

Occupational Hygiene

Occupational Hygiene - Occupational Disease

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What is an occupational disease?

An occupational disease is a health condition or disorder (e.g., cancer, musculoskeletal disorders, post-traumatic stress, etc.) that is caused by your work environment or activities related to your work. In general, health conditions or disorders that occur among a group of people with similar occupational exposures at a higher frequency than the rest of the population are considered to be occupational diseases.

How are occupational diseases identified?

Determining if exposure at the workplace (the “cause”) results in occupational disease (the “effect”) is a complex issue. Many criteria must be considered. One set of criteria that is commonly used is credited to Dr. Bradford Hill from 1965. While Bradford Hill did not intend this list to be used as a checklist, it often is. Rather, he intended these considerations as a starting point, saying that “none of my nine viewpoints can bring indisputable evidence for or against the cause-effect hypothesis, and none can be required as an essential element or condition. What they can do, with greater or less strength, is to help us to make up our minds on the fundamental question – is there any other way of explaining the set of facts before us, is there any other answer equally, or more, likely than cause and effect?”

1. Strength of Association

The stronger the association, the more likely that the relationship is causal. Heavy smoking is associated with 20 times the increased risk of lung cancer and only 2 times the increased risk of coronary heart disease. The association between smoking and lung cancer is far more likely to be causal than the association with heart disease.

2. Consistency

The association is consistent when the results are confirmed by different people, in different places, circumstances and times, using different experimental methods. This consideration is why many different studies need to be done before meaningful statements can be made about the causal relationship between two or more factors. For example, it required thousands of highly technical studies of the relationship between cigarette smoking and cancer before a definitive conclusion could be made that cigarette smoking increases the risk of lung cancer.

Tools like a “meta-analysis” means that studies that meet certain inclusion criteria are gathered and analyzed together. The conclusions from meta-analyses are much stronger than those from a single or a few studies.

3. Specificity of Association

Specificity of association means that there is a one-to-one relationship between the cause and effect, or one cause equals one effect. An example of specificity of association is mesothelioma (a form of cancer) that is believed to be only caused by asbestos exposure – it is a one-to-one relationship.

Specificity of association is considered by some to be the weakest criterion of causation. For example, it does not hold true for cigarette smoking and lung cancer. If you smoke, you do not have a 100% chance of developing lung cancer. Likewise, if you have lung cancer, it does not mean that it is 100% certain that you were exposed to cigarette smoke.

4. Temporal Relationship

The exposure must always precede (come before) the outcome or effect. This consideration is essential. If smoking is a cause of lung cancer, the smoking must occur before the cancer, not after.

5. Biological Gradient (Dose-Response Relationship)

Biological gradient refers to exposure levels and resulting health effects. An increase in the exposure increases the effect or disease incidence; a lower exposure decreases the effect. The presence of a dose-response relationship is strong evidence for a causal relationship. If you consider our smoking and cancer example, light smokers would be less likely to develop lung cancer than moderate smokers, and both of these would be less than heavy smokers – this effect is known as a dose-response relationship.

However, a threshold may exist below which the effect of interest will not be seen. Stated another way, the exposure may be so low that the effect is not observed or is very rarely observed – this observation does not mean that the exposure does not cause the effect.

In addition, sometimes a low exposure may produce no effect, a moderate exposure may produce a beneficial effect (e.g., a drug or vitamin), and a high exposure may cause harm.

6. Plausibility

Plausibility asks, "Does the observed relationship make sense considering current scientific knowledge of the pathological processes." For example, one may, by chance, discover an association between the price of Tim Horton's donuts and election results in a country other than Canada, but there is not likely to be any logical connection between the two phenomena. Also, consider the concept of latency – was the timing of exposure and disease development biologically plausible?

7. Coherence

Coherence means that the association should not conflict with existing theory and knowledge. In other words, it is necessary to evaluate claims of causality within the context of the current state of knowledge within a given field and in related fields. However, remember that research that disagrees with established theory is not necessarily false; it may, in fact, force a reconsideration of accepted beliefs and principles.

The difference in Bradford Hill's definitions of plausibility and coherence is subtle. Plausibility is worded positively (an association should be in line with substantive knowledge). Coherence is verbalized negatively (the association should not conflict with substantive knowledge). Plausibility asks: "Could you imagine a mechanism that, if it had truly operated, would have produced results such as those observed?" By contrast, coherence asks: "If you assume that the established theory is correct, would the observed results fit into that theory?"

8. Experimental Evidence

Does experimental evidence support the cause/effect relationship? Can researchers design an experimental study to confirm the observed relationship? In a workplace setting, if the dust in the workshop is reduced or lubricating oils are changed, do you get different results? Is the frequency of associated events (asthma or skin rashes) reduced?

9. Analogy

With analogy, knowing that a drug like thalidomide or a virus like Rubella can cause birth defects makes us more willing to accept similar evidence when attributing these effects to a closely related drug or virus.

Current science relies on this type of consideration with information from computer generated structure-activity relationships for chemicals. This type of information helps identify the potential for harm so that expensive human populations and animal studies can be more targeted or avoided completely.

Adapted from: A. Bradford Hill. The Environment and Disease: Association or Causation? Proceedings of the Royal Society of Medicine, 58 (1965), 295-300

As noted above, making associations of cause and effect must be done with caution. Other authors caution that:

- Statistical significance should not be mistaken for evidence of a substantial association.
- Association does not prove causation (other evidence must be considered).
- Precision should not be mistaken for validity (non-random errors exist).
- Evidence (or belief) that there is a causal relationship is not sufficient to suggest action should be taken.
- Uncertainty about whether there is a causal relationship (or even an association) is not sufficient to suggest action should not be taken.

Source: Phillips and Goodman. "The missed lessons of Sir Austin Bradford Hill",
Epidemiologic Perspectives & Innovations 2004, 1:3

What factors may contribute to the development of occupational diseases?

Occupational diseases can be caused by:

- Biological agents- bacteria, viruses, fungi, parasites, insects, plants, birds, animals, humans, etc.
- Chemical agents- beryllium, lead, benzene, isocyanates, etc.
- Ergonomic issues- repetitive movements, improper set up of workstations, poor lighting, poor design of tools, etc.
- Physical agents - ionizing and non-ionizing radiation, magnetic fields, pressure extremes (high pressure or vacuum), extreme temperatures, noise, vibration, etc.
- Psychosocial issues- stress, violence, bullying, harassment, lack of recognition, etc.

There are other factors that determine the development of an occupational disease, including:

- Amount of exposure or dose entering the body
- Duration or length of exposure
- Route of entry into the body
- Toxicity of the chemical
- Removal from the body
- Biological variation (individual susceptibility)

- Effects of interaction, such as [synergism](#) (e.g., smoking, alcohol use, exposure to other chemicals).

Exposure to the hazardous agent may occur only once in a while or only in very small amounts, or the exposure may be daily and/or in very large amounts. The number of weeks or years on the job may provide an estimate of the degree of exposure. In general, the higher the exposure (duration and/or amount), the higher the risk of developing a health effect.

See the OSH Answers documents [What Makes Chemicals Poisonous?](#) and [How Workplace Chemicals Enter the Body](#) for more information.

How do I know what is considered an occupational disease?

Some agencies create general documents, such as the International Labour Organization (ILO)'s [List of Occupational Diseases \(revised 2010\)](#).

As indicated above, it is often difficult to determine if exposure at the workplace may result in an occupational disease. The worker's compensation boards across Canada each maintain criteria about what conditions may be work-related and therefore covered by compensation. It is recommended that you contact the [compensation board in your jurisdiction](#) directly for more information.

How can an occupational disease be prevented?

Use the information from CCOHS and other health and safety agencies and providers to learn about how to eliminate hazards and control the risks in your workplace. Some hazards and their controls will be specifically outlined in legislation. In all cases, the employer has a duty of [due diligence](#) and is responsible for taking all reasonable precautions, under particular circumstances, to prevent injuries or incidents in the workplace.

In situations where there is not a clear way to control a hazard, or if legislation does not impose a limit or guideline, you should seek guidance from occupational health professionals such as an occupational hygienist or safety professional about what is "good practice" or "standard practice" when working in that situation.

In general:

- Learn about the hazards at your workplace (e.g., find out what products are being used, understand how actions such as heavy lifting can affect the body, etc.).
- Employers should develop - and employees should follow - systems, programs, procedures, and practices that are designed to [protect](#) people from workplace hazards.
- Communicate all health hazards and exposures to employees. Provide the appropriate information and training for the hazards present.

- Work with health professionals to investigate injuries or illnesses that may have characteristics that suggest it may be work-related. (e.g., tell your health professional where you work, what you do, and what products you work with).
 - Keep a list of all jobs and industries you have worked in.
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Where can I find more information?

More information is available from other organizations*, such as:

- Occupational Health Clinics for Ontario Workers - [Occupational Disease Portal](#)
- International Agency for Research on Cancer (IARC) - [Occupational Exposures](#)
- National Institute for Occupational Safety and Health (NIOSH) - [Industries and Occupations](#)

(*We have mentioned these organizations as a means of providing a potentially useful referral. You should contact the organization(s) directly for more information about their services. Please note that mention of these organizations does not represent a recommendation or endorsement by CCOHS of these organizations over others of which you may be aware.)

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