Lung Diseases

Lung disease refers to several types of diseases or disorders that prevent the lungs from functioning properly. Lung disease can affect respiratory function, or the ability to breathe, and pulmonary function, which is how well lungs work.

Chronic lower respiratory diseases are a set of conditions that include chronic obstructive pulmonary disease (COPD), emphysema, and chronic bronchitis. Together, chronic lower respiratory diseases are a leading cause of death in the United States.1

Respiratory diseases, such as COPD and asthma, involve a narrowing or blockage of airways that reduce air flow and affect breathing.

In other conditions—such as pulmonary fibrosis, a lung tissue scarring, and pneumonia, an infection in which air sacs fill with fluid—the lungs have reduced ability to hold air.

Lung cancer is a disease marked by the abnormal growth of cells. Though most lung cancer starts in the lungs, some cases start in other parts of the body and spread to the lungs.

What causes lung disease?

As types of lung diseases vary, so do causes. Some lung diseases are caused by bacterial, viral, or fungal infections. Other lung diseases are associated with environmental factors, including asthma, emphysema, mesothelioma, and lung cancer. Outdoor and indoor environmental factors linked to lung disease include asbestos, radon gas, air pollution, and chemicals such as uranium, beryllium, vinyl chloride, and arsenic.2

Cigarette smoking is the overall leading cause of lung cancer. Research shows that smoking just a few cigarettes a day causes long-term lung damage, suggesting all levels of smoking are associated with progressive lung damage.3 Breathing secondhand smoke can also increase a person’s chance of developing the disease.

What does NIEHS research tell us about lung disease?

NIEHS conducts and funds studies to understand the genetic and environmental contributions to lung disease development, and to identify new ways to prevent and treat lung disease.

Air pollution studies. The NIEHS-supported, landmark Harvard Six Cities Study showed that fine-particulate air pollution contributes to excess death from lung cancer and cardiopulmonary disease in certain U.S. cities.4 Long-term exposure to air pollutants can increase the chance of developing emphysema, a disease usually associated with smokers.5 The findings might explain why some people who never smoked develop lung disease.

Breathing air pollution can lead to COPD, as shown by an NIEHS-funded study that found diesel exhaust particles, a major source of air pollution, affected genes involved in stress response in the lungs.6 Two large studies show an association between decreases in levels of air pollutants and some improvement in lung function along with reductions in asthma symptoms.7,8 The findings underscore the importance of air pollution reduction policies and strategies on improved air quality and health.
Risk of respiratory disease. Respiratory syncytial virus (RSV) is the leading global cause of lower respiratory tract infection in infants. Researchers discovered mutations in a gene called macrophage receptor with collagenous structure, or MARCO, contributed to the severity of RSV. The findings may help identify people who have a greater chance of developing this disease.

Hexavalent chromium and lung changes. Drinking water contaminated with hexavalent chromium, an industrial chemical, can lead to genetic changes in lung cells. Chromium is considered a human lung carcinogen.

Lung on a chip. NIEHS supported the development of a three-dimensional model of a breathing human lung on a microchip to test effects of environmental exposures and safety of new drugs.

Lung cancer treatment. Non-small-cell lung cancer is often resistant to chemotherapy. Related to this type of cancer, NIEHS researchers found that silencing a gene called INO80 led to reduced tumor growth, potentially leading to better treatment options and improved patient outcomes.

Genetics and lung function. By analyzing data from studies around the world, NIEHS researchers and collaborators identified more than 50 genetic changes that affect the risk of pulmonary disorders in people of European, African, Asian, and Hispanic descent. This information could affect how drugs are developed to treat lung function problems.

Global Health at NIEHS: Cookstoves, Smoke, and Disease

Globally, about 3 billion people cook daily meals using stoves fueled by wood, coal, or dung. These cooking methods produce smoke that contributes to an estimated 4.3 million annual deaths, with women and young children affected most. Cookstove smoke contributes to lung diseases such as acute pneumonia in children under 5, lung cancer, tuberculosis, and COPD, as well as cardiovascular disease. NIEHS invested about $9 million in research related to cookstoves and their health effects, primarily in community-based intervention studies in Guatemala, Ecuador, Nepal, Pakistan, Ghana, and the U.S.

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