Scientific Facts on

Respiratory Diseases

in Children

Source document:
EC (2003)

Summary & Details:
GreenFacts

Level 2 - Details on Respiratory Diseases

This Digest is a faithful summary of the leading scientific consensus report produced in 2003 by European Commission (EC):
"Baseline Report on Respiratory Health in the framework of the European Environment and Health Strategy"

The full Digest is available at: https://www.greenfacts.org/en/respiratory-diseases/

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- Each question is answered in Level 1 with a short summary.
- These answers are developed in more detail in Level 2.
- Level 3 consists of the Source document, the internationally recognised scientific consensus report which is faithfully summarised in Level 2 and further in Level 1.

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1. To what extent do respiratory diseases affect children?

1.1 How common and severe are respiratory diseases in children?

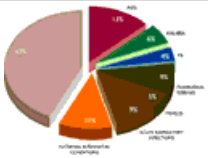

Figure 1 [see Annex 1, p. 10] : causes of death in children in Africa and South East Asia

Respiratory diseases are the most common cause of illness in children in developed countries and a leading cause of death in underdeveloped countries. The respiratory health state of children is determined by the interactions of different factors. These include environmental factors, individual sensitivity and genetic factors. Such factors can determine not only children's respiratory health, but may have also consequences for respiratory health in later life. In developed countries, there are now fewer cases of life threatening acute respiratory infections. However, asthma and respiratory allergies are getting more frequent and it is not yet entirely clear why.

1.2 Are deadly respiratory diseases becoming rarer in developed countries

In developed countries the frequency of life threatening acute respiratory infections has dropped over the last 50 years. This is due in part to the use of antibiotics and vaccines against infectious diseases, as well as to a general increase in the standard of living. Respiratory illnesses could be further reduced, for instance, by developing an effective vaccine against viral bronchiolitis or by preventing exposure to cigarette smoke during pregnancy and early childhood. Sudden Infant Death Syndrome (SIDS) is rarer now than it was in the 1980s, but it still affects about one child out of 1500. Although its causes are still unknown, the practical recommendation that infants should sleep on their backs may have helped to reduce the number of cases.

Better health care allows more and more children to survive serious lung and airway diseases. However, these individuals tend to remain particularly sensitive to environmental triggers such as air pollution in their adult life.

1.3 Are there geographical variations in respiratory diseases in Europe?

Within Europe, there tends to be more asthma and allergy in the wealthier West and more infectious disease in the poorer East. Moreover, there are also differences between the North and the South in terms of asthma and allergies.

It is unclear whether these regional variations can be entirely explained by differences in the way diseases are diagnosed or by real differences in factors related to the environment or to the sensitivity of individuals.

2. Which factors cause respiratory diseases in children?

2.1 What are the multiple causes of disease?

There are three main groups of factors which are involved in the development of diseases in general, and also for respiratory diseases in children:

- the genetic background of a person (host genetics),

- the living conditions or lifestyle of a person (host conditions), which includes nutrition, income and housing, but also depends on age. It can influence the person's likelihood to respond to environmental factors,
- exposure to environmental factors including all kinds of substances present in air, water, food, soil, and consumer products, as well as other circumstances, such as weather conditions or damp housing.

Asthma, for instance, is a result of different combinations and interactions of factors from these three groups. Those people who are susceptible due to their genetic background and who are exposed to adverse environmental factors have the highest risk of developing a disease such as asthma.

Figure 5
[see Annex 2, p. 11] :
Multi-causality Framework for Environment and Health
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The fact that there are multiple causes creates many obstacles to understanding the mechanisms and factors that lead to disease development, but it also provides opportunities for preventing harm when certain critical factors can be identified and removed.

2.2 What is the difference between causes and triggers of diseases?

While some respiratory diseases have clearly identifiable causes, others including asthma and bronchitis have a variety of potential causes and triggers.

See also GreenFacts' Digest on Air Pollution [see /en/index.htm]

Whereas underlying causes are responsible for a disease, triggers are factors that bring on or worsen symptoms. For instance, although the role of air pollution in the onset of asthma is unclear, it has a clear role in precipitating asthma attacks in children who already have the disease.

Even if reducing a trigger does not remove the underlying causes of a disease and the number of people affected, it may lead to substantial health gains because it reduces the symptoms.

3. Which circumstances can affect children's sensitivity to respiratory diseases?

To what extent environmental factors may lead to health effects in children will depend on certain personal circumstances such as genetic background, gender, age, ethnicity, and social conditions.

3.1 What is the role of genetic factors?

Pulmonary diseases in children may have a genetic basis. Usually several genes are involved, except in the case of cystic fibrosis, which results from a change in a single gene.

In the case of asthma a genetic predisposition is usually necessary for the onset of the disease, but environmental factors are also involved. Children of affected parents are two to three times more likely to develop asthma. However, in addition to genetic factors, environmental factors may also be important since the increased prevalence of asthma and allergy cannot be explained by genetic factors alone.

Environmental and genetic factors often interact. Therefore, researchers are interested in identifying environmental factors, such as exposure to tobacco smoke and air pollution, that may contribute to causing or triggering asthma, allergies, or other respiratory diseases.

See also GreenFacts' Digest on Tobacco [see https://www.greenfacts.org/en/tobacco/index.htm] and Air Pollution [see /en/index.htm]

3.2 Could gender affect the development and frequency of asthma?

In early childhood, about twice as many boys suffer from asthma than girls do. During adolescence this ratio is reversed and a larger number of girls are affected. The timing of this gender reversal suggests that sex hormones play a certain role in asthma.

3.3 Are the earliest stages of life critical for later respiratory health?

Many diseases that appear during childhood or adult life may have their origins in very early stages of life. In humans, the development of the lungs occurs during development in the womb or shortly after birth, and there seems to be a link between low birth weight and respiratory problems later in life.

It has been observed that both serious respiratory infections in childhood and early exposure to adverse environmental factors may result in respiratory problems in adults. For instance, exposure to environmental tobacco smoke after birth can cause respiratory problems in children. However, if a mother exposes her unborn child to tobacco smoke by smoking during pregnancy, this can lead to even longer lasting effects.

Children have a higher breathing rate than adults. This means that children breathe in more air relative to their body weight compared to adults and are thus more exposed to environmental factors, such as airborne particulate matter.

3.4 Does poverty increase the risk of respiratory diseases?

In developing countries, respiratory infections, often combined with malnutrition, are one of the most common causes of death in children under 5 years of age. Lack of access to clean water and sanitation, malnutrition and poor access to medical services can foster the development of infectious diseases.

In developed countries, such as the United Kingdom, adults and children of lower socio-economic status have also been demonstrated to be at higher risk of respiratory infections. This may be due to crowding, increased exposure to infectious agents or reduced immunity related to a bad diet.

3.5 How are infections, asthma and allergies linked to living conditions?

Living conditions can modify the effect of both genetic and environmental factors. Thus in theory, improving living conditions is a powerful way to prevent disease.

3.5.1 In Western Europe, there has been a steep decrease in the prevalence of severe infectious diseases such as tuberculosis. Worldwide, pneumonia is the respiratory disease

that causes the largest number of deaths in children, and is linked both to infections and living conditions.

3.5.2 Asthma and allergies have become more and more frequent in Western Europe. One explanation for this increase is the "hygiene hypothesis" which assumes that infections in early childhood may prevent the development of allergic diseases. The human immune system uses two complementary types of biological responses to infections. When one part of the immune system lacks practice fighting bacteria and viruses, perhaps from an overly sanitary lifestyle, the other part can overreact to harmless substances like pollen, causing an allergic reaction.

Other possible explanations for the increase in asthma and allergies are changes in diet, such as a higher salt intake, a lower intake of certain vitamins and a lower consumption of fish that contains omega-3 fatty acids, that may also contribute to the development of asthma.

In addition, factors affecting the development of the fetus may lead to a greater risk of asthma later in life. For instance, there is a higher number of children suffering from asthma among those who were very small at birth or those who are born from older mothers. Moreover, if a mother smokes during pregnancy it affects on her child's birthweight and early childhood respiratory health. However, it is not clear if this increases the risks of developing asthma and allergies in the longer term. In contrast, breast feeding for at least 6 months can protect children against respiratory problems in early life, but longer-term benefits for asthma and allergies are not clear.

4. Can outdoor air pollution contribute to respiratory diseases in children?

There is clear evidence that air pollution is associated with troublesome respiratory symptoms in children. However, it is less clear whether specific pollutants are directly responsible for the development of respiratory diseases.

4.1 Which pollutants are present in outdoor air?

Particulate matter is the sum of all solid and liquid particles suspended in air. Many of these particles are due to the burning of fuel for energy and transport. In Europe, overall concentrations of particulate matter (PM_{10}) in outdoor air have generally decreased between 1996 and 2000. However, near busy roads, concentrations often exceed recommended limits, because of motor vehicle emissions.

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See also GreenFacts' Digest on Air Pollution [see /en/index.htm]

Another type of pollution are gases, such as ozone (O_3), sulphur dioxide (SO_2), and nitrogen oxides (NO_x)

- Ground level Ozone (O_3) is a pollutant that is formed under the action of light from other air pollutants, particularly during sunny weather. In the last few years annual average concentrations have generally increased, whereas short term peak concentrations have remained stable.
- Nitrogen dioxides (NO_2) that results from fuel combustion is a major contributor to smog and acid rain. Concentrations have generally decreased between 1996 to 2000, but in some traffic hot-spots and urban centres recommended values are exceeded.
- Sulphur dioxide (SO_2) is a gas released mainly by industrial processes, most notably by coal power plants. It is a major contributor to acid rain. Urban and

local SO_2 concentrations continue to decrease in most areas in Western Europe, but short-term peaks still represent a problem in some industrial hot-spots.

4.2 What respiratory diseases can outdoor pollution lead to?

There is increasing evidence that the most common air pollutants (PM, O_3, NO_x and SO_2) adversely affect the respiratory health of children. While air pollution may not be the main cause of the greater frequency of respiratory disease, it significantly worsens the symptoms. When levels of air pollution are high, an increase in the number of hospital admissions and emergency room visits is observed.

Particular attention is currently given to particles in air which can be breathed in and that are small enough to enter deep into the lung, as these may be a major contributor to the adverse effects of air pollution.

Some studies suggest that living near busy roads is linked to respiratory problems including reduced lung function, as well as to a higher prevalence of asthma and respiratory symptoms such as wheezing.

Studies that compare two groups of people exposed to different levels of air pollution provide the strongest evidence for a relationship between respiratory disease and air pollution.

For example, the temporary closing of a steel mill in the Utah Valley in the late 1980's provided researchers with the unique opportunity to demonstrate a relationship between exposure to air pollution particles and respiratory health. During the mill's closure the number of children with respiratory symptoms admitted into hospital decreased substantially and then increased to pre-strike levels when the mill reopened. Another study followed 110 children who were relocated to areas with either more or less air pollution. Those who moved to less polluted areas showed an increase in lung function, and those who moved to more polluted areas showed a decrease.

4.3 Does exposure to pollen lead to respiratory allergies?

Pollen allergies are caused by some specific substances released from pollen into the air (pollen allergens). In Europe pollen allergens may be responsible for 10-20% of allergic diseases. Although the relationship between pollen allergens and hayfever (allergic rhinitis) is clear the relationship between pollen allergens and asthma is less clear.

In different regions different plant species are responsible for pollen allergies. For instance, grasses and birch trees are the main cause of pollen allergies in Northern and Central Europe, ragweed in Central and Eastern Europe, and olive trees and cypresses in Southern Europe.

The occurrence of allergic reactions depends on the length of the pollen season, the amount of pollen in the air, the number and level of the pollen peaks, and how readily allergens are taken up by the body.

One study has suggested that in highly polluted areas air pollution may increase the frequency of pollen allergies. However, other studies have not shown such a relationship and another recent study carried out on children during the pollen season suggested that air pollution does not increase pollen-related allergies.

Global climate change might cause particular plant species to spread to new areas which become climatically suitable. Warming may cause an earlier and longer pollen season for some species. It remains uncertain how these changes would affect the frequency and severity of allergies in different regions.

5. Can indoor air pollution contribute to respiratory diseases in children?

Indoor air pollution can be much worse than the air pollution outdoors. In Europe, most children spend 90% of their time indoors. Therefore, they are particularly affected by indoor air quality at home, but sometimes also at day care or school, and during recreational activities such as swimming.

5.1 In what way can children be exposed to and affected by indoor pollution?

5.1.1 Outdoor pollution may affect indoor air quality. Moreover, there can be indoor pollution due, for instance, to the presence of hazardous building materials, the use of cleaning products, or to smoking. Increased insulation tends to decrease air exchange between the indoor and outdoor environment. Insufficient air exchange can lead to the build-up of both air pollutants and moisture, which favours the development of mites and moulds.

5.1.2 Poor indoor air quality can cause or contribute to the development of respiratory diseases such as **irritations and infections of the respiratory tract and exacerbation of** asthma. In addition, it can cause headaches, dry eyes, nausea, and fatigue. Children who already have respiratory diseases are at increased risk of suffering from the effects of indoor air pollution.

5.2 What air pollutants can affect children at home?

5.2.1 In the home, tobacco smoke can be an important source of toxic air contaminants and contribute to a number of health effects that can be chronic, such as childhood asthma, or even deadly, such as Sudden Infant Death Syndrome.

If a mother smokes during pregnancy, the growth of the unborn child can be adversely affected, increasing the risk of low birth weight. In children, passive smoking can lead to a variety of effects affecting the upper and lower respiratory tract, as well as ear infections and non specific symptoms of cough and wheezing. Passive smoking can worsen symptoms in children with allergies and may make them more sensitive to food allergens.

[see https://www.greenfacts.org/en/tobacco/index.htm] See also study on Active & Passive smoking [see https://www.greenfacts.org/en/tobacco/index.htm]

5.2.2 Living organisms such as moulds, bacteria, viruses, and dust mites can adversely affect indoor air quality. In newer houses, due to increasing energy-saving standards, air exchange between indoor and outdoor is limited. This can increase humidity which promotes the growth of micro-organisms and increases the amount of indoor air allergens. This in turn can lead to a higher risk of allergic disorders and an increase in respiratory health effects such as wheezing and asthma.

5.2.3 There is disagreement as to whether exposure of children to pets either leads to protection against allergies or increases the sensitivity to allergens. This may in part be explained by the timing of the exposure to animals. Exposure to animals in early life may result in tolerance to animal allergens whereas exposure later in life may lead to sensitisation and allergic symptoms.

5.2.4 Cooking and heating, particularly with gas, can lead to high NO_x levels, which may increase a child's susceptibility to develop different respiratory diseases.

5.2.5 Indoor chemicals may also be released from building materials, particularly after renovation activities. For instance, volatile organic compounds may be released by solvents used in paints. It has also been shown that exposure to indoor chemicals during early childhood increases the risk of infectious respiratory diseases.

5.3 What air pollutants can affect children at school and in their spare time?

In general, the same factors that influence indoor air quality at home are also relevant to indoor air quality in day care facilities and schools. Indoor air is mainly affected by tobacco smoke, allergens such as moulds, gases from heating and cooking appliances, products from cleaning and building materials, and outdoor air pollution. As the establishment of active smoking often occurs in late childhood and early adolescence , there is a need for health education to prevent children from starting to smoke.

In adolescents choosing a technical education, specific exposures can occur during practical classes and on-the-job training, for instance when handling paints, animals, or food. This may lead to work-related asthma.

When children are playing or doing sports they increase their rate and depth of breathing and consequently receive higher "doses" of air pollutants. Therefore, it is important that physical activities take place in the cleanest possible environment, be it youth clubs, sport halls, or swimming pools.

6. Which aspects of respiratory diseases require further research?

In order to better assess respiratory health risks for children, researchers need to:

- Study impacts on respiratory health of new building materials and agents used in the indoor environment.
- Evaluate interactions between the outdoor and indoor environments.
- Evaluate interactions between the effects of the environment and genes.
- Assess effects of exposure to air pollution at different stages of development.
- Establish uniform European definitions for respiratory symptoms.
- Carry out evidence based reviews of environmental hazards.
- Develop methods for the identification of genetic susceptibility.
- Identify genes associated with respiratory disorders.
- Study the medium- to long-term effects of exposures in early life by following the health of children over a number of years.

7. Conclusions

Environmental factors greatly affect a child's resistance to respiratory diseases.

Particularly beneficial factors are good housing and nutrition, avoidance of exposure to cigarette smoke (both before and after birth), active encouragement of physical exercise in a clean air environment, avoidance of obesity, and good health care including immunization programmes.

In prosperous countries, there has been a reduction in life threatening respiratory infectious disease and an increase in asthma and allergies. Many environmental factors thought to

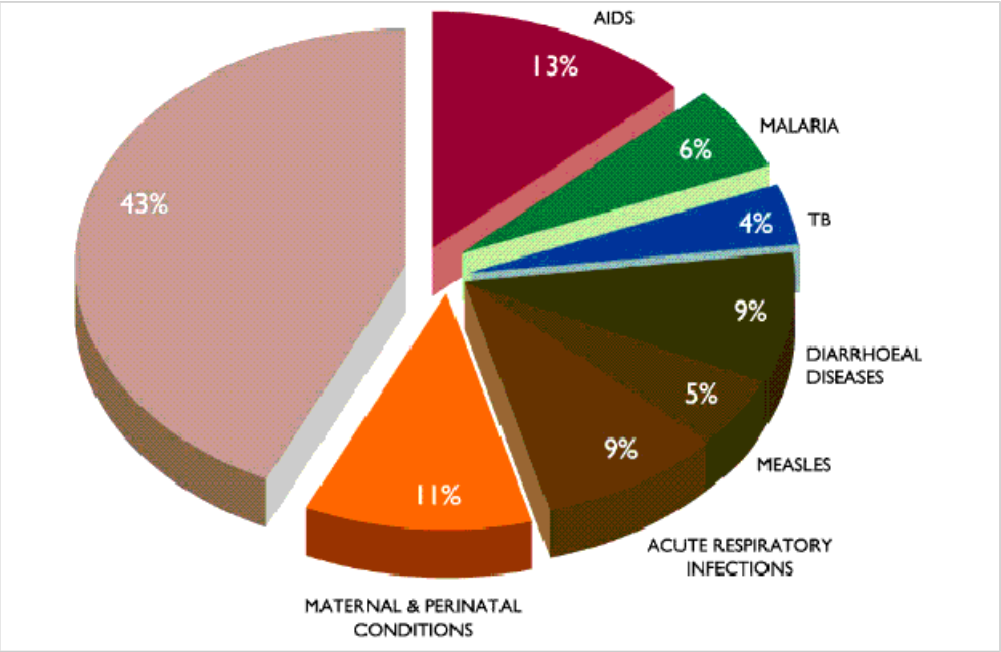
influence children's respiratory health remain unclear and sometimes controversial. This is especially the case with respect to asthma and allergies and further research is needed.

Because it is expected that asthma and allergies will increase in a number of European countries in the coming years, further research is necessary in this area to understand the underlying factors such as the consequences of exposures early in life.

Annex

Annex 1:

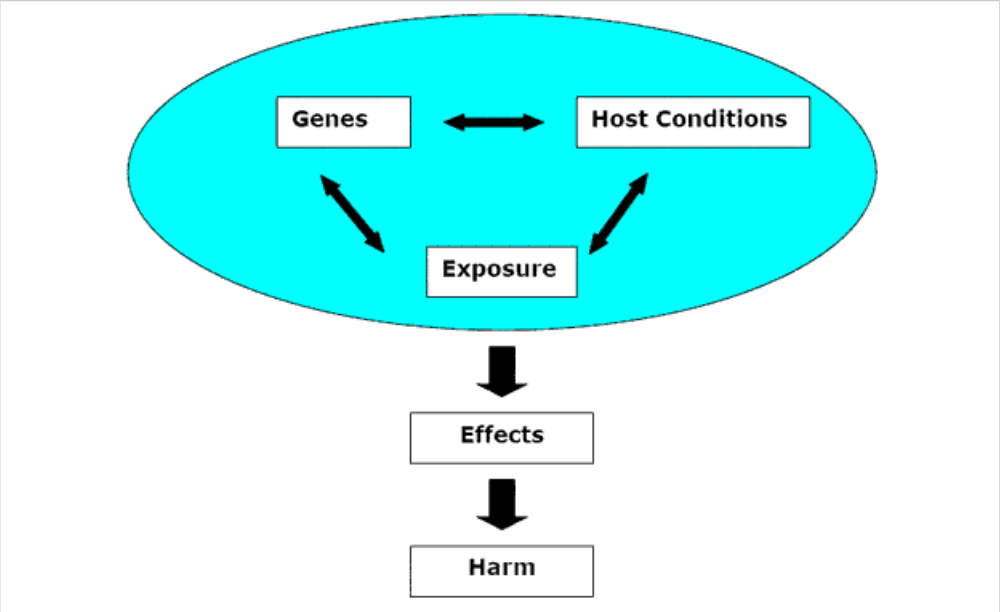
Figure 1. Identifiable causes of death in children and young adults in Africa and South East Asia (ages 0-44)



Source: www.who.int/inf-new/conclu.htm [see http://www.who.int/inf-new/conclu.htm] quoted in Baseline Report on Respiratory Health [see http://ec.europa.eu/environment/health/pdf/respiratory_health.pdf] Section 2.1

Annex 2:

Figure 5: Multi-causality Framework for Environment and Health



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