5G tower radiation harms student

Swedish researchers, Professor Lennart Hardell and Mona Nilsson, have shown that a 5G mobile phone tower caused radiation-related symptoms in an eight-year-old boy attending a school nearby.

The boy developed headaches soon after he began attending the school. Over time the headaches became more frequent and more severe (often 'unbearable') and other symptoms – fatigue and dizziness – developed too. 'These are all part of the microwave syndrome or the radiofrequency sickness/illness described already during the 1960's and the 1970's,' the authors say.

Hardell and Nilsson measured radiation levels at the school and recorded 76,590 $\mu\text{W}/\text{m}^2$ [microwatts per square metre] in the boy's classroom and 267,536 $\mu\text{W}/\text{m}^2$ in the playground. While these levels comply with international radiation limits (ICNIRP Guidelines), they are above levels at which harmful effects occur in the body and well above the 3-6 $\mu\text{W}/\text{m}^2$ recommended by the independent BioInitiative Report (2012).

Interestingly, the boy does not experience headaches when he wears a shielded cap or when he is at home, where the radiation levels are much lower.

'This suggests that there is a causal relationship between the elevated radiation at the school and the boy's severe headache,' the authors wrote. 'The result is a classic example of a provocation study; symptoms (headache, fatigue, dizziness) occur with 5G exposure but cease/are absent without 5G exposure.'

The authors believe that 5G radiation is more harmful than previous generations of mobile phone technology. 'The Radio Frequency (RF) radiation emitted from 5G masts or 5G base stations is particularly problematic in terms of effects on human health and the environment because the technology produces fast, repetitive, very intense pulses of radiation. Biologically, this is unfavorable as the time to repair organ damage is too short.'

Professor Hardell, an oncologist, is particularly concerned about the cancer risks of exposure. 'Epidemiological studies performed to date show clear association between exposure to RF radiation and cancer,' he says. He and his team have conducted numerous studies showing links between mobile phone radiation and increased risks of brain tumours. And these have been strengthened by the results of two major animal studies conducted in the USA (National toxicology Program) and Italy (Ramazzini Institute).

In their paper, Hardell and Nilsson express grave concerns about the exposure from this and similar radiofrequency transmitters. They say, 'Radiofrequency radiation is an environmental pollutant. The exposure to RF radiation at the boy's school, both outdoors and in his classroom, is so high that it can cause the acute symptoms in the form of headache, fatigue, and dizziness that the boy repeatedly has experienced in school but much less in the home where the RF radiation is considerably lower. In the long term there is also the possibility of increased cancer risk. It can be assumed that more children at this school and other schools with 5G antennas in close proximity also suffer from symptoms caused by the increased RF radiation from 5G. Children are generally more sensitive than adults to harmful environmental factors. This case study underscores the urgent need for a moratorium on 5G deployment (www.emfcall.org, www.5Gappeal.eu).'

Lennart Hardell and Mona Nilsson, *Ann Clin Case Stud.* 2024;6(1): ACCS-06-1093; <https://www.medtextpublications.com/open-access/an-eight-year-old-boy-developed-severe-headache-in-a-1582.pdf>

Mobile phones & thyroid tumours

The global incidence of thyroid cancer has been growing rapidly. Thyroid cancer is now the most common cancer of the endocrine system and is projected to be the fourth most prevalent cancer by the end of the decade.

Mobile phone use has also been growing globally.

Could the two be connected? Quite possibly, say researchers from China in a recent paper that examined the risks factors for this disease.

'It has been established since the 1940s that radiation is an independent risk factor for TC [thyroid cancer], and mobile phones are also a source of radiation,' they say. 'The number of mobile phone users has also increased tremendously. In 2016, the total number of global mobile phone users reached 7.5 billion, indicating a significant increase in usage. Smartphones are classified as non-ionising electromagnetic field devices, potentially carcinogenic to humans. Due to the antenna being located at the bottom, the thyroid gland in the neck is more susceptible to exposure to radio frequency electromagnetic radiation than the brain.'

The authors refer to research showing that long-term and heavy mobile phone use increased the risks of small thyroid tumours and to studies showing that people with some genetic characteristics are more vulnerable to developing thyroid cancer if they use mobile phones.

Why might this be the case?

The authors explain that 'Studies have shown that non-ionising radiation can cause oxidative stress by interfering with oxidative repair and damaging cellular components, including DNA, which can eventually lead to cancer. Specifically, electromagnetic radiation can interfere with the production of antioxidants that neutralise free radicals. The body normally produces antioxidants that neutralise free radicals, but interference from electromagnetic radiation leads to an increase in free radicals, causing oxidative damage to cells. This explains why cell phone exposure is associated with an increased risk of cancer.'

Although the jury might still be out on the connection between mobile phone radiation and thyroid cancer, it seems like a good idea to reduce exposure as a precaution.

Yi Shen et al, Modifiable risk factors for thyroid cancer: lifestyle and residence environment, Endokrynologia Polska DOI: [10.5603/ep.97258](https://doi.org/10.5603/ep.97258) ISSN 0423-104X, e-ISSN 2299-8306 e

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News bites

- British Prime Minister Rishi Sunak is planning regulations that could restrict kids' access to social media platforms and ban teens from buying smartphones. <https://www.mirror.co.uk/news/politics/children-under-16-years-old-32583099>
- Florida is also introducing restrictions on children's use of social media. <https://www.washingtonpost.com/politics/2024/03/25/ron-desantis-florida-social-media-ban-children/>
- 48 models of mobile phones have been withdrawn from the French market or have had updates to their SAR [Specific Absorption Rates] <https://phonegatealert.org/en/list-of-mobile-phones-with-non-compliant-sars-removed-or-updated-in-france-2/>
- Despite being more than ever connected on social media, Australian youth is suffering an epidemic of loneliness, with people aged 18 to 24 being most affected. <https://citynews.com.au/2024/simple-action-to-combat-loneliness-epidemic/#:~:text=Like%20health%20guidelines%20encouraging%2010%2C000,meaningful%20social%20interaction%20each%20day.>
- Analyst Paul Budde reports that smart cities are vulnerable to cyberattacks. <https://independentaustralia.net/business/business-display/smart-cities-vulnerable-to-cyberattacks,17473>
- The BBC reports on people with electromagnetic hypersensitivity: <https://www.youtube.com/watch?v=ZiXR77yyO24>
- Research finds US teens are happier and more at peace without smart phones. <https://thehill.com/changing-america/well-being/mental-health/4524566-majority-teens-happy-peaceful-without-smartphones-survey/>

Symptoms in government workers

In 2015 US embassy employees and family members living overseas began reporting symptoms that had a sudden onset and included dizziness, pain, visual problems and cognitive dysfunction.

These symptoms are often thought to have been caused by wireless radiation¹ and were originally called 'Havana Syndrome' because they were reported in Cuba. However, similar symptoms have now been reported in other geographic locations as well and the US Government has chosen to refer to them as 'anomalous health incidents' (AHIs).

In two papers published last month, researchers investigated the condition in more detail.

The first study compared government employees with and without AHI.² While the researchers didn't find differences between the groups for all of the tests they conducted, they did find some interesting results. They found:

- 'Headache was the most common symptom (74%) following AHI, followed by cognitive challenges (69%), sleep disorders (59%), tinnitus (56%), imbalance (52%), dizziness (37%), and vision change concerns (37%). The most common type of headache was migraine headache (36%), followed by new daily persistent headache (29%), and unspecified headache (19%; mostly transient headache following AHI).'
- 'Individuals with AHIs reported significantly more posttraumatic stress ..., fatigue ..., and depressive symptoms, as well as reduced satisfaction with life ... compared with control participants.'
- Participants with AHIs scored worse on self-reported balance questionnaires.

These symptoms are consistent with those reported by people exposed to wireless radiation.

The second study involved MRI brain imaging of small numbers of people with and without AHI. The authors reported, 'we did not find substantial differences between AHI and control groups, except for the functional connectivity in the salience networks.' They added, 'That this study did not identify a neuroimaging signature of brain injury in this AHI cohort does not detract from the seriousness of the clinical condition.'

'Havana Syndrome' – a link between wireless radiation and symptoms. https://emraustralia.com.au/blogs/news-1/havana-syndrome-a-link-between-wireless-radiation-and-symptoms?_pos=1&_sid=326b9a78b&_ss=r

Chan L, Hallett M, Zalewski CK, et al. Clinical, Biomarker, and Research Tests Among US Government Personnel and Their Family Members Involved in Anomalous Health Incidents. *JAMA*. Published online March 18, 2024.

Pierpaoli C, Nayak A, Hafiz R, et al. Neuroimaging Findings in US Government Personnel and Their Family Members Involved in Anomalous Health Incidents. *JAMA*. Published online March 18, 2024. [doi:10.1001/jama.2024.2424](https://doi.org/10.1001/jama.2024.2424)

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'... embassy employees and family members ... began reporting symptoms that had a sudden onset and included dizziness, pain, visual problems and cognitive dysfunction.'