ELECTROMAGNETIC SENSITIVITY (ES)

All humans are sensitive to environmental electromagnetic fields (EMF), both natural and manmade. Natural EMFs include sunlight, the Schumann resonance and other geomagnetic energy, causing biological effects, e.g. vitamin D and circadian and brain wave entrainment.

The degree of environmental sensitivity to EMF energy depends on the individual. It ranges from high sensitivity, producing severe symptoms for a few, to some people who feel no symptoms, although they may still react subconsciously. Provocation tests often concern only conscious symptoms, but diagnosis also involves objective markers at a subconscious level.

Surveys suggest that up to 40% of the general population link a few conscious symptoms to environmental man-made EMFs, while 1.5% to 4.6% have definite adverse symptoms. Common specific symptoms from ES include headaches from using a mobile phone, blurred vision near CFLs, digestive problems or increased urge for urination from Wifi, a sense of internal pressure near powerlines, and disturbed sleep near a mobile phone mast. Some symptoms are dose-response but others are non-linear, since there are 'windows' of frequency to which individuals are sensitive and at which biological reactions, such as calcium flux, occur.

The diagnosis of ES is often by a self-diagnosis questionnaire on conscious symptoms. Studies indicate that some people who react subconsciously to EMF exposures, as shown by cardiovascular or EEG scans, do not also have conscious or immediate reactions.

ELECTROMAGNETIC HYPER-SENSITIVITY (EHS)

For some people, their ES develops in frequency and severity, with an increased range of more severe symptoms at lower levels and to a wider range of environmental exposures. This may result from cumulative exposure. It can also occur after a sudden increase in their environmental exposure, such as when a smart meter or Wifi is installed at home or at work, or a mobile phone mast or a neighbour's Wifi is activated nearby. This condition, called EHS and known since the 1970s, is a severe form of ES. It can cause functional impairment in an EMF environment and exclude the person from work, affecting about 0.1% of the general population.

The triggering process, although not yet fully understood, involves, at least for some people, changes to skin and mast cells, the autonomic nervous system, or genetic factors, where one genetic variant is almost ten times more common in people with EHS than in others (De Luca C et al, 2014). In addition, medical conditions affecting the myelin which protects the nervous system have been implicated, as has metal work inserted into the body.

A diagnosis of EHS requires a comprehensive medical history, including "all symptoms and their occurrences in spatial and temporal terms and in the context of EMF exposures" (Belyaev I et al, 2016). Common EHS and ES symptoms are the same, including headaches, concentration difficulties, sleep problems, depression, a lack of energy, fatigue, and flu-like symptoms. EMF exposure is measured at home and work (e.g. Bogers RP et al, 2018).

In the long term, the removal of the cause of the symptoms also removes the symptoms (Nordic Council of Ministers, ICD, 2000). For short-term tests, removal of the cause applies only to the particular frequency and modulation to which the individual is allergic, and even then individuals will react differently on different occasions, with different cumulative effects. Individual susceptibility is always variable. The human body is not an EMF meter, even if all

cells react to EMF exposures, just as some people lack conscious symptoms during the actual process of sunburn, a strong natural EMF environmental exposure, as opposed to afterwards.

Diagnostic tools for EHS include 3d fMRI scans (Heuser G et al, 2017) and genetic tests (De Luca C et al, 2014). A diagnostic marker can cover up to 40% of EHS cases. These include histamine and cortisol, saliva alpha amylas, nitrotyrosin and protein S100B for opening of the blood-brain barrier, autoantibodies against O-myelin for autoimmune effects, increased Hsp27 and/or Hsp70, decreased 24 h urine 6-hydroxymelatonin sulfate (6-OHMS)/creatinin ratio for impaired sleep and fatigue, and blood brain flow tests showing hypoperfusion in the capsulo-thalamic area implying an inflamed limbic system and thalamus (Belpomme D et al, 2015).

As with all multi-system chronic conditions, the pattern of all biomarkers and symptoms in relation to exposures and history is important, not one single marker. EHS involves "inflammation-related hyper-histaminemia, oxidative stress, autoimmune response, capsule-thalamic hypoperfusion and BBB opening, and a deficit in melatonin metabolic availability; suggesting a risk of chronic neurodegenerative disease" (Belpomme D et al, 2015). "~80% of EHS self-reporting patients present with 1, 2 or 3 detectable oxidative stress biomarkers [TBARs, MDA, GSS and NTT, and anti-oxidative: SOD, GSH and GPx] in their peripheral blood, meaning that these patients - as for cancer, Alzheimer's disease or other pathological conditions - present with a true objective new pathological disorder" (Irigaray P et al, 2018).

The key treatment is the prevention or reduction of EMF exposure at home and at work. The environment must be treated, as well as the person with EHS (Belyaev I et al, 2016).

ELECTROPHOBIA (EPh)

Electrohobia (EPh), also known as the nocebo effect and Idiopathic Environmental Intolerance attributed to Electromagnetic Fields (IEI-EMF), depends on prior cognitive conditioning. It is diagnosed by, or assumed from, self-reported conscious symptoms related to 'sham' exposures, but not by physiological markers for real EHS. It cannot apply to the unaware adults, young children or animals with real EHS, since they lack prior cognitive conditioning (Lamech F, 2014, Dieudonné M, 2016). Centres diagnosing EHS estimate that 1% with real EHS also have EPh or IEI-EMF. EPh or IEI-EMF has sometimes been confused with ES and EHS.

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