



## Interpreting Epidemiology

Studies have been conducted of human populations investigating possible associations between exposure to radiofrequency signals from mobile phones and broadcast towers and adverse human health effects. Whilst these studies have received public attention, their interpretation is not straightforward. Furthermore, while epidemiological studies can indicate possible factors influencing health they cannot unequivocally prove causation.

### What is Epidemiology?

Epidemiologists study *statistical associations* between risk factors and patterns of illness that occur in human populations. Through epidemiology we have been able to learn a great deal about disease incidence and causes of disease. Such studies are important for health risk assessments as they directly study people, however, they must be interpreted with caution.

### Conducting an Epidemiological Study

Every study must first begin with a clear and fixed definition of one or more *hypotheses* (ideas) regarding what risk factors and illnesses are to be tested. Appropriate study populations are then selected, and their exposure to the agent under study is assessed. Studies may be *prospective* (following the future developing pattern of exposure and illness) or *retrospective* (examining past exposures and present illness). The most common study types are *cohort*, *case control* and *ecological*.

### Cohort

These studies follow a group of healthy people with different exposure levels and assess what happens to their health over time. In these studies exposure precedes the disease, which is necessary to establish possible causation. Whilst expensive and time consuming these studies suffer least from bias as they make fewer assumptions about the study subjects. Cohort studies are most useful for relatively common diseases.

### Case Control

These studies compare past exposure of individuals with a particular disease (*cases*) and those without the disease (*controls*) to assess whether the exposure increases risk. They have a higher potential for *bias*, but are cheaper and often quicker to conduct than cohort studies. They also allow study of rare diseases with smaller study sizes.

### Ecological

These studies (also known *correlation studies*) describe patterns or trends of disease on a geographic or community-level. However, ecological studies are the least informative, as they cannot reliably estimate individual exposures.



### **Bias, Confounding and Exposure**

The results of epidemiological studies, whether they show an association or not, will often be affected by limitations of the study design or analysis. Results may be influenced by errors or unidentified bias in the data, the influence of other relevant factors, or by chance variation. *Selection bias* can be minimised by choosing comparison populations that are similar (e.g. age, sex, socio-economic, etc) except for the exposure under study. In case control studies, bias in exposure assessments may arise in a subject's ability to recall and report past exposures (*recall bias*). Another important issue is *confounding*, whereby a (potentially unrecognised) factor is both a risk factor for the disease and associated with the exposure of interest. *Exposure misclassification* will also affect the strength of the results.

A challenge for RF epidemiology is the quality of assessment of RF exposure, ideally this should assess the exposures induced inside the body.

### **Strength of Association**

The strength of an association between exposure and disease is most commonly stated as a relative risk or an odds ratio.

The *relative risk* is defined as the ratio of the incidence rate of the disease in exposed group to the incidence rate in unexposed group.

The *odds ratio* is defined differently for cohort and case-control studies but approximates the relative risk when the disease is rare.

The risk estimates will also have quoted an estimate of the statistical uncertainty termed the *confidence interval*. Where the lower bound of the confidence interval goes below 1, the finding is stated as not being *statistically significant*. The statistical uncertainty may also be quoted as a p-value, by convention when this is  $<0.05$ , the result is termed statistically significant.

### **Association not Causation**

Epidemiological studies cannot establish a clear cause and effect relationship, mainly because they detect only statistical associations between exposure and disease, which may or may not be caused by the exposure.

The five main criteria for establishing a likely association are the *strength of association* (the relationship must be clear), *consistency* (repeatable in other study populations), *temporality* (cause must precede the disease), *plausibility* (it must make sense biologically) and *biological gradient* (dose-response relationship).

Epidemiology is strongest when the risk increase is large. For small risk increases scientists may be divided about how to interpret the results.



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### **Where to go for more information**

GSMA: <http://www.gsmworld.com/health>