Health effects of indoor air pollutions

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Air pollutions (WHO stats)

- Approximately 8 millions excess death yearly
  - **People that die who would have died later if there was no air pollution**
  - Cancer, cardiovascular diseases, lung infections, stroke, KOLS, asthma

- About 4.2 millions due to outdoor air pollution
  - Fuel combustion from motor vehicles (e.g. cars and heavy-duty vehicles)
  - Heat and power generation (e.g. oil and coal power plants and boilers)
  - Industrial facilities (e.g. manufacturing factories, mines, and oil refineries)
  - Municipal and agricultural waste sites and waste incineration/burning

- About 3.8 millions due to indoor air pollution
  - Primarily as a result of household exposure to smoke from dirty cookstoves and fuels
  - Tobacco smoke
  - Radon gas

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Kilder: WHO og EEA

The indoor environment

- Chemicals and particles can be up-concentrated
  - Less ventilation
  - …but most are still in very low concentrations
- Different types of contaminants than found outdoor
  - Particles from textiles have a fibrous form
  - Different sources
- Household products contains a range of different substances of which many are not identified or assessed for their risk
  - Carpets, wall painting, furniture, toys, electrical equipment
- Chemicals appears in mixtures with particles and other chemicals

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Building-related illness (BRI)

- **Conditions with known specific symptoms and origin**

- Immunologically mediated inflammations and irritants
  - Asthma, allergy, KOLS, mucous membrane irritation (eye, nose, and respiratory irritations)
  - Tobacco, volatiles from mold, VOCs, SO2, particles from burning, pollen, pets, mold
- Infections
  - Virus, bacteria (Legionella)
- Cardiovascular diseases
  - Particulate matter (combustion, tobacco smoke, from traffic)
- Cancer
  - Radon, tobacco smoke and indoor combustion (PAHs)

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Sick building diseases (SBS)

- Conditions with non-specific symptoms and origin
  - Sensory irritation of eyes, nose, throat
  - Neurobehavioral, headache, memory loss, depressions, dizziness
  - Skin irritation and hypersensitivity
- Toxicity criteria are not fulfilled
  - No dose-response relationship,
  - Chemical exposure associated with the symptoms are far below levels known to cause toxicity
  - Symptoms disappear when leaving the building
- **Health problems often related to poor ventilation and new buildings**
  - More chemical emissions from new buildings
  - Also psychological factors are considered important

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Sources of indoor air pollutants (private and public)

- Particles (PM10; 2.5; nano)
  - House dust (primarily from textiles (plastics, cotton))
  - Indoor mold, mites, pets, people
  - Cosmetics
  - Indoor combustion (candles, firewood)
  - Other household products (plastics, furniture)
  - From outdoor air (traffic, industry, biological origin)
- Volatiles, semi-volatiles and gases
  - From plastic products
    - Plasticizers (e.g. phthalates)
    - Flame retardants, monomers and solvents
  - From cosmetics (e.g. siloxanes, perfumes)
  - From furniture, carpets, hobby supplies
    - Benzene, formaldehyde, naphthalene, Trichloroethylene, Tetrachloroethylene, different solvents
  - From combustion
    - Benzene, formaldehyde, naphthalene, NO2, PAH, SO2
  - Toxins from mold
  - From outdoor air
    - Traffic, industry, agriculture activity (NO2, PAH, SO2, O3, pesticides)

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Complex mix of chemicals

- **Who guidelines:**
  - Benzene, CO, formaldehyde, naphthalene, NO2, PAH, radon, trichloroethylene, tetrachloroethylene.
- Other WHO- referred chemicals:
  - Acetaldehyde Asbestos, Biocides, pesticides, Flame retardants, Glycol ethers, Hexane, Nitric oxide, Ozone, Phthalates, Styrene, Toluene, Xylenes

- **Danish study, volatile and semi volatile chemicals in toys**
- Volatiles and semi-volatiles
  - D-limonen, benzylalkohol, L-linalool, delta-3-Caren, alfa-pinen, beta-pinen, N,N-diimethylformamid (DMF), N,N-dimethylaminoethanol, triethylendiamin, bis(2-(dimethylamino)ethyl) ether, 1,2-ethandiamin, N-[2-(dimethylamino)ethyl] N,N',N'-trimethyl-cyclohexanon, 1,1,4,7,7-pentamethyldiethylentriamin
  - Formaldehyd, acetaldehyd, propanal, butanal, acrolein og crotonaldehyd
  - Dioxan, phenols, 2-ethylhexylsyre, 4-tert-butylcyclohexyl acetat, 3-(4-Isopropylphenyl)-2-methylpropionaldehyd, BHT (Butylated Hydroxytoluene), 4,4'-methylenebis benzenamin, Drometrizol, Bis(2-ethylhexyl) phthalat (DEHP)
- Perfumes, plasticizers, monomers from polymerization process, catalysts, antioxidants

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Summary

- Indoor air is attributed to serious health effects
  - Primarily as a result of exposure to smoke from dirty cookstoves, fuels, tobacco smoke and radon gas
- There are frequent reports of illnesses due to indoor air
  - Both specific and non-specific health effects
- We can be exposed to very complex mixtures of particles and chemicals
  - 100-1000(???) different chemicals (known and unknown)
  - Particles from different sources
  - Knowledge of how complex mixture affect health is limited
  - …and difficult to study
- Easier to reduce exposure than identify causes of effect
  - Good ventilation and cleaner air
  - Use products with less emission of chemicals

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