

GLOSSARY

AC

Alternating current. An electrical current whose magnitude and direction vary cyclically, as opposed to direct current, whose direction remains constant.

Action potential (nerve impulse or “spike”)

A sudden brief reversal of the local membrane electrical potential that occurs once a threshold depolarisation has been exceeded and which quickly propagates down a nerve axon conveying “digitally” encoded information.

Acute effect

Effect of short duration and occurring rapidly (usually in the first 24 h or up to 14 d) following a single dose or short exposure to a substance or radiation.

Adverse health effect

A biological effect which has a detrimental effect on mental, physical and/or general well being of exposed people, either in the short term or long term.

Antibody

A class of proteins produced by (B) lymphocytes that recognises and binds to a specific antigen, thereby aiding its elimination, or elimination of the agent, such as a bacterium, expressing it.

Antigen

Any substance, usually (but not always) foreign, that provokes an antigen-specific immune response, such as antibody-binding.

Apoptosis

A specific form of cell death during which cells degrade their own DNA. Apoptosis can occur normally during organ formation, or as a result of DNA or cellular damage.

Autonomic nervous system

A part of the peripheral nervous system that regulates the visceral or “house-keeping” functions of the body, such as heart-rate and blood pressure. Its cell bodies lie either in the central nervous system, or in ganglia in other parts of the body.

Background levels

The amounts of EMF found (that are not due to an obviously specific source) in a typical environment of an industrialized society.

Basic restrictions

Restrictions on exposure to time-varying electric, magnetic, and electromagnetic fields that are based directly on established health effects. Depending upon the frequency of the field, the physical quantities used to specify these restrictions are induced electric field (E), current density (J), specific energy absorption rate (SAR), and power density (S). Only power density in air, outside the body, can be readily measured in exposed individuals.

Bias

A systematic tendency to error as a consequence of the design or conduct of a study.

Biological effect

A measurable change in a biological system in response (for example) to an electromagnetic field.

Biophysical mechanisms

Physical and/or chemical interactions of electric and magnetic fields with biological systems.

Blind study

A study in which the subject or, in the case of studies using animals, tissues or cell cultures, the experimenter, is unaware of whether exposure is to the agent under test or to a neutral or comparison agent until completion of the experiment, in order to avoid unconscious subjective bias affecting the study outcome.

Blood-brain barrier

A physiological “barrier” comprising endothelial and epithelial cells that regulates the composition of cerebrospinal fluid of the central nervous system.

Calcium efflux

The release of calcium ions from a sample into a surrounding solution.

Cancer

An uncontrolled and abnormal proliferation of cells that causes disease.

Carcinogen

An agent that can induce cancer.

Carcinoma

A tumour arising from epithelial tissue (e.g. glands; breast; skin; linings of the urogenital, intestinal and respiratory systems).

Case-control study

An investigation into the extent to which a group of persons with a specific disease (the cases) and comparable persons who do not have the disease (the controls) differ with respect to exposure to putative risk factors.

Causal relationship

A causal relationship occurs between two agents when one causes the other. For example, researchers are studying whether there is a causal relationship between EMF and cancer, meaning that they are studying to see if EMF causes, or affects the progress of, cancer.

Cell signalling (pathways)

A sequence of intracellular changes linking a “signalling event”, such as activation of membrane-bound ion channels or ligand-receptors, and a “response”, such as a change in gene expression, for example, leading to increased proliferation.

Central nervous system (CNS)

Usually taken to mean the cells, such as neurons and glial cells, of the brain and spinal cord. It also includes the retina, which is formed as an outgrowth of the forebrain.

Chromosome

A single molecule of DNA, comprising a large number of genes and other DNA, together with associated protein molecules that condense during cell division to form a deeply staining, rod-shaped body.

Chronic effect

Consequence which develops slowly and has a long-lasting course (often but not always irreversible).

Circularly polarized

If the electric field is viewed as a point in space, the locus of the end point of the vector will rotate and trace out an ellipse, once each cycle.

Cognition

Information processing by the brain, including processes such as attention, perception, learning, reasoning, comprehending and memory.

Cohort study

An investigation involving the identification of a group of individuals (the cohort) about whom certain exposure information is collected, and the ascertainment of occurrence of diseases at later times. For each individual, information on prior exposure can be related to subsequent disease experience. Cohort studies may be conducted prospectively or retrospectively.

Combined analysis

Analysis of data pertaining to the same topic that have been collected in several different studies. Usually based on individual level data from each of the available studies, rather than on the published findings (see Meta analysis).

Comet assay

A single cell electrophoresis assay in which DNA is caused to migrate away from the nucleus by an applied electric field. The extent of migration gives a measure of DNA damage.

Conductance

The reciprocal of resistance. Symbol: G. Unit: siemens (S).

Conductivity, electrical

The scalar or vector quantity which, when multiplied by the electric field strength, yields the conduction current density; it is the reciprocal of resistivity. Expressed in siemens per meter ($S\ m^{-1}$).

Confidence interval (CI)

An interval calculated from data when making inferences about an unknown parameter. In hypothetical repetitions of the study, the interval will include the parameter in question on a specified percentage of occasions (e.g. 90% for a 90% confidence interval).

Confounding

Spurious findings due to the effect of a variable that is correlated with both the exposure and disease under study.

Contact current

Current flowing between an energized, isolated, conductive (metal) object and ground through an electrical circuit representing the equivalent impedance of the human body.

Continuous exposure

Exposure for durations exceeding the corresponding averaging time. Exposure for less than the averaging time is called short-term exposure.

Continuous wave (CW)

A wave whose successive oscillations are identical under steady-state conditions.

Coronary thrombosis

A blood clot which blocks one of the coronary arteries, leading to a heart attack.

Current density

A vector of which the integral over a given surface is equal to the current flowing through the surface; the mean density in a linear conductor is equal to the current divided by the cross-sectional area of the conductor. Unit: ampere per square meter ($A\ m^{-2}$).

Diastole

The period of relaxation of heart muscle, following contraction (systole).

Dielectric constant

See Permittivity.

Dielectric material

A class of materials that act as electric insulators. For this class, the conductivity is presumed to be zero, or very small. The positive and negative charges in dielectrics are tightly bound together so that there is no actual transport of charge under the influence of a field. Such material alters electromagnetic fields because of induced charges formed by the interaction of the dielectric with the incident field.

Differentiation (cellular)

The development of a specialised cellular structure and function from less specialised “precursor” cells such as stem cells which is generally accompanied by a loss of proliferative capacity.

Dipole

A centre-fed open antenna excited in such a way that the standing wave of current is symmetrical about the mid point of the antenna.

Dose

A term for the amount of a chemical or physical agent delivered to a target organ. Since neither the target organ nor the mechanism of delivery are well understood for most biological effects of EMF fields, an EMF dose can sel-

dom be defined, and the concept of exposure metric (see below) is used instead.

Dose-response relationship

Mathematical description of the relationship between the dose and occurrence of the disease.

Dosimetry

Measurement or determination by calculation of the internal electric field strength or induced current density, or of the specific absorption (SA) or specific absorption rate (SAR) distribution in humans or animals exposed to electromagnetic fields.

Double blind study

A volunteer study in which the subject and the experimenter until completion are unaware of whether exposure is to the agent under test or to a neutral or comparison agent, in order to avoid unconscious subjective bias affecting the study outcome.

Duty factor

The ratio of the sum of pulse durations to a stated averaging time. For repetitive phenomena, the averaging time is the pulse repetition period.

Electric and magnetic fields or electromagnetic fields (EMF)

The combination of time-varying electric and magnetic fields.

Electric field

A vector field E measured in volts per metre ($V\ m^{-1}$).

Electric field strength (E)

Force exerted by an electric field on an electric point charge, divided by the electric charge. Expressed in newtons per coulomb or volts per metre ($N\ C^{-1} = V\ m^{-1}$).

Electrical ground

The earth or a metal surface placed in contact with the earth, or connected to the earth with a conductor.

Electrocardiogram (ECG)

A recording of the electrical activity of the heart from electrodes placed on the body.

Electroencephalogram (EEG)

A recording of the electrical activity of the brain from electrodes placed on the head.

Electromagnetic energy

The energy stored in an electromagnetic field. Expressed in joule (J).

Electromagnetic interference (EMI)

Degradation of the performance of a device, a piece of equipment, or a system caused by an electromagnetic disturbance.

Electroretinogram (ERG)

A recording of the electrical activity of the retina from electrodes placed on the surface of the eye and the head.

Embryo

The stage of prenatal development between the fertilised ovum and the completion of major organ development. In humans, this occurs in the first trimester.

Enteric nervous system

Comprises the intrinsic neurons of the gut, about the same in number (approximately 100 million) as those of the spinal cord, and which exhibit a high degree of independence from the central nervous system.

Epidemiology

The study of the distribution of disease in populations and of the factors that influence this distribution.

Epilepsy

Epileptic seizures arise from an excessively synchronous and sustained discharge of a group of neurons; a persistent increase in neuronal excitability is a key feature.

Event-related (or evoked) potential (ERP or EP)

A recording of the electrical activity of the brain after a stimulus event, such as a visual or auditory stimulus (resulting in VEPs and AEPs respectively). Late components are associated with cognitive processing.

Exposure

The subjection of a person to electric, magnetic, or electromagnetic fields or to contact currents other than those originating from physiological processes in the body and other natural phenomena.

Exposure standard

A standard that limits EMF exposure to humans. See Standard.

Exposure, intermittent

This term refers to alternating periods of exposure and absence of exposure varying from a few seconds to several hours. If exposure lasting a few minutes to a few hours alternates with periods of absence of exposure lasting 18-24 hours (exposure repeated on successive days), “repeated exposure” might be a more appropriate term.

Exposure, long term

This term indicates exposure during a major part of the lifetime of the biological system involved; it may, therefore, vary from a few weeks to many years in duration.

Exposure metric

A single number that summarizes an electric and/or magnetic field exposure over a period of time. An exposure metric is usually determined by a combination of the instrument’s signal processing and the data analysis performed after the measurement.

Exposure, partial-body

Exposure that results when EMF are substantially non-uniform over the body. Fields that are non-uniform over volumes comparable to the human body may occur due to highly directional sources, standing waves, re-radiating sources, or in the near field region of a radiating structure.

Exposure, short term

Exposure for durations less than the corresponding averaging time.

Exposure, whole-body

Pertains to the case in which the entire body is exposed to the incident electromagnetic energy or the case in which the cross section (physical area) of the body is smaller than the cross section of the incident radiation beam.

Extremities

Limbs of the body.

Fetus (foetus)

The stage of prenatal development between the embryo and birth.

Fibrillation (ventricular)

The loss of organised ventricular contractions of the heart.

Field strength

The magnitude of the electric or magnetic field, normally the root-mean-square value.

Free radicals

Highly reactive chemical species (part of a molecule) with an unpaired electron.

Free space

An ideal perfectly homogeneous medium possessing a relative dielectric constant of unity, in which there is nothing to reflect, refract, or absorb energy. A perfect vacuum possesses these qualities.

Frequency

The number of cycles completed by electromagnetic waves in 1 s; usually expressed in hertz (Hz).

Frequency response

An instrument's output as a function of frequency relative to the magnitude of the input signal. Specification of an instrument's frequency response includes the type of filter and its bandwidth.

Gene expression

The production of a functional protein or an RNA molecule from genetic information (genes) encoded by DNA.

Genotoxin

An agent which damages DNA and RNA.

Geomagnetic fields

Magnetic fields originating from the earth (including the atmosphere). Predominantly a static magnetic field, but includes some oscillating components and transients.

Guideline

A recommended limit for a substance or an agent intended to protect human health or the environment.

Haematology

The study of blood; its formation, normal composition, function and pathology.

Harmonic

A frequency which is a multiple of the frequency under consideration.

Health

A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

Health hazard

A biological effect that is detrimental to health or well-being.

Immune system

The body's primary defence against abnormal growth of cells (i.e. tumours) and infectious agents such as bacteria, viruses, and parasites.

Impedance, wave

The ratio of the complex number (vector) representing the transverse electric field at a point, to that representing the transverse magnetic field at that point. Expressed in ohm (Ω).

Implantation

The attachment of the early embryo to the uterine wall.

In vitro

Experimental studies of cells or tissues, usually in a sustaining oxygenated, fluid medium. Literally means "in glass", isolated from the living organism and artificially maintained, as in a test tube or culture dish.

In vivo

Occurring within the whole living body. 'In life'; experimental studies of processes in living organisms.

Latency

The time between exposure to an injurious agent and the manifestation of a response.

Leukocyte

A white blood cell.

Lymphocyte

White blood cells produced in lymphoid tissue that initiate adaptive, antigen-specific immune responses. Some T-lymphocytes are cytotoxic; B-lymphocytes secrete antibodies.

Macrophage

A phagocytic cell derived from myeloid progenitor cells found in various tissues.

Magnetic field strength (H)

A field vector, H , that is equal to the magnetic flux density divided by the permeability of the medium. Expressed in units of amperes per meter ($A\ m^{-1}$).

Magnetic flux density (B)

The force on a moving unit positive charge at a point in a magnetic field per unit velocity. A vector field quantity, B , expressed in tesla (T).

Malignant

Neoplasms or tumours that have become invasive.

Meta-analysis

Analysis of data pertaining to the same topic that have been collected in several different studies. Usually refers to an analysis based on published findings from individual studies, rather than on the original data sets (see Combined analysis).

Metabolic rate

See Resting metabolic rate.

Metabolism

The biochemical reactions by which energy is made available for the use of an organism from the time a nutrient substance enters, until it has been utilized and the waste products eliminated.

Metastasis

Tumour cells that leave their site of origin and migrate to other sites in the body.

Micronucleus

Chromosome fragments that have not been lost on cell division.

Mutation

A stable heritable change in the DNA at a specific site in the genome of a cell by an agent (mutagen) such as ionising radiation.

Natural killer (NK) cells

Lymphocytes that are not antigen-specific but nevertheless bind to and kill certain tumour and virus-infected cells.

Neonate, neonatal

Newly born.

Neoplasm

New growth of abnormal tissue.

Neural network

Group of interacting neurons.

Neural tube defect

A defect of the newly formed precursor of the central nervous system, commonly anencephaly (failure of brain to develop), encephalocele (cyst of the brain), and spina bifida (defects in the closure of the neural tube).

Neuron

Nerve cell, specialised for the transmission of neural information.

Neurotransmitter

A substance released by a neuron that causes a post-synaptic response that is relatively quick in onset (< 1 ms) and short ($< 10^2$ ms) in duration, as distinct from the more prolonged action of neuromodulators.

Neutrophil

Phagocytic white blood cells derived from myeloid progenitor cells.

Non-differential measurement errors

Errors in exposure assessment that do not depend on whether or not someone develops the disease under study.

Occupational exposure

Exposure experienced by adults who are generally exposed under known conditions and are trained to be aware of potential risk and to take appropriate precautions.

Odds ratio

The ratio of the odds of disease occurrence in a group with exposure to a factor to that in an unexposed group; within each group, the odds are the ratio of the numbers of diseased and non-diseased individuals.

Oncogene

A gene which contributes to cancer in a dominant fashion through the mutation and/or abnormal expression of a gene (proto-oncogene) involved in regulating cell proliferation.

Operant behaviour

Behaviour, such as pressing a lever, which is “shaped” by rewards (such as food pellets) or punishment (such as a mild electric shock).

Organogenesis

The process of organ formation in developing organisms.

Peripheral nervous system (somatic)

The part of the nervous system that mainly deals with the voluntary and conscious aspects of neural control such as voluntary muscle (motor) contraction and sensations such as those of warmth or pressure. The cell bodies lie within the spinal cord, but the peripheral nerves (axons) terminate on muscle fibres or in specialised sensory receptors throughout the body.

Permeability

The scalar or tensor quantity whose product by the magnetic field strength is the magnetic flux density. Note: For isotropic media, the permeability is a scalar; for anisotropic media, a matrix.

Synonym: absolute permeability. If the permeability of a material or medium

is divided by the permeability of vacuum (magnetic constant) μ_0 , the result is termed relative permeability (μ). Unit: henry per metre (H m^{-1}).

Permittivity; dielectric constant

A constant defining the influence of an isotropic medium on the forces of attraction or repulsion between electrified bodies. Symbol: ϵ . Unit: farad per metre (F m^{-1}).

Permittivity, relative

The ratio of the permittivity of a dielectric to that of a vacuum. Symbol: ϵ_r .

Phase

Of a periodic phenomenon, the fraction of a period through which the time has advanced relative to an arbitrary time origin.

Phosphene

The perception of flickering light in the periphery of the visual field induced by non-visual means such as a trans-retinal electric current.

Prospective study

An epidemiological study in which data on exposures and disease outcome are collected as the events occur, unlike a retrospective study (see below). Some cohort studies are conducted prospectively.

Public exposure

All exposure to EMF experienced by members of the general public, excluding occupational exposure and exposure during medical procedures.

Recall bias

Bias resulting from the tendency of a class of subjects to recall relevant events better than other subjects.

Reference level

EMF exposure level provided for practical exposure assessment purposes to determine whether the basic restrictions are likely to be exceeded. Some reference levels are derived from relevant basic restrictions using measurement and/or computational techniques and some address perception and adverse indirect effects of exposure to EMF.

Reinforcement (behavioural)

An action such as reward or punishment that increases the likelihood of a certain behaviour.

Relative risk

The ratio of the disease rate in the group under study to that in a comparison group, with adjustment for confounding factors such as age, if necessary.

Reproductive effects

Effects on reproduction which may include, but not be limited to, alterations in sexual behaviour, onset of puberty, fertility, gestation, parturition, lactation, pregnancy outcomes, premature reproductive senescence, or modifications in other functions that are dependent on the integrity of the reproductive system.

Resonance

The change in amplitude occurring as the frequency of the wave approaches or coincides with a natural frequency of the medium.

Retrospective study

An epidemiological study in which data on exposures and disease outcome are collected some time after the event, unlike a prospective study (see above). Examples include case-control studies and some cohort studies.

Root-mean-square (RMS)

Certain electrical effects are proportional to the square root of the mean value of the square of a periodic function (over one period). This value is known as the effective value or the root-mean-square (RMS) value, since it is derived by first squaring the function, determining the mean value of the squares obtained, and extracting the square root of the mean value to determine the end result.

Safety factor

A reduction factor incorporated into limits in standards or guidelines that allows for uncertainties in the determination of a threshold level of exposure, above which established health effects begin to appear.

Selection bias

Bias resulting from a faulty way to select subjects for a study. Epidemiological studies depend on a reliable comparison between subjects with a disease and a reference population as to their exposure. If the subjects chosen for a study are not representative of the corresponding population, the comparison becomes flawed and the association between disease and exposure becomes biased.

Shield

A mechanical barrier or enclosure provided for protection. The term is modified in accordance with the type of protection afforded; e.g., a magnetic shield is a shield designed to afford protection against magnetic fields.

Short term exposure

See exposure, short term

Significance level

The probability of obtaining a result at least as extreme as that observed in the absence of a raised risk. A result that would arise less than 1 in 20 times in the absence of an underlying effect is often referred to as being “statistically significant”.

Sinus arrhythmia

The normal variation of heart rate during the breathing cycle.

Spatial average

The root mean square of the field over an area equivalent to the vertical cross section of the adult human body, as applied to the measurement of electric or magnetic fields in the assessment of whole-body exposure.

Spot measurements

Magnetic field measurements taken at various individual locations throughout a room or area.

Standard

- 1) A documented agreement containing technical specifications or other precise criteria to be used consistently as rules, guidelines or definitions of characteristics to ensure that materials, products, processes and services are fit for their purpose.
- 2) A legally enforceable limit for a substance or an agent intended to protect human health or the environment. Exceeding the standard could result in unacceptable harm.

Static field

A field vector that does not vary with time.

Statistical power

The probability that, with a specified degree of confidence, an underlying effect of a given magnitude will be detected in a study.

Synapse

A junction between two neurons, or between a neuron and a muscle fibre, that allows the transmission of electrical information, usually by means of a chemical transmitter (neurotransmitter) released from the presynaptic terminal of one neuron onto the closely juxtaposed post-synaptic terminal of the other.

Systole

The period of contraction of heart muscle following relaxation (diastole).

Teratogen

An agent that can cause birth defects.

Threshold

The lowest dose of an agent at which a specified measurable effect is observed and below which it is not observed.

Thrombosis

Blocking of an artery or vein by a blood clot.

Time-weighted average (TWA)

The average of various measurements, each of which is given more or less weight according to how much time a person is likely to spend in the spot where that measurement was taken. The term is used more generally to indicate the average of field levels over a specific amount of time. This is one method used to summarize exposure to exposure to magnetic fields.

Transcription factor

A protein that binds to a DNA sequence with a “regulatory” function thereby, directly or indirectly, affecting the initiation of transcription.

Transformation

Conversion of cells to a state of unrestrained growth in culture, resembling or identical with a tumour-forming (tumorigenic) state.

Transgenic organism

A genetically modified organism, which has foreign DNA such as a gene stably integrated into its genome.

Transients

Brief bursts of high frequency fields, usually resulting from mechanical switching of AC electricity.

Transmission lines

High voltage power lines that carry large quantities of power over large distances.

Tumour

A growth of tissue resulting from abnormal cell proliferation.

Tumour initiator

An agent that can produce an initial carcinogenic event such as a mutation.

Tumour progression

The process by which initiated and promoted cells become increasingly malignant.

Tumour promoter

An agent that can stimulate the proliferation (clonal expansion) of initiated cells.

Tumour suppressor gene

A normal cellular gene involved in regulating cell proliferation whose mutation and/or abnormal expression can contribute to cancer in a recessive manner.

Vasoconstriction

The contraction of blood vessels, making them narrower.

Vasodilatation (or vasodilation)

The relaxation of blood vessels, making them wider.

Vigilance tasks

Responding to unusual and infrequent stimuli (signals) occurring against a background of usual and frequent stimuli (events). Vigilance can be either visual or auditory.

Voltage-gated ion channel

Cell membrane proteins that allow the passage of particular ion species across the cell membrane in response to the opening of a molecular “gate” which is steeply sensitive to the transmembrane voltage. They are associated with electrical excitability.

Wavelength (λ)

The distance between two successive points of a periodic wave in the direction of propagation, in which the oscillation has the same phase. Symbol: λ . Unit: metre (m).

Wild type (gene)

The gene that is found in nature or in the standard laboratory stock for a given organism.

Working memory

An active system for temporarily storing and manipulating information needed in the execution of complex cognitive tasks.

