Back to basics: environmental health concepts often confused

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Exposure versus Dose

Source: http://www.tpchd.org/files/library/a0db302320aed741.pdf

- *Exposure* refers to a part of the body coming into contact with an agent

  An agent can be chemical (such as benzene or mercury), biological (such as bacteria or pollen) or physical (radiation)

  Exposure can happen through inhalation, ingestion or dermal contact

- *Dose* refers to an agent that has passed the body's defence mechanisms

  Dose is typically measured as unit of the agent per unit of body weight (for example milligrams of chemical/kilogram of body weight).

In vitro versus *In vivo*

- *In vitro* refers to any process that happens outside of the body, for example in a test tube

- *In vivo* refers to any process that happens inside the body

Incidence versus prevalence

- *Incidence* refers to “new” cases, and is usually expressed as the number of new cases per 100 000 of the population over a specified time period (usually one year)
  - Example: Incidence of TB in SA between 2000 and 2010 was 981/100 000/year

    (WHO 2012 Stats report)

- *Prevalence* refers to “existing” cases and is normally presented as a percentage.
  - Example: Prevalence of HIV in SA = 11.23% (WHO 2012 Stats report)

Morbidity versus mortality

- *Morbidity* refers to disease

- *Mortality* refers to death

Acute versus chronic

- *Acute* refers to a short period of time, mostly less than 24 hours but generally less than 14 days
  - Acute exposure considers exposure over a period of less than 1 hour up to 14 days
  - Acute effects refer to effects that may present shortly after exposure and which may be short lived

- *Chronic* refers to long-term
  - Chronic exposure considers exposure over a period of longer than 3 months, but generally refers to exposure of one year or longer
  - Chronic effects refer to effects that may last for years or a life time and may include effects that only present long (i.e. several years) after exposure

Epidemiology vs toxicology

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- *Epidemiology* from “epi” (among) and “demos” (people) refers to the study of the distribution of health-related conditions (diseases) in populations

- *Toxicology* refers to studies under controlled conditions (in laboratories); mostly involving animals

Relative Risk (RR)and Odds ratio (OR)

- OR and RR measures the statistical strength between a risk factor (for example an exposure) and an outcome (for example a disease)

  A risk factor is a factor found to be statistically significant associated with an outcome, and may be a possible cause of the outcome

- *RR* is the risk of an event happening (such as developing a disease) relative to a particular exposure. It indicates the risk of the outcome (disease) in the exposed group in comparison to another group (regarded as not exposed)

$$\frac{\text{Risk (of disease) among the Exposed Group}}{\text{Risk (of disease) among the not exposed (Control) Group}}$$

A relative risk of 1 means there is no difference in risk between the two groups
A relative risk of > 1 means the event is more likely to occur in the exposed group than in the control group.
A relative risk of < 1 means the event is less likely to occur in the exposed group than in the control group.

Odds ratio

The OR represents the **odds** that an outcome (disease) will occur given a particular exposure, compared to the **odds** of the outcome occurring in the absence of that exposure and may be defined as:

$$\frac{\text{Odds of exposure in the } \mathbf{Group\ with\ disease}}{\text{Odds of exposure in the } \mathbf{Control\ Group\ (without\ disease)}}$$

OR calculated as:

$$\frac{[(\text{exposed and ill}) \times (\text{not exposed and not ill})]}{[\text{exposed and not ill}) \times (\text{not exposed and ill})]}$$

- A value of 1.0 means there is no difference in odds between two groups
- OR <1.0 indicates that being in the exposed/selected group *decreases* the odds of experiencing the outcome,
- OR >1.0 indicates that being in the exposed/selected group *increases* the odds of experiencing the outcome.

95% Confidence interval (CI)

- A **confidence interval** gives an estimated range of values which is likely to include an unknown population parameter of interest, with the estimated range being calculated from a given set of sample data.
- A confidence interval has an upper and a lower boundary (range of the CI) and, in the case of a 95% confidence level, indicates that you are 95% sure that a certain value will fall between those two boundaries

For example in a poll of election voting-intentions, the result might be that 40% of respondents intend to vote for a certain party. A confidence interval with a 95% confidence level, for the proportion in the whole population having the same intention from the survey data might be 36% to 44%. Thus we are 95% sure that the % of voters (intending to vote for the particular party) are between 36 and 44 %.

All other things being equal, a survey result with a small CI is more reliable than a result with a large CI. One of the main factors controlling this interval in the case of population surveys, is the size of the population sampled

P-value

- *P value* -- statistical piece of evidence, which tells you how likely it is that the association that you have found, is purely by chance.

- *P-values* range from 0 (no chance) to 1 (absolute certainty that it is purely by chance).

- The p-value does not refer to the probability of the association being the truth, but refers to the degree of certainty that the association is not by chance

Vulnerability versus susceptibility

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In the current context:

- *Vulnerability* represents the interface between exposure to a threat or hazard (which may include physical, biological or chemical agents) to human health and well-being and the capacity to cope with those threats or hazards

- *Susceptibility* refers to intrinsic factors (such as age, existing diseases and genetic make-up) that may render a person more vulnerable to a hazard.

Emission versus concentration in terms of air pollution

- *Emission* is measured in weight per time (grams/second)

  Example: a gas or particles emitted through a stack or a vehicle's tail pipe

- *Concentration* of an air pollutant is measured in weight per volume (mg/m^3) and may be determined in ambient or indoor air

Modelling versus monitoring

- *Modelling* - Concentrations of pollutants that people may be exposed to in the environment can be determined through mathematical models. If the concentration in air is being modelled, inputs into such a model would include emissions from a stack, as well as climate and topography parameters

- *Monitoring* - Concentrations of pollutants in the environment may also be monitored (measured). Monitoring may involve taking samples and having them analysed in a laboratory, or directly reading concentrations from an instrumentation

Active versus passive air monitoring/sampling

- During *active monitoring/sampling*, air is actively drawn into an instrument that can either give a direct reading, or may sample the pollutant (for example onto a filter) for subsequent analysis

- During *passive monitoring/sampling* air diffuses onto a substrate (for example a filter)

Global warming and the hole in the ozone layer

- *Global warming* refers to the gradual increase in the temperature of the earth's climate systems (including atmosphere and oceans) due to increased emissions of greenhouse gases (such as carbon dioxide and methane)

- *The hole in the* (stratospheric) *ozone layer* as a result of chloro-fluoro carbons (CFCs) emitted in the troposphere, results in more harmful UV rays from the sun reaching the surface of the earth

Weather versus climate

- *Weather refers to* cold fronts, tropical cyclones, heatwaves etc. which may change on a daily basis

- *Climate* refers to the average of weather conditions, occurring over a long period of time; 30 years or longer

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