



University of California, San Francisco
c/o California Poison Control System
San Francisco Division, Box 1369
San Francisco, CA 94143-1369
415-206-4320

University of California, Irvine
Center for Occupational & Environmental Health
5201 California Avenue, Suite 100
Irvine, CA 92617
949-824-1857

Health Risks of Wild Fires for Children – Acute Phase

James M. Seltzer, M.D., Mark Miller, M.D., M.P.H., and Diane L. Seltzer, M.A.
Pediatric Environmental Health Specialty Unit (PEHSU) Region IX
University of California, Irvine School of Medicine
University of California, San Francisco
October 28, 2007

Children are especially vulnerable to environmental hazards. They eat more food, drink more liquids, and breathe more air than adults on a pound for pound basis. Children are in a critical period of development when toxic exposures can have profound negative effects, and their exploratory behavior often places them in direct contact with materials that adults would avoid. Wildfires expose children to a number of environmental hazards, e.g., fire, smoke, psychological effects, and the byproducts of combustion of wood, plastics, and other chemicals released from burning structures and furnishings. During the acute phase of wildfire activity, the major hazards to children are fire and smoke. Acute stress also can impact children during this time, although generally, psychological effects are predominantly seen during the recovery phase, i.e., during displacement and subsequent return to their residences.

The acute phase environmental hazards for children and their family are highlighted below.










- **SMOKE** consists of very small organic particles, liquid droplets, and gases such as CO, CO₂, and other volatile organic compounds, such as formaldehyde and acrolein; actual contents depends upon the fuel source
- **HEALTH EFFECTS OF SMOKE**: Common health effects from smoke include eye and respiratory tract irritation, reduced lung function, and exacerbation of pre-existing lung or cardiovascular disease, e.g., asthma, chronic bronchitis, or cardiac arrhythmias. As a result of inflammation of the lungs and effects on the cardiovascular system, the consequences of smoke inhalation can include chest tightness, shortness of breath, wheezing, coughing, respiratory tract and eye burning, chest pain, dizziness or lightheadedness, and other symptoms. The development of adverse health effects also depend upon fuel source, duration and extent of exposure, and health of the exposed individual. The risk of developing cancer from short-term exposures is small.
- **POPULATIONS AT INCREASED RISK**: pre-existing lung or cardiovascular problems, pregnant women, children, elderly, smokers.
- **CHILDREN ARE NOT JUST SMALL ADULTS**. Their lungs are still in the process of developing and their airways are narrower than adults. They spend more time outdoors,

they inhale more air per pound of body weight, and they engage in more vigorous activity outside. As a result, they are more susceptible to the health effects of smoke.



RECOMMENDATIONS

MINIMIZE PERSONAL SMOKE EXPOSURE

Stay indoors

-  with windows and doors closed and any gaps in the building envelope sealed
-  If available and if needed for comfort, run air-conditioner on “re-circulate” setting. Be sure to change the filter at appropriate intervals to keep it working efficiently
-  If a period of improved air quality, open up (air out) house and clean to remove dust particles that have accumulated inside.
-  Avoid indoor activities that may add to indoor air contamination, e.g., cooking with gas or propane stoves, smoking, vacuuming (if do not have a HEPA filter vacuum or central vacuum system), burning wood stoves or furnaces
-  Additional room or central air filtration systems may help remove airborne particles, but they need to be selected to adequately filter the area in which they serve and be of the right technology. Some electronic air cleaners and ozone generating “filters” can generate dangerous amounts of ozone indoors. (See “Wildfire smoke” reference”). These filtration systems do not removed harmful gaseous contaminants from the air.
-  Humidifiers or breathing through a wet washcloth may be useful in dry climates to keep mucous membranes moist, although this does nothing to reduce airborne contaminant inhalation.
-  Reduce activity, e.g., don’t exercise, to reduce the amount of air contaminants you inhale
-  When riding in a car, keep the windows and vents closed. If comfort requires air circulation, turn the air-conditioning on “re-circulate” to reduce the amount of outside air drawn into the car.
-  Those people in a “high risk” group or those who cannot find adequate shelter from the smoke outside may need to move to publicly provided clean air shelters if they cannot find adequate “clean air” shelter in their home or other that of a friend or relative, assuming these are readily available.

Masks

-  Paint, dust, and surgical masks are not effective obstacles to inhalation of the fine airborne particles generated by wildfires.
-  Masks that filter out 95% of particles measuring 0.3 micrometers diameter or larger can be effective if properly fitted to the wearer’s face. They are available at hardware stores and from mail order catalogues, and are usually termed “N95,” “R95,” or “P95”. Even more efficient masks, e.g., “N99” or “N100”, are also available. Full-face and half-face respirators with HEPA filter cartridges that efficiently filter out the fine airborne particles in smoke as well as some gases can be purchased, but are significantly less comfortable than the masks. No mask is effective unless it is fitted properly. Any of these masks can be uncomfortable to wear and breathe in for any extended period of time. Some brands produce masks for

various sized faces. Although smaller sized masks may appear to fit a child's face, none of these manufacturers recommend their use in children. If your child is in air quality severe enough to warrant wearing a mask, you should remove them to an indoor environment with cleaner air.

- The local **AIR QUALITY INDEX (AQI)** provides an indicator of the level of air quality for the region where it is measured. This index, in turn, provides a measure of the degree of air contamination and consequent health risk. Because the predominant size of particulate matter (PM) from wood smoke is 0.4 – 0.7 micrometers in diameter, the health risk for people inhaling contaminated air can be determined from the measurement of the concentration of particles in this size range in the air, e.g., PM₁₀ or PM_{2.5}: Good (PM = 0-40 µg/m³), Moderate (41-80), Unhealthy for sensitive groups (81-175), Unhealthy (176-300), Very Unhealthy (301-500), Hazardous (>500). These ranges may vary from region to region. Recommended actions for healthy and sensitive populations for each level of air quality can be found in the Wildfire Smoke reference cited below. Your current air quality index can be found at <http://www.airnow.gov>.
- **MINIMIZE OUTDOOR ACTIVITY**. Outdoor activity should be minimized and athletic and physical education halted, until air quality improves sufficiently to a level that does not put children's health at risk. Children predisposed to greater sensitivity to smoke exposure should be kept indoors until air quality has returned to baseline for the area.
- **CLOSING OF SCHOOLS AND BUSINESSES** because of smoke exposure risk (not considering the risk of nearby fires) may become necessary when air quality is so poor that even traveling between indoor locations places people at risk. However, in some situations closing schools, where children may spend a large part of their day in a relatively protected indoor environment and where their activity can be monitored, may place the child at even greater risk of smoke exposure.
- **CONSIDERATION OF EVACUATION** because of smoke exposure should weigh the degree of smoke exposure likely during an evacuation versus that resting quietly inside one's home. If evacuation is required because of very poor air quality or nearby fires, community resources should be positioned to assist with an orderly and safe exit from the smoke/fire zone. The smoke can significantly impair visibility. Also, a disorderly evacuation can unnecessarily increase the duration and extent of smoke exposure.
- People in an **INCREASED RISK OR "SENSITIVE" GROUP** should monitor themselves or be monitored closely for smoke exposure risk and also for signs or symptoms of the adverse health effects described above. Despite the risks of traveling, someone who is showing evidence of a smoke-related pre-existing or even new illness, and who cannot bring this under control with self-treatment, should seek medical care at a nearby facility with appropriate measures to minimize smoke exposure en route.
- **ASH**: The recent fires have deposited large amounts of ash on indoor and outdoor surfaces in areas near the fire. This ash may be irritating to the skin and may be irritating to the nose and throat and may cause coughing. The following steps are recommended (complete steps are available in the full document, above):

- ✿ Do not allow children or animals to play in ash.
 - ✿ Wear gloves, long sleeved shirts, and long pants when handling ash, and avoid skin contact.
 - ✿ Wash any home-grown fruits or vegetables before eating.
 - ✿ Avoid spreading the ash in the air; wet down the ash before attempting removal; do not use leaf blowers or shop vacuums.
 - ✿ Avoid washing ash into storm drains.
 - ✿ Collected ash may be deposited in the regular trash in plastic bags.
- 🌍 **PSYCHOLOGICAL EFFECTS ON CHILDREN:** During the acute phase, parents and caregivers should also be alert to children's emotional health and psychological wellbeing. It is important to keep in mind the youngest members of our society may easily become saturated with graphic pictorial images and incessant talk of smoke, flames and destruction. Resulting stress and anxiety may be manifested in a variety of ways, depending upon the developmental stage of an individual child:
- ✿ Clinging
 - ✿ Nightmares
 - ✿ Fears
 - ✿ Regression
 - ✿ Irritability
 - ✿ Uncooperative behaviors
 - ✿ Physical complaints
 - ✿ Changes in eating or sleeping patterns
 - ✿ Indifference

Parents and caregivers can support children in a number of ways, beginning with maintaining previously established routines and structures as much as possible. Provide an open door and a listening ear for children; encourage the expression of feelings through a variety of pathways, e.g., music, art, journaling, talking. Answer questions openly and honestly, remaining mindful the age of the child will determine how information is shared. Reassure and hug when hugs are wanted; practice patience and adopt a peaceful demeanor, as children can be emotional sponges, taking their cues from the clues given by their parents and the environment.

More details on the health effects of wildfires and ash cleanup are available at the following sites, from which some of this material was adopted:

- http://www.oehha.ca.gov/air/risk_assess/wildfirev8.pdf
- <http://www.calepa.ca.gov/Disaster/Documents/FireAsh.pdf>
- <http://sis.nlm.nih.gov/enviro/californiafires.html#a1>
- <http://www.airnow.gov>

The PEHSU websites for U.S. Environmental Protection Agency Region IX:

- www.coeh.uci.edu/pehsu
- www.ucsf.edu/ucpehsu