

Polycyclic Aromatic Hydrocarbons (PAHs): Health effects

PAHs can be released into the air, water and soil from burning, industrial processes and use of some household products. They can persist in the environment for very long periods of time.

The effects on human health depend on the concentration of PAHs and the type and extent of exposure.

What are Polycyclic Aromatic Hydrocarbons (PAHs)?

PAHs comprise a group of over 100 different chemicals that are produced during the incomplete burning of fuels, garbage or other organic substances such as tobacco, plant material or meats. These combustion processes produce a mixture of chemicals with soot being a well known example. Tobacco smoke contains many chemicals including PAHs which are found in the tar that accumulates in the lungs of smokers.

Some of these PAHs are manufactured for research or are used in medicines, dyes, plastics and pesticides such as naphthalene found in mothballs. PAHs can also be found in coal tar, bitumen, crude oil, creosote and roofing tar.

The distribution of PAHs in the environment is extensive and the general public may be exposed to PAHs found in soil/dust, air, water, food or household products.

17 PAHs have been identified as being of greatest concern with regard to potential exposure and adverse health effects on humans and are thus considered as a group. These include:

- acenaphthene
- acenaphthylene
- anthracene
- benz[a]anthracene
- Benzo[a]pyrene

- benzo[e]pyrene
- benzo[b]fluoranthene
- benzo[g,h,i]perylene
- benzo[j]fluoranthene
- benzo[k]fluoranthene
- chrysene
- dibenz[a,h]anthracene
- fluoranthene
- fluorene
- indeno[1,2,3-c,d]pyrene
- phenanthrene
- pyrene

What are the acute or short-term health effects of PAHs?

The effects on human health will depend mainly on the extent of exposure (length of time, etc), the amount one is exposed to (or concentration), the innate toxicity of the PAHs and whether exposure occurs via inhalation, ingestion or skin contact. A variety of other factors can also affect health impacts from such exposure, including pre-existing health status and age.

Intake of PAHs from contaminated soil may occur via ingestion, inhalation or dermal (skin) exposure to contaminated soil/dust, and from inhalation of PAH vapours. Tilling of dry soil can result in ingestion of small but measurable amounts of soil.



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The ability of PAHs to induce short-term health effects in humans is not clear. Occupational exposures to high levels of pollutant mixtures containing PAHs has resulted in symptoms such as eye irritation, nausea, vomiting, diarrhoea and confusion. However, it is not known which of the mixture components were causative for these effects. Mixtures of PAHs are known to cause skin effects in animals and humans such as irritation and inflammation. Anthracene, benzo(a)pyrene and naphthalene are direct skin irritants while anthracene and benzo(a)pyrene are reported to be skin sensitisers, i.e. cause an allergic skin response in animals and humans.

What are the chronic or long-term health effects of PAHs?

Health effects from chronic or long-term exposure to PAHs may include cataracts, kidney and liver damage and jaundice. Repeated contact with skin may induce redness and skin inflammation. Naphthalene, a specific PAH, can cause the breakdown of red blood cells if inhaled or ingested in large amounts.

Animals exposed to levels of some PAHs over long periods in laboratory studies have developed lung cancer from inhalation, stomach cancer from ingesting PAHs in food and skin cancer from skin contact.

Long-term studies of workers exposed to mixtures of PAHs and other workplace chemicals have shown an increased risk of skin, lung, bladder and gastrointestinal cancers. These studies have also reported asthma-like symptoms, lung function abnormalities, chronic bronchitis and decreased immune function. However, it is not clear from these studies whether exposure to PAHs was the cause as other potential cancer-causing agents were also present.

Are there any other health effects of PAHs?

Laboratory studies in mice have demonstrated that ingestion of high levels of a specific PAH known as benzo[a]pyrene during pregnancy resulted in difficulty in reproducing. This effect was also seen in the offspring. Effects in the offspring also included birth defects and decreased body weight. It is not known whether these effects can occur in humans.

What are the effects of exposure to children?

The effects of short-term exposure to children are the same as for adults. However children, who have lower bodyweights than adults, do not require as great an exposure to experience the same health effects as adults. Young children are also prone to behaviours that may increase their potential for exposure, e.g. crawling on bare dirt surfaces, eating soil, and more hand-to-mouth activities.

Populations at special risk

Some people have an increased susceptibility to the effects of PAHs. This generally includes the elderly who have declining organ function and young children with immature and developing organs. Such susceptibility is however, common for all chemicals not just PAHs.

In addition, people who smoke (and therefore inhale PAHs and thus have higher exposure), have a history of excessive sun exposure (enhanced skin cancer response if simultaneously exposed to PAHs via skin), have liver and skin diseases and women of child bearing age have an increased susceptibility to PAHs. It is also recognised that PAHs (e.g. in mothers who smoke tobacco) may cross the placenta and enter the body of the unborn fetus.

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What is the safe level of PAH intake?

Prudent public health practice is to minimise exposure to any agent that may have cancer-causing potential. Estimations of safe PAH intake levels are problematic because of the complexity of such mixtures. Regarding cancer risk, this is complicated by the need to rely on high dose benzo(a)pyrene animal studies and by differences in risk estimation approaches of various jurisdictions.

How can potential exposure be determined (environmental monitoring)?

Potential exposures to chemicals may be assessed by testing contaminated soil, air or water for the chemicals of interest and estimating the degree of intake of each of these media into the human body.

Can the level of PAHs in the body be tested (biological monitoring)?

Several methods have been developed to assess internal exposure (the amount absorbed by the body and distributed to various organs and tissues) to PAHs. Most of these methods are based on determining metabolites in urine of exposed people.

The most widely used method is the determination of 1-hydroxypyrene in urine and this has been demonstrated to provide useful evaluation of recent exposures to PAHs in workers exposed to PAHs. However, this test is not generally recommended for the general population.

What precautions should I take to reduce potential exposure to soil contaminated with PAHs?

Should you be living on a site known to contain PAHs in the soil potential exposure may be reduced by various common sense precautions. Young children and pets should be excluded from bare earth areas in the garden if the soil contains PAHs.

Cessation of gardening activities will diminish most soil exposure. If gardening is continued, precautions to avoid contact with soil should be used such as gloves, dust masks and washing of gardening equipment and footwear. Contaminated soil should not be allowed to enter the indoor environment.

Some PAHs may evaporate from contaminated soil and result in the detection of odours. Should odours arising from ground sources be detected, avoid the inhalation of these odours and contact SA Health's Scientific Services on 8226 7100 for advice.

What is the safe distance from an area contaminated with PAHs?

The safe distance from a site will be dictated by onsite activities that may result in release of contaminated dust or vapours. Appropriate management of a contaminated site includes ensuring that off-site releases are minimised and do not result in significant exposure to surrounding residents.

Should I continue to use groundwater from my bore?

It is possible for soil contaminants to migrate from areas of soil contamination to the groundwater. This will depend on many factors such as subsurface hydrogeology, types of soil contaminants, their distribution, and how long the contaminants have been in the soil.

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It is important that groundwater is tested to ensure it is suitable for its intended use irrespective of whether there is a potential for contamination from a contaminated soil source. If there is a concern regarding contamination arising from a contaminated site further investigation is necessary.

How can I protect children from soil containing PAHs?

In young children, particularly those aged under 5 years, exposure to PAHs from contaminated soil may occur from ingestion of the soil or from skin contact with the soil.

Children's hands should be washed before eating and after playing in the yard. Young children's toys that are taken outside should be cleaned frequently to reduce the risk of transferring soil to the mouth.

Contaminated soil should be kept out of homes in which very young children live. Dirty boots that have been worn for gardening in contaminated bare earth areas should be cleaned of soil before entering the house.

Children should be excluded from areas where odours from ground contamination are noticed, particularly where these odours are confined in small areas such as small pits (sandpits), cellars and cubby houses.

Who can I contact for more information?

If you have any health queries, please call SA Health's Scientific Services on 8226 7100.

Translation service

For information in languages other than English, call the Interpreting and Translating Centre and ask them to call the Department of Health.

This service is available at no cost to you; contact 8226 1990.

Contact

Scientific Services
Public Health
SA Health

1st floor, Citi Centre Building
11 Hindmarsh Square
Adelaide SA 5000

PO Box 6, Rundle Mall
Adelaide SA 5000

Tel 08 8226 7100
Fax 08 8226 7102

ABN 97 643 356 590

Email: public.health@health.sa.gov.au
Web: www.health.sa.gov.au/pehs/enviro-health-index.htm

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