What Is Secondhand Smoke (SHS)?

Mainstream Smoke (MS): The smoke drawn through the mouthpiece of the cigarette when puffs are taken.

Sidestream Smoke (SS): The smoke emitted from the smoldering cigarette between puffs.

Secondhand Smoke (SHS): Combination of SS and exhaled MS.
SHS or Environmental Tobacco Smoke (ETS)?

- **SHS or ETS?**
  - SHS preferred
  - ETS originated with industry

- Active smoking

- Passive smoking

- Involuntary smoking

What Is in SHS?

- SHS contains the same gases and particles as MS

- SHS is a dynamic mixture, changing as it ages

- SHS can be considered as qualitatively comparable to MS in terms of potential toxicity
What Are the Health Effects of SHS?

- Evidence comes from knowledge of SHS components and their toxicity
- Evidence on active smoking and health provides a foundation
- Studies have assessed exposures and doses, using biomarkers
- Epidemiological studies provide direct evidence on health risks

Hirayama’s Study

<table>
<thead>
<tr>
<th>Population at enrollment</th>
<th>Standard mortality rate for lung cancer over 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonsmoker wives of nonsmoker husbands</td>
<td>21,895</td>
</tr>
<tr>
<td>Nonsmoker wives of husbands who smoke</td>
<td>69,645</td>
</tr>
<tr>
<td>Women who smoke</td>
<td>17,366</td>
</tr>
</tbody>
</table>

Health Effects of Passive Smoking: Jonathan Samet, MD, MS

1986 Surgeon General’s Report

C. Everett Koop, MD
Former U.S. Surgeon General

Relative Risks and 95% Confidence Intervals in Case-Control Studies of Passive Smoking and Lung Cancer

Years Per day Per day Per day Pack-years Smoking habits of spouses


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1986: Three Key Reports

The Health Consequences of involuntary smoking
A report of the Surgeon General

Environmental Tobacco Smoke: Measuring Exposures and Assessing Health Effects

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Health Effects of Passive Smoking: Jonathan Samet, MD, MS

IARC, 2004

- Involuntary smoking (exposure to secondhand or “environmental” tobacco smoke) is carcinogenic to humans (Group 1)


Passive Smoking and Lung Cancer: 1986

- “Involuntary smoking is a cause of disease, including lung cancer, in healthy nonsmokers”
The 2006 Surgeon General’s Report

"The Surgeon General’s Report that we are releasing today, The Health Consequences of Involuntary Exposure to Tobacco Smoke, documents beyond any doubt that secondhand smoke harms people’s health. In the course of the past 20 years, the scientific community has reached consensus on this point."

— Vice Admiral Richard H. Carmona, MD, MPH, FACS
United States Surgeon General
U.S. Department of Health and Human Services, June 27, 2006
2006 Surgeon General’s Report: Major Conclusions

1. Secondhand smoke causes premature death and disease in children and in adults who do not smoke

2. Children exposed to secondhand smoke are at increased risk for sudden infant death syndrome (SIDS), acute respiratory infections, ear problems, and more severe asthma (smoking by parents causes respiratory symptoms and slows lung growth in their children)

3. Exposure of adults to secondhand smoke has immediate adverse effects on the cardiovascular system and causes coronary heart disease and lung cancer


4. The scientific evidence indicates that there is no risk-free level of exposure to secondhand smoke

5. Many millions of Americans, both children and adults, are still exposed to secondhand smoke in their homes and workplaces, despite substantial progress in tobacco control

6. Eliminating smoking in indoor spaces fully protects nonsmokers from exposure to secondhand smoke (separating smokers from nonsmokers, cleaning the air, and ventilating buildings cannot eliminate exposure of nonsmokers to secondhand smoke)

Health Effects of Passive Smoking: Jonathan Samet, MD, MS

Diseases and Adverse Health Effects Caused by SHS

- Adults
  - Lung cancer
  - Heart disease

- Children
  - SIDS
  - Exacerbation of asthma
  - Chronic respiratory illness
  - Reduced lung function growth
  - Middle ear disease
  - Acute respiratory illness


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Health Effects of Secondhand Smoke in Children

- Sudden infant death syndrome (SIDS)

  - Risk factors for SIDS include the following:
    - Active maternal smoking: risk increases with increased maternal smoking during pregnancy
    - Prematurity and low birthweight: both associated with maternal smoking

- SHS promotes direct irritation of the airways and respiratory infection

- Exposure to nicotine may alter an infant’s response to hypoxia

Text source: U.S. Surgeon General’s Report. (2006); image source: Hemera Photo-Objects copyright-free image CD.

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### SHS and Risk of SIDS: Meta-Analysis

<table>
<thead>
<tr>
<th>SHS exposure</th>
<th>Pooled OR*</th>
<th>(95% CI†)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prenatal maternal smoking</td>
<td>2.8</td>
<td>(2.5 - 3.1)</td>
</tr>
<tr>
<td>Postnatal maternal smoking</td>
<td>1.9</td>
<td>(1.6 - 2.4)</td>
</tr>
</tbody>
</table>

* OR: odds ratio
† CI: confidence interval

Source: adapted by CTLT from Anderson and Cook. (1997).

### Asthma

- Maternal smoking during pregnancy may affect lung growth and responsiveness
- SHS increases airway hyper-responsiveness
- SHS exposure may increase the risk of childhood atopy
- SHS exposure predisposes young children to an increased risk of lower respiratory infection

Asthma and Respiratory Symptoms: Meta-Analysis

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Pooled OR††</th>
<th>(95% CI‡)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma</td>
<td>1.23</td>
<td>(1.14-1.33)</td>
</tr>
<tr>
<td>Wheeze</td>
<td>1.26</td>
<td>(1.20-1.33)</td>
</tr>
<tr>
<td>Chronic cough</td>
<td>1.35</td>
<td>(1.27-1.43)</td>
</tr>
<tr>
<td>Chronic phlegm</td>
<td>1.35</td>
<td>(1.30-1.41)</td>
</tr>
<tr>
<td>Breathlessness</td>
<td>1.31</td>
<td>(1.14-1.50)</td>
</tr>
</tbody>
</table>

* OR: odds ratio  
† Either parent smoking  
‡ CI: confidence interval


Chronic Respiratory Illness

- Common childhood respiratory symptoms include the following:
  - Cough
  - Phlegm or sputum production
  - Wheezing

- SHS exposure may increase symptom risk by causing irritation or inflammation of the lung

Health Effects of Passive Smoking: Jonathan Samet, MD, MS

### SHS and Chronic Respiratory Symptoms: Meta-Analysis

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Pooled OR*</th>
<th>(95% CI)‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic cough</td>
<td>1.45†</td>
<td>1.34-1.58†</td>
</tr>
<tr>
<td></td>
<td>1.27</td>
<td>1.21-1.33</td>
</tr>
<tr>
<td>Chronic phlegm</td>
<td>1.35</td>
<td>1.30-1.41</td>
</tr>
</tbody>
</table>

* OR: odds ratio  
† CI: confidence interval  
‡ Shows unadjusted values


### Reduced Lung Function and Growth

- In early childhood, lung development comes to completion with the formation of alveoli
- Lung function growth parallels the change in height throughout childhood
- SHS increases risk for respiratory infections, which may adversely affect lung function
- In utero exposure to maternal smoking may have lasting effects on airways of the lung
- Reduction in lung function observed with active smoking in older children
Health Effects of Passive Smoking: Jonathan Samet, MD, MS

Middle Ear Disease

- Eustachian tube dysfunction is central to the development of middle ear disease

- SHS may contribute to eustachian tube dysfunction through the following:
  - Decreased mucociliary clearance
  - Adenoidal hyperplasia
  - Mucosal swelling
  - Increased frequency of upper respiratory tract infections

SHS and Middle Ear Disease: Meta-Analysis

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Pooled OR*†</th>
<th>(95% CI†)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recurrent otitis media</td>
<td>1.37</td>
<td>(1.10-1.70)</td>
</tr>
<tr>
<td>Middle ear effusion (glue ear)</td>
<td>1.33</td>
<td>(1.12-1.58)</td>
</tr>
</tbody>
</table>

* OR: odds ratio
† Shows either parent smoking; used a random effects model to pool odds ratios
‡ CI: confidence interval

Health Effects of Passive Smoking: Jonathan Samet, MD, MS

SHS and Acute Respiratory Illness (ARI)

- SHS particles are small and can penetrate to the airways and alveoli of the lung
- Gaseous components of SHS may adversely affect lung defenses
- SHS may increase ARI severity through irritation and inflammation of the lung

SHS and Risk of ARI: Meta-Analysis

<table>
<thead>
<tr>
<th>Parental smoking</th>
<th>Pooled OR*†</th>
<th>(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Either parent</td>
<td>1.51</td>
<td>(1.47-1.73)</td>
</tr>
<tr>
<td>Mother smoked</td>
<td>1.56</td>
<td>(1.59-1.86)</td>
</tr>
<tr>
<td>Father smoked</td>
<td>1.31</td>
<td>(1.19-1.43)</td>
</tr>
</tbody>
</table>

* OR: odds ratio  
† Used random effects model to pool odds ratios  
‡ CI: confidence interval

Effects of Secondhand Smoke in Adults: Lung Cancer

- No evidence of threshold in lung cancer risk for active smokers
- Presence of carcinogens in SHS
- Genotoxic activity demonstrated for many SHS components
- SHS-exposed nonsmokers have increased levels of SHS biomarkers, confirming uptake

SHS and Lung Cancer: Meta-Analysis

- Significant dose-response relationship of lung cancer risk with both number of cigarettes smoked by the spouse and with exposure duration

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Pooled RR*</th>
<th>(95% CI†)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Husband smoker</td>
<td>1.37</td>
<td>(1.05-1.79)</td>
</tr>
<tr>
<td>Wife smoker</td>
<td>1.22</td>
<td>(1.13-1.31)</td>
</tr>
</tbody>
</table>

* RR: relative risk
† CI: confidence interval

Health Effects of Passive Smoking: Jonathan Samet, MD, MS

Respiratory Symptoms and Lung Function

- Active smoking leads to an increased prevalence of respiratory symptoms and a decrease in pulmonary function

- Tobacco smoke
  - Causes lung inflammation with the release of proteolytic enzymes from inflammatory cells
  - Inhibits antiproteases
  - Increases airway responsiveness
  - Inhibits mucociliary clearance
  - Causes goblet cell hyperplasia and mucus hypersecretion

Coronary Heart Disease (CHD)

- SHS exposure may increase the risk of heart disease by:
  - Promoting atherogenesis
    - Direct injury of the endothelium
  - Promoting thrombogenesis
    - Increasing platelet aggregability

- Precipitating acute ischemia
  - Increasing oxygen-carrying capacity of the blood
  - Increasing myocardial demand for oxygen
**SHS and CHD: Meta-Analysis**

<table>
<thead>
<tr>
<th>Exposure level</th>
<th>Pooled RR*</th>
<th>(95% CI†)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low to moderate (1-14 cig./day)</td>
<td>1.16</td>
<td>(1.03-1.32)</td>
</tr>
<tr>
<td>Moderate to high (≥15 cig./day)</td>
<td>1.44</td>
<td>(1.13-1.82)</td>
</tr>
</tbody>
</table>

* RR: relative risk  
† CI: confidence interval


---

**Other Health Effects of SHS**

- **Established**
  - Eye, nose, and throat irritation

- **Potential**
  - Children
    - Reduced birth weight
    - Adverse neurodevelopmental and behavioral effects
    - Cardiovascular consequences
    - Exacerbation of cystic fibrosis
## Summary

- SHS causes disease and premature deaths in children and adults.
- In children, SHS causes SIDS and many other diseases, primarily related to the respiratory tract.
- In adults, SHS causes lung cancer and coronary heart disease.
- SHS can be controlled effectively by eliminating smoking indoors.

“The right of smokers to smoke ends where their behavior affects the health and well-being of others”

— C. Everett Koop, 1986

## More Information

- U.S. Surgeon General’s Web site
  - http://www.surgeongeneral.gov
- CDC Office on Smoking and Health (includes access to all SGR reports on smoking)
  - http://www.cdc.gov/tobacco/sgr/index.htm
- Institute for Global Tobacco Control at the Johns Hopkins Bloomberg School of Public Health
  - http://www.jhsph.edu/global_tobacco/
- Global Tobacco Research Network (includes The Tobacco Atlas online)
  - http://www.tobaccoresearch.net/