

## 2. Health effects of pesticides

### 2.1 Why are pesticides hazardous to health?

Pesticides are poisonous chemicals that can lead to a number of acute and chronic health effects and irreversible injury (1) if not handled with precaution. On world-basis the highest levels of pesticide exposure are found in farmers, pesticide applicators and people who live adjacent to heavily treated agricultural land (2, 3).

Farmers in developing countries are especially at risk of pesticide exposure due to almost no use of personal protective equipment and proper hygiene when handling pesticides (4, 5).

In industrialized countries the problem of pesticides is mostly chronic health effects caused by long-term exposure to low levels of pesticides, whereas in developing countries the main focus of attention is acute health effects (6). Acute health effects are caused by short-term exposure, usually to high-level doses of pesticides or very toxic pesticides and are associated with high mortality (6). However, long-term exposure to pesticides should also be given attention in development countries, because it can induce neurotic, reproductive, fetotoxic and carcinogenic effects (7).

### 2.2 Sources of exposure

Exposure to pesticide poisonings can be divided into non-intentional and intentional (8):

#### Non-intentional:

- Occupational: exposure to pesticides occurs during work, where a pesticide has been used in the context of the work progress, including the application, transportation, storage and disposal.
- Accidental: unexpected exposure to pesticides (excludes those related to work practice). For example accidental contamination can be due to intake of food items containing pesticide residues or re-entry in to fields that have been treated with pesticides.

#### Intentional:

- Exposure to pesticides with the intention of causing harm. This includes suicide attempts, suicides and homicides.

### 2.3 Vulnerable groups

Vulnerability refers to characteristics of an individual or population that places them at increased risk of an adverse effect (9). The greatest adverse impact of a given pesticide will be to those people who are most exposed and/or most susceptible to exposure (10). In exposure assessments it is important to identify conditions that lead to exposure of the most vulnerable groups because they

are at greater risk of exposure than other groups. There is a focus on children and pregnant women because several factors contribute to their increased vulnerability to pesticide exposure (11, 12):

### Children

- Increased vulnerability during growth and development: cell growth, development of the nervous system.
- Immature metabolism.
- Greater exposure: children are in proportion more heavily exposed pr. unit of body weight to toxins than adults. Absorption rates are greater in children.
- Longer time at risk: children have more time than adults to develop chronic diseases.

### Pregnant women

- Long-term, inter-generational effects of bioaccumulation: toxins that the body can't break down with its enzymes/metabolize will bioaccumulate in the body, which means that they will tend to build up in the body with increasing age. For example lipophilic organochlorines are sequestered in lipid rich tissues in all organisms. They can then be passed on to the next generation across the placenta and in the breast milk (13).

#### For further reading on vulnerable groups:

- WHO and EEA: Children's health and environment: A review of evidence, 2002 [http://www.euro.who.int/\\_data/assets/pdf\\_file/0007/98251/E75518.pdf](http://www.euro.who.int/_data/assets/pdf_file/0007/98251/E75518.pdf)
- WHO, ILO and UNEP: Principles for evaluating health risks in children associated with exposure to chemicals: [http://www.who.int/ipcs/features/ehc\\_children.pdf](http://www.who.int/ipcs/features/ehc_children.pdf)

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## 2.4 Acute health effects

Acute effects are harmful effects that occur within 48 hours of exposure to the pesticide (14). The general acute symptoms are extreme weakness and fatigue (15). In the table below acute symptoms are listed according to the organ or biological system that the pesticide affects:

**Box 2.1 Acute symptoms (15):**

<i>Organs or biological systems</i>	<b>Acute symptoms</b>
Skin	Irritation, burning sensation, excessive sweating, staining
Eyes	Itching, burning sensation, watering, difficult or blurred vision, narrowed or widened pupils
Digestive system	Burning sensation in mouth and throat, excessive salivation, nausea, vomiting, abdominal pain, diarrhea
Nervous system	Headaches, dizziness, confusion, restlessness, muscle twitching, staggering gait, slurred speech, fits, unconsciousness,
Respiratory system	Cough, chest pain, tightness, difficulty with breathing, wheezing

**Effect of different pesticides**

The acute toxicity of pesticides varies according to the type of pesticide (5,16):

- Very acute toxicity (organophosphates, carbamates, some herbicides): blocking the effect of the enzyme cholinesterase leading to an overstimulation in the neurons where acetylcholine is the transmitter substance.
- Less acute toxicity (organochlorines and pyrethroids): mainly peripheral neurotoxic effect.

**For further reading acute health effects:**

- Thundiyil, Josef G et al.: Acute pesticide poisoning: a proposed classification tool, Bull World health organ, vol. 86, no. 3, 205-9, 2008
- WHO: Emergency measures. Vector Control - Methods for Use by Individuals and Communities. World Health Organization 1997: <http://www.who.org>

**2.5 Chronic health effects**

Acute health effects are well-documented, whereas evidence on chronic health effects is limited. Chronic effects are harmful effects that occur from exposure to the pesticide over a longer period of time. Most studies on long-term pesticide exposure are in vitro studies and animal studies and only

a small number of epidemiological studies on humans are available (17). This makes it difficult to evaluate chronic health effects.

- **Neurotoxic effects:** long-term pesticide exposure can cause neurophysiological changes such as lowered concentration and memory, fatigue, irritability, nervousness (18, 19). Furthermore the effects of pesticides on the nervous system may contribute to chronic neurodegenerative disorders, most notably Parkinson's disease (19).
- **Reproductive effects:** exposure to pesticides may result in either embryoletality, malformations or other outcomes such as growth retardation or functional alteration. Similarly, pesticides affecting reproduction may act on selected stages targeting the prenatal stage, prepubertal stage or the adult, resulting in damage to the reproductive organs and/or impaired fertility (20).
- **Immunotoxicity:** pesticides can potentially cause an increase in activation of the immune system with the potential to develop into an autoimmune disease, a decrease in the immune system activity resulting in immunosuppression and development of hypersensitivity (21).
- **Carcinogenicity:** According to Zahm et al. (22), of the 51 pesticides evaluated by the U.S. National Cancer Institute and National Toxicology Program, 24 exhibited carcinogenicity in chronic animal bioassays. These authors further reported the International Agency for Research on Cancer (IARC) had classified 26 pesticides as having sufficient evidence of carcinogenicity in animals and 19 as having limited evidence.

**For further reading on chronic health effects:**

- Krieger, Robert: Hayes handbook of pesticide toxicology, Academic Press, 2010
- EPA: Specific chemical fact sheets: [http://www.epa.gov/pesticides/factsheets/chemical\\_fs.htm](http://www.epa.gov/pesticides/factsheets/chemical_fs.htm)
- IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Occupational Exposures in Insecticide Application and some Pesticides. IARC Lyon 1991; vol 53

# Educative session

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## Educative video

### Health effects of pesticide poisoning - symptoms and treatment of poisoning:

- Mercedes Condori, peasant, tells about the symptoms she has experienced after spraying with pesticides.
  - Esmeralda Choquehuanca, shopkeeper, tells about her experiences with peasants reporting symptoms of poisoning.
  - Jose Ricardo Chape Yujra, nurse, tells about poisoning cases that health personnel are confronted with in the hospital.
  - Rolando Gomez, medical doctor, comments on the magnitude of poisoning cases.
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## Study questions

- How do people get exposed to pesticides?
- How do you think pesticides enter the body?
- Mention vulnerable groups to pesticide exposure and explain why these are vulnerable?
- Mention five acute symptoms of pesticide poisoning and three chronic health effects

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14. Thundiyil JG, Stober J, Besbelli N, Pronczuk J. Acute pesticide poisoning: a proposed classification tool. *Bull World health organ*. 2008;86(3).
15. WHO. Emergency measures. Vector Control - Methods for Use by Individuals and Communities: World Health Organization; 1997
16. Midtgård U, Simonsen L, Knudsen LE. Toksikologi i arbejdsmiljøet. Arbejdsmiljøinstituttet; 1999.
17. Ramsingh D. The Assessment of the Chronic Toxicity and Carcinogenicity of Pesticides. Hayes handbook of toxicology: Academic Press; 2010.
18. Baldi I, Gruber A, Rondeau V, Lebailly P, Brochard P, Fabrigoule C. Neurobehavioral effects of long-term exposure to pesticides: results from the 4-year follow-up of the PHYTONER Study. *Occup Environ Med*. 2010.
19. Costa LG, Giordano G, Guizzetti M, Vitalone A. Neurotoxicity of pesticides: a brief review. *Front Biosci*. 2008;13.
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22. Zahm SH, Ward MH, Blair A. Pesticides and cancer. *Occup Med*. 1997;12.