HOW MIGHT EMF CONTRIBUTE TO AUTISM?
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If someone had asked me nearly 20 years ago, when I first started working in autism research and seeing autism patients, whether electromagnetic fields (EMF) or radiofrequency radiation (RFR) had anything to do with it, I would have had no idea what they were talking about. At that point I was already hooked on computers and email, but the web was new and we weren't using cell phones, so there were no cell towers. I had a microwave oven and used it to "nuke" my food with only the vaguest inchoate concerns. So not so much Wi-Fi, and not so much autism either – a coincidence? Lots of other things have changed since then too, [1] and there was already plenty of electricity, [2] but in any case I had hardly seen any autistic patients during my training in the early 1990s, and back then, the teaching was that autism and other childhood neurodevelopmental or neuropsychiatric disorders were caused by genetically based early disturbances of brain development. [3]

Many things have transpired to bring me to the point where I would co-author a 40,000 word paper with 560 scientific footnotes supporting the plausibility of a connection between autism and EMF. [Editor's note: This paper may be may be downloaded from http://www.bioinitiative.org/report/wp-content/uploads/pdfs/sec20_2012_Findings_in_Autism.pdf, and a revised version has been published in the journal *Pathophysiology*. [4]]

Over the years, I have learned a lot from watching and listening very carefully to my patients. I found large discrepancies between what I had been taught to look for in my brain research and what I was actually finding in the data. I started learning about more and more ways the environment and diet could affect brain and body. And I watched the numbers of autistic kids skyrocket when it was supposed to be purely genetic and inherited. [5-7]

Listening to my patients was a huge impetus in changing my thinking. My pediatric neurology training did not really prepare me for the problems my patients presented. My first clinic was in 1996, in a neuropsychiatric practice. As my clinical practice filled with children with autism, ADHD, obsessive-compulsive disorder, trouble in school, and seizures, I sometimes put them through the elaborate hunts for genetic and metabolic underpinnings that I had been trained to do, but I rarely found anything wrong. As I listened to their stories I found myself intrigued by the commonplace problems that were shared by so many patients who were in other ways different from each other. These children were just plain not healthy! They had diarrhea, or constipation, or rashes. They had headaches. They could not sleep. They wiggled a lot in their chairs. They had food allergies. They ate a few foods and refused many others. They hated certain textures, or sensations. I had to work really hard and rephrase and repeat a lot to get them to follow my instructions when I examined them. All these challenges happened with most of my patients, not just the ones with autism. And my practice was filling up with these unhealthy, unstable kids.

As I straddled the worlds of brain research, environmental neurotoxicology, and in-the-trenches medical care I found I could no longer be satisfied with the questions people were asking in any one corner. It wasn't enough to ask how the brains of people who had autism or other neuropsychiatric conditions

might differ from the brains of people who are "normal," or what toxins in the environment might cause autism. I didn't see those questions as directly helping me get my patients better. And in fact, some of my patients, and patients of friends of mine, WERE getting better – but HOW were we changing the brain's "autism" if it wasn't supposed to be changeable?

Over time I gathered more and more evidence to support the idea that autism is not about having a "broken brain," but about having a brain that is having a hard time regulating itself. This set me on a hunt not for "what causes autism," but HOW autism is caused, and how you might un-cause it. [8,9] [10,11]

So what kind of things can dys-regulate a brain? Well, lots of things. [12] Like disrupted sleep or insomnia. Like exposure to pesticides and fumes from automobiles or household chemicals and glues, and other chemicals. Like having a diet that is short on zinc or magnesium or other vital nutrients or has too much sugar or additives or other junk. Like having a gut so irritated or inflamed that you don't absorb your nutrients well. Like having allergies.

A dys-regulated brain may or may not show changes in its anatomy – on what you see if you look at an MRI picture of what the brain looks like. It may not show brainwaves that are sufficiently abnormal to be seizures if you do an EEG brainwave study. But on more subtle examination, brain researchers who study brain FUNCTION in ASD find that the different parts of the brain aren't as well coordinated with each other as in kids with more typical development. [13-15]

Now we're starting to get close to where EMF/RFR came into the picture for me. These brain waves that the brain uses to communicate with inside of itself are electrical, or electromagnetic. So is EMF/RFR. Given the proliferation of devices that emit RFR (such as cell phone towers, cell phones, DECT cordless phones, Wi-Fi routers etc.) we are walking around in an invisible soup of electromagnetic signals without really knowing whether we might be complicating or confusing the communication processes in our brains.

That might seem a little far-fetched, but there is more here. First of all, it's not just the brain that uses electromagnetic signaling. The more sensitive our scientific measurement instruments become, the more we learn that every cell in our body uses electromagnetic signaling – many cellular processes, and even DNA, involve electromagnetic properties that change in meaningful ways. The main thing different about the brain is that it takes this electromagnetic activity to a dazzlingly high and complex level of organization. [16]

When we go to school we study biology, chemistry and physics (including electromagnetism) as separate subjects, but in reality our biological bodies and brains operate through processes that are simultaneously chemical and electrical. Chemical ions set up electrical voltage differences across cellular membranes, for example, that keep us alive. Recently it was found that people with lower voltage difference between the inside and outside of a membrane are more vulnerable to cancer, and if you increase the voltage difference between the inside and the outside of the cell, the vulnerability goes down and the cancer may improve. [17] So even cancer may be simultaneously electrical and chemical.

Our vital biological functions derive from countless chemical-electrical interactions, and for us to be at our best they need to be optimized. I think there is enough strong scientific support to argue that *EMF/RFRs are important contributors to degrading the optimal chemical-electrical function of our bodies – thereby detuning our brains and nervous systems.* [18]

How would EMF/RFR do this? The problems I list below are parallel to issues that have been documented in people with autism spectrum disorders. [4,18]

- EMF/RFR stresses cells. It lead to cellular stress, such as production of heat shock proteins, even when The EMF/RFR isn't intense enough to cause measurable heat increase. [19-21]
- EMF/RFR damages cell membranes, and make them leaky, which makes it hard for them to maintain important chemical and electrical differences between what is inside and outside the membrane. This degrades metabolism in many ways – makes it inefficient. [22-30]
- EMF/RFR damages mitochondria. Mitochondria are the energy factories of our cells. Mitochondria conduct their chemical reactions on their membranes. When those membranes get damaged, the mitochondria struggle to do their work and don't do it so well. Mitochondria can also be damaged through direct hits to steps in their chemical assembly line. When mitochondria get inefficient, so do we. This can hit our brains especially hard, since electrical communication and synapses in the brain demands huge amounts of energy.
- EMF/RFR creates "oxidative stress." Oxidative stress is something that occurs when the system can't keep up with the stress caused by utilising oxygen, because the price we pay for using oxygen is that it generates free radicals. These are generated in the normal course of events, and they are "quenched" by antioxidants like we get in fresh fruits and vegetables; but when the antioxidants can't keep up or the damage is too great, the free radicals start damaging things.
- EMF/RFR is genotoxic and damage proteins, with a major mechanism being EMF/RFR-created free radicals which damage cell membranes, DNA, proteins, anything they touch. When free radicals damage DNA they can cause mutations. This is one of the main ways that EMF/RFR is genotoxic – toxic to the genes. When they damage proteins they can cause them to fold up in peculiar ways. We are learning that diseases like Alzheimer's are related to the accumulation of mis-folded proteins, and the failure of the brain to clear out this biological trash from its tissues and fluids.
- EMF/RFR depletes glutathione, which is the body's premier antioxidant and detoxification substance. So on the one hand EMF/RFR creates damage that increases the need for antioxidants, and on the other hand they deplete those very antioxidants.[4,18]
- EMF/RFR damages vital barriers in the body, particularly the blood-brain barrier, which protects the brain from things in the blood that might hurt the brain. When the blood-brain barrier gets leaky, cells inside the brain suffer, be damaged, and get killed. [4,18,31]
- EMF/RFR can alter the function of calcium channels, which are openings in the cell membranes that play a huge number of vital roles in brain and body. [32-41]
- EMF/RFR degrades the rich, complex integration of brainwaves, and increase the "entropy" or disorganisation of signals in the brain – this means that they can become less synchronised or coordinated; this has been measured in autism. [13-15,42-51]
- EMF/RFR can interfere with sleep and the brain's production of melatonin. [52-54]
- EMF/RFR can contribute to immune problems. [55,5657-61]
- EMF/RFR contribute to increasing stress at the chemical, immune and electrical levels, which we experience psychologically. [62-68 31,69-73 74-79]

Please note that:

1. There are a lot of other things that can create similar damaging effects, such as thousands of "xenobiotic" substances that we call toxicants. Significantly, toxic chemicals (including those that

contain naturally occurring toxic elements such as lead and mercury) cause damage through many of the same mechanisms outlined above.

2. In many of the experimental studies with EMF/RFR, damage could be diminished by improving nutrient status, particularly by adding antioxidants and melatonin. [80-83]

We live in a world full of new-to-nature substances and electromagnetic frequency combinations and intensities, many of which damage our cells, tissues and living processes in similar ways. So it is hard for me to believe that EMF/RFR is the ONLY contributor to ASD or other neuropsychiatric or health issues. On the other hand, its impact could be significant – and we can do a lot to reduce exposure and thereby reduce that impact. [84]

We have barely begun to explore the impact of EMF/RFR on fetuses and babies, but it does not look good. A developing fetus or young infant is engaged in an incredible set of dynamic processes that are very vulnerable, where even small shifts can have lifelong consequences. And yet how many people put wireless baby monitors right next to their babies' head, blithely unaware of the potential degradation they may be inflicting on their child's brain? [85] How many pregnant women plug in their laptops and put them on their laps while they are pregnant, exposing their fetuses? [86] How many men stick their cell phones in their pants pockets when this has been demonstrated to degrade sperm counts and lead to mutations? [87-92]

The more I know about the underlying biology of autism and of many other chronic neuropsychiatric and medical diseases, the less store I hold by the labels we put on specific diseases. From the point of view of protecting people and helping them get better, I don't care so much about whether it's autism or ADHD or OCD or whatever other label you may choose, because under the surface I see more overlap than differences. Where I think we can make a difference is addressing the FUNCTION of our bodies and brains, [8] by

- reducing noxious exposures as much as we can, to avoid the degradation of our body function and to prevent the detuning of our brains and nervous systems – and
- maximising the quality of our food through a high nutrient density diet so that our bodies have all the nutrients they need to protect themselves and to function at their best.

Meanwhile, given how much we have already learned about the subtle biological, cellular and electrical impacts of EMF/RFR, we need to update our out-of-date regulations to take into account of how exquisitely vulnerable we now know we are. And we need to aim for safer ways of meeting our needs for communication and other devices that generate EMF/RFR. Just because EMR/RFR is invisible doesn't mean it's harmless. We need to admit that we have a problem, and do something about it.

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Dr. Martha Herbert is an Assistant Professor of Neurology at Harvard Medical School, a Pediatric Neurologist at the Massachusetts General Hospital in Boston, and an affiliate of the Harvard-MIT-MGH Martinos Center for Biomedical Imaging, where she is director of the TRANSCEND Research Program (Treatment Research and Neuroscience Evaluation of Neurodevelopmental Disorders). Information about Dr Herbert's research may be found at these links: www.transcendresearch.org - http://nmr.mgh.harvard.edu/transcend/ and www.marthaherbert.org. Dr Herbert's approach to autism treatment is to methodically identify the issues for each child and respond by optimising nutrition, reducing toxic exposures, supporting the immune system, reducing stress and promoting creativity. She is the author of the book *The Autism Revolution: Whole Body Strategies for Making Life All it Can Be*.

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References

1. Herbert M. Time to Get a Grip. Autism Advocate 2006;45:19-26 (available on www.marthaherbert.org under publications).
2. Milham S. Dirty Electricity: Electrification and the Diseases of Civilization: iuniverse.com; 2010.
3. Rapin I, Katzman R. Neurobiology of autism. Ann Neurol 1998;43:7-14.
4. Herbert MR, Sage C. Autism and EMF? Plausibility of a Pathophysiological Link, Parts I and II. Pathophysiology In press.
5. Hertz-Picciotto I, Delwiche L. The rise in autism and the role of age at diagnosis. Epidemiology 2009;20:84-90.
6. King M, Bearman P. Diagnostic change and the increased prevalence of autism. Int J Epidemiol 2009;38:1224-34.
7. Grether JK, Rosen NJ, Smith KS, Croen LA. Investigation of shifts in autism reporting in the California Department of Developmental Services. J Autism Dev Disord 2009;39:1412-9.
8. Herbert MR, Weintraub K. The Autism Revolution: Whole Body Strategies for Making Life All It Can Be. New York, NY: Random House with Harvard Health Publications; 2012.
9. Autism WHY and HOW. 2012. at www.autismWHYandHOW.org.)
10. Herbert MR. Autism: The centrality of active pathophysiology and the shift from static to chronic dynamic encephalopathy: Taylor & Francis / CRC Press; 2009.
11. Herbert M. Autism: From Static Genetic Brain Defect to Dynamic Gene-Environment Modulated Pathophysiology. In: Krimsky S, Gruber J, eds. Genetic Explanations: Sense and Nonsense. Cambridge, MA: Harvard University Press; 2013:122-46.
12. Herbert MR. Contributions of the environment and environmentally vulnerable physiology to autism spectrum disorders. Curr Opin Neurol 2010;23:103-10.
13. Just MA, Cherkassky VL, Keller TA, Minshew NJ. Cortical activation and synchronization during sentence comprehension in high-functioning autism: evidence of underconnectivity. Brain 2004;127:1811-21.
14. Muller RA, Shih P, Keehn B, Deyoe JR, Leyden KM, Shukla DK. Underconnected, but how? A survey of functional connectivity MRI studies in autism spectrum disorders. Cereb Cortex 2011;21:2233-43.
15. Wass S. Distortions and disconnections: disrupted brain connectivity in autism. Brain Cogn 2011;75:18-28.
16. Buzsaki G. Rhythms of the Brain. New York: Oxford University Press; 2006.
17. Lobikin M, Chernet B, Lobo D, Levin M. Resting potential, oncogene-induced tumorigenesis, and metastasis: the bioelectric basis of cancer in vivo. Phys Biol 2012;epub:epub.
18. Herbert MR, Sage C. Findings in Autism Spectrum Disorders consistent with Electromagnetic Frequencies (EMF) and Radiofrequency Radiation (RFR). In: Sage C, Carpenter DO, eds. BioInitiative Update: www.BioInitiative.org; 2012.
19. Blank M, ed. Electromagnetic Fields2009.
20. Blank M. Evidence for Stress Response (Stress Proteins) (Section 7)2012.
21. Evers M, Cunningham-Rundles C, Hollander E. Heat shock protein 90 antibodies in autism. Mol Psychiatry 2002;7 Suppl 2:S26-8.
22. Desai NR, Kesari KK, Agarwal A. Pathophysiology of cell phone radiation: oxidative stress and carcinogenesis with focus on male reproductive system. Reprod Biol Endocrinol 2009;7:114.

23. Phelan AM, Lange DG, Kues HA, Lutty GA. Modification of membrane fluidity in melanin-containing cells by low-level microwave radiation. Bioelectromagnetics 1992;13:131-46.
24. Beneduci A, Filippelli L, Cosentino K, Calabrese ML, Massa R, Chidichimo G. Microwave induced shift of the main phase transition in phosphatidylcholine membranes. Bioelectrochemistry 2012;84:18-24.
25. El-Ansary A, Al-Ayadhi L. Lipid mediators in plasma of autism spectrum disorders. Lipids Health Dis 2012;11:160.
26. El-Ansary AK, Bacha AG, Al-Ayahdi LY. Plasma fatty acids as diagnostic markers in autistic patients from Saudi Arabia. Lipids Health Dis 2011;10:62.
27. Chauhan A, Chauhan V, Brown WT, Cohen I. Oxidative stress in autism: increased lipid peroxidation and reduced serum levels of ceruloplasmin and transferrin--the antioxidant proteins. Life Sci 2004;75:2539-49.
28. Pecorelli A, Leoncini S, De Felice C, et al. Non-protein-bound iron and 4-hydroxynonenal protein adducts in classic autism. Brain Dev 2012:epub.
29. Ming X, Stein TP, Brimacombe M, Johnson WG, Lambert GH, Wagner GC. Increased excretion of a lipid peroxidation biomarker in autism. Prostaglandins Leukot Essent Fatty Acids 2005;73:379-84.
30. Yao Y, Walsh WJ, McGinnis WR, Pratico D. Altered vascular phenotype in autism: correlation with oxidative stress. Arch Neurol 2006;63:1161-4.
31. Salford LG, Nittby H, Persson BR. Effects of EMF from Wireless Communication Upon the Blood-Brain Barrier2012.
32. Pall ML. Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. J Cell Mol Med 2013.
33. Nesin V, Bowman AM, Xiao S, Pakhomov AG. Cell permeabilization and inhibition of voltage-gated Ca(2+) and Na(+) channel currents by nanosecond pulsed electric field. Bioelectromagnetics 2012;33:394-404.
34. Maskey D, Kim HJ, Kim HG, Kim MJ. Calcium-binding proteins and GFAP immunoreactivity alterations in murine hippocampus after 1 month of exposure to 835 MHz radiofrequency at SAR values of 1.6 and 4.0 W/kg. Neurosci Lett 2012;506:292-6.
35. Maskey D, Kim M, Aryal B, et al. Effect of 835 MHz radiofrequency radiation exposure on calcium binding proteins in the hippocampus of the mouse brain. Brain Res 2010;1313:232-41.
36. Kittel A, Siklos L, Thuroczy G, Somosy Z. Qualitative enzyme histochemistry and microanalysis reveals changes in ultrastructural distribution of calcium and calcium-activated ATPases after microwave irradiation of the medial habenula. Acta Neuropathol 1996;92:362-8.
37. Dutta SK, Das K, Ghosh B, Blackman CF. Dose dependence of acetylcholinesterase activity in neuroblastoma cells exposed to modulated radio-frequency electromagnetic radiation. Bioelectromagnetics 1992;13:317-22.
38. Palmieri L, Persico AM. Mitochondrial dysfunction in autism spectrum disorders: cause or effect? Biochim Biophys Acta 2010;1797:1130-7.
39. Peng TI, Jou MJ. Oxidative stress caused by mitochondrial calcium overload. Ann N Y Acad Sci 2010;1201:183-8.
40. Pessah IN, Lein PJ. Evidence for Environmental Susceptibility in Autism: What We Need to Know About Gene *x* Environment Interactions: Humana; 2008.
41. Stamou M, Streifel KM, Goines PE, Lein PJ. Neuronal connectivity as a convergent target of gene-environment interactions that confer risk for Autism Spectrum Disorders. Neurotoxicol Teratol 2012.
42. Bachmann M, Lass J, Kalda J, et al. Integration of differences in EEG analysis reveals changes in human EEG caused by microwave. Conf Proc IEEE Eng Med Biol Soc 2006;1:1597-600.

43. Marino AA, Nilsen E, Frilot C. Nonlinear changes in brain electrical activity due to cell phone radiation. Bioelectromagnetics 2003;24:339-46.
44. Marino AA, Carrubba S. The effects of mobile-phone electromagnetic fields on brain electrical activity: a critical analysis of the literature. Electromagn Biol Med 2009;28:250-74.
45. Vecchio F, Babiloni C, Ferreri F, et al. Mobile phone emission modulates interhemispheric functional coupling of EEG alpha rhythms. Eur J Neurosci 2007;25:1908-13.
46. Hountala CD, Maganioti AE, Papageorgiou CC, et al. The spectral power coherence of the EEG under different EMF conditions. Neurosci Lett 2008;441:188-92.
47. Duffy FH, Als H. A stable pattern of EEG spectral coherence distinguishes children with autism from neuro-typical controls - a large case control study. BMC Med 2012;10:64.
48. Isler JR, Martien KM, Grieve PG, Stark RI, Herbert MR. Reduced functional connectivity in visual evoked potentials in children with autism spectrum disorder. Clin Neurophysiol 2010.
49. Murias M, Swanson JM, Srinivasan R. Functional connectivity of frontal cortex in healthy and ADHD children reflected in EEG coherence. Cereb Cortex 2007;17:1788-99.
50. Murias M, Webb SJ, Greenson J, Dawson G. Resting state cortical connectivity reflected in EEG coherence in individuals with autism. Biol Psychiatry 2007;62:270-3.
51. Coben R, Clarke AR, Hudspeth W, Barry RJ. EEG power and coherence in autistic spectrum disorder. Clin Neurophysiol 2008;119:1002-9.
52. Rossignol DA, Frye RE. Melatonin in autism spectrum disorders: a systematic review and meta-analysis. Dev Med Child Neurol 2011;53:783-92.
53. Buckley AW, Rodriguez AJ, Jennison K, et al. Rapid eye movement sleep percentage in children with autism compared with children with developmental delay and typical development. Arch Pediatr Adolesc Med 2010;164:1032-7.
54. Giannotti F, Cortesi F, Cerquiglini A, Vagnoni C, Valente D. Sleep in children with autism with and without autistic regression. J Sleep Res 2011;20:338-47.
55. Johansson O. Disturbance of the immune system by electromagnetic fields-A potentially underlying cause for cellular damage and tissue repair reduction which could lead to disease and impairment. Pathophysiology 2009;16:157-77.
56. Johannson O. Evidence for Effects on Immune Function2007 2007.
57. Bilbo SD, Jones JP, Parker W. Is autism a member of a family of diseases resulting from genetic/cultural mismatches? Implications for treatment and prevention. Autism Res Treat 2012;2012:910946.
58. Persico AM, Van de Water J, Pardo CA. Autism: where genetics meets the immune system. Autism Res Treat 2012;2012:486359.
59. Kong SW, Collins CD, Shimizu-Motohashi Y, et al. Characteristics and predictive value of blood transcriptome signature in males with autism spectrum disorders. PLoS One 2012;7:e49475.
60. Waly MI, Hornig M, Trivedi M, et al. Prenatal and Postnatal Epigenetic Programming: Implications for GI, Immune, and Neuronal Function in Autism. Autism Res Treat 2012;2012:190930.
61. Lintas C, Sacco R, Persico AM. Genome-wide expression studies in autism spectrum disorder, Rett syndrome, and Down syndrome. Neurobiol Dis 2012;45:57-68.
62. Andrzejak R, Poreba R, Poreba M, et al. The influence of the call with a mobile phone on heart rate variability parameters in healthy volunteers. Ind Health 2008;46:409-17.
63. Szmigielski S, Bortkiewicz A, Gadzicka E, Zmyslony M, Kubacki R. Alteration of diurnal rhythms of blood pressure and heart rate to workers exposed to radiofrequency electromagnetic fields. Blood Press Monit 1998;3:323-30.
64. Bortkiewicz A, Gadzicka E, Zmyslony M, Szymczak W. Neurovegetative disturbances in workers exposed to 50 Hz electromagnetic fields. Int J Occup Med Environ Health 2006;19:53-60.

65. Graham C, Cook MR, Sastre A, Gerkovich MM, Kavet R. Cardiac autonomic control mechanisms in power-frequency magnetic fields: a multistudy analysis. Environ Health Perspect 2000;108:737-42.
66. Saunders RD, Jefferys JG. A neurobiological basis for ELF guidelines. Health Phys 2007;92:596-603.
67. Buchner K, Eger H. Changes of Clinically Important Neurotransmitters under the Influence of Modulated RF Fields—A Long-term Study under Real-life Conditions (translated; original study in German). Umwelt-Medizin-Gesellschaft 2011;24:44-57.
68. Bellieni CV, Acampa M, Maffei M, et al. Electromagnetic fields produced by incubators influence heart rate variability in newborns. Arch Dis Child Fetal Neonatal Ed 2008;93:F298-301.
69. Narayanan A, White CA, Saklayen S, et al. Effect of propranolol on functional connectivity in autism spectrum disorder--a pilot study. Brain Imaging Behav 2010;4:189-97.
70. Anderson CJ, Colombo J. Larger tonic pupil size in young children with autism spectrum disorder. Dev Psychobiol 2009;51:207-11.
71. Anderson CJ, Colombo J, Unruh KE. Pupil and salivary indicators of autonomic dysfunction in autism spectrum disorder. Dev Psychobiol 2012.
72. Daluwatte C, Miles JH, Christ SE, Beversdorf DQ, Takahashi TN, Yao G. Atypical Pupillary Light Reflex and Heart Rate Variability in Children with Autism Spectrum Disorder. J Autism Dev Disord 2012.
73. Ming X, Bain JM, Smith D, Brimacombe M, Gold von-Simson G, Axelrod FB. Assessing autonomic dysfunction symptoms in children: a pilot study. J Child Neurol 2011;26:420-7.
74. Hirstein W, Iversen P, Ramachandran VS. Autonomic responses of autistic children to people and objects. Proc Biol Sci 2001;268:1883-8.
75. Toichi M, Kamio Y. Paradoxical autonomic response to mental tasks in autism. J Autism Dev Disord 2003;33:417-26.
76. Ming X, Julu PO, Brimacombe M, Connor S, Daniels ML. Reduced cardiac parasympathetic activity in children with autism. Brain Dev 2005;27:509-16.
77. Mathewson KJ, Drmic IE, Jetha MK, et al. Behavioral and cardiac responses to emotional stroop in adults with autism spectrum disorders: influence of medication. Autism Res 2011;4:98-108.
78. Cheshire WP. Highlights in clinical autonomic neuroscience: New insights into autonomic dysfunction in autism. Auton Neurosci 2012;171:4-7.
79. Chang MC, Parham LD, Blanche EI, et al. Autonomic and behavioral responses of children with autism to auditory stimuli. Am J Occup Ther 2012;66:567-76.
80. Kesari KK, Kumar S, Behari J. 900-MHz microwave radiation promotes oxidation in rat brain. Electromagn Biol Med 2011;30:219-34.
81. Oktem F, Ozguner F, Mollaoglu H, Koyu A, Uz E. Oxidative damage in the kidney induced by 900-MHz-emitted mobile phone: protection by melatonin. Arch Med Res 2005;36:350-5.
82. Lai H, Singh NP. Melatonin and a spin-trap compound block radiofrequency electromagnetic radiation-induced DNA strand breaks in rat brain cells. Bioelectromagnetics 1997;18:446-54.
83. Xu S, Zhou Z, Zhang L, et al. Exposure to 1800 MHz radiofrequency radiation induces oxidative damage to mitochondrial DNA in primary cultured neurons. Brain Res 2010;1311:189-96.
84. Lee DH, Jacobs DR, Jr., Porta M. Hypothesis: a unifying mechanism for nutrition and chemicals as lifelong modulators of DNA hypomethylation. Environ Health Perspect 2009;117:1799-802.
85. Bellieni CV, Tei M, Iacoponi F, et al. Is newborn melatonin production influenced by magnetic fields produced by incubators? Early Hum Dev 2012;88:707-10.
86. Bellieni CV, Pinto I, Bogi A, Zoppetti N, Andreuccetti D, Buonocore G. Exposure to electromagnetic fields from laptop use of "laptop" computers. Arch Environ Occup Health 2012;67:31-6.
87. Agarwal A, Deepinder F, Sharma RK, Ranga G, Li J. Effect of cell phone usage on semen analysis in men attending infertility clinic: an observational study. Fertil Steril 2008;89:124-8.

88. Agarwal A, Desai NR, Makker K, et al. Effects of radiofrequency electromagnetic waves (RF-EMW) from cellular phones on human ejaculated semen: an in vitro pilot study. Fertil Steril 2009;92:1318-25.
89. Wdowiak A, Wdowiak L, Wiktor H. Evaluation of the effect of using mobile phones on male fertility. Ann Agric Environ Med 2007;14:169-72.
90. De Iuliis GN, Newey RJ, King BV, Aitken RJ. Mobile phone radiation induces reactive oxygen species production and DNA damage in human spermatozoa in vitro. PLoS One 2009;4:e6446.
91. Fejes I, Zavaczki Z, Szollosi J, et al. Is there a relationship between cell phone use and semen quality? Arch Androl 2005;51:385-93.
92. Aitken RJ, Bennetts LE, Sawyer D, Wiklendt AM, King BV. Impact of radio frequency electromagnetic radiation on DNA integrity in the male germline. Int J Androl 2005;28:171-9.