



PUBLIC HEALTH

**ALWAYS WORKING FOR A SAFER AND
HEALTHIER WASHINGTON**

Smoke Gets in Your Eyes

Wood Stoves, Fireplaces and Chronic Disease

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Environmental Health Assessments

Why this study was done

- Wood smoke is a common trigger for asthma attacks. Smoke from wood-burning has also been implicated as a factor in other chronic respiratory diseases as well as cardiovascular disease. A committee of public health professionals concerned about the link between poor air quality and health were successful in adding questions to the 2007 WA Behavioral Risk Factor Surveillance Survey (BRFSS) to help determine patterns of wood burning in home heating. This study is the result of analysis of that data.

Why we should be concerned

- Air pollution from **particulate matter** (PM), **especially PM_{2.5}**, is associated with development and worsening of lung and cardiovascular disease. Death rates from these diseases increase as PM levels rise. Even very low levels of PM_{2.5}, below the current federal standard, have been linked to health effects in some people.^[i]

[i] U.S. Environmental Protection Agency. (2004). *Air Quality for Particulate Matter* (Volume II). <http://cfpub2.epa.gov/ncea/cfm/recordisplay.cfm?deid=87903>. Accessed March 5, 2007.

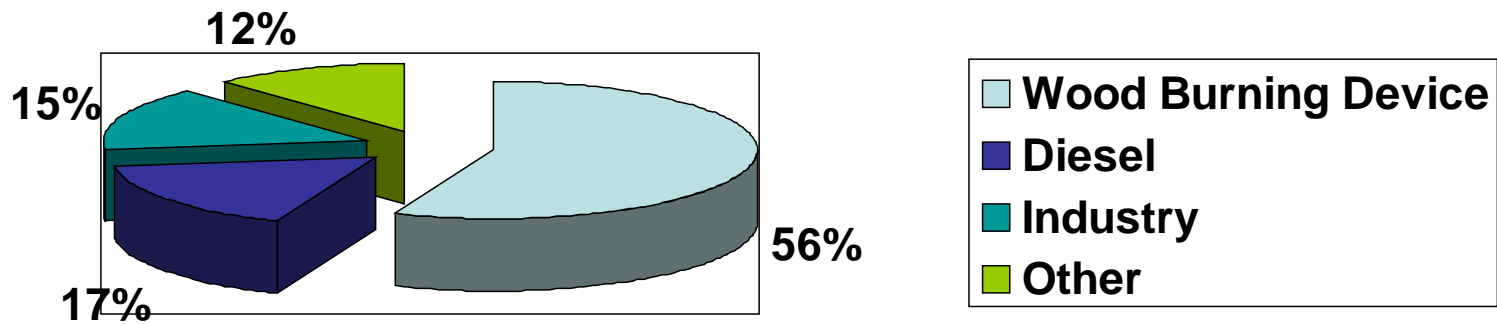
Why we should be concerned (continued)

- Fine particles less than 2.5 microns in diameter (PM_{2.5}), the kind most associated with negative health outcomes, come from combustion,
- In the winter, when PM_{2.5} pollution is highest, wood stoves and fireplaces account for **56%** of this pollution.[\[iii\]](#),[\[iii\]](#)

[\[iii\]](#) Wood Smoke Work Group report to the governor and the legislature. (2007). Reducing the impacts of wood smoke from solid fuel burning devices.

[\[iii\]](#) WA State Dept of Ecology, Air Quality. A New Federal PM2.5 Air Quality Standard: How Does it Affect Washington?

WA Wintertime Sources of PM_{2.5}



Washington State Department of Ecology 2005 Emissions Inventory

WA PM_{2.5} Emissions from Wood Burning Devices

Type Device	# Devices	Tons/year	% PM _{2.5} Emissions
Uncertified stoves, inserts, furnaces	292,841	8435	58%
Certified stoves, inserts, pellet	322,113	3600	25%
Fireplaces	705,985	2509	17%
Total	1,320,959	14,544	

Washington State Dept. of Ecology, 2005 Emission Inventory Data

Composition of Wood Smoke

- Gases and fine particles suspended in air
 - Inhalable particulate matter
 - Carbon monoxide
 - Volatile organic gases
 - Aldehyde gases
 - Nitrogen oxides
 - PAHs
 - benzo[a]pyrene, benzene, formaldehyde
(Known or probable human carcinogens)

Wintertime Inversions & Air Stagnation

- November – February
- Inversion = layer of warm air acts like a lid and traps cold air and pollutants near ground level
- Stagnation = lack of air movement to clear away pollution
- Wood smoke pollutants trapped at ground level



Why we should be concerned (continued)

- **Health Effects:** Few studies of air pollution have isolated wood smoke and linked it to particular health outcomes. However, recent studies done in developing countries where use of wood for cooking is common are provocative:

- Pakistan: Prenatal exposure to wood fuel smoke linked to low birth weight.¹
- Nigeria: Wood smoke exposure linked to mortality among young urban children with pneumonia.²
- Guatemala: Women whose cook stoves were outfitted with chimneys experienced reductions in blood pressure.³
- Mexico: Non-smoking patients with long exposure to wood smoke had obstructive lung disease, chronic bronchitis, emphysema, and pulmonary hypertension *comparable to smokers*.⁴

¹ Siddiqui AR, et al, Prenatal Exposure to Wood Fuel Smoke and Low Birth Weight. Environmental Health Perspectives, 116(4):543-549, 2008.

² Johnson ABR et al, Etiologic agents and outcome determinants of community-acquired pneumonia in urban children: A hospital-based study. Journal of the National Medical Association, 100(4): 370-385, 2008.

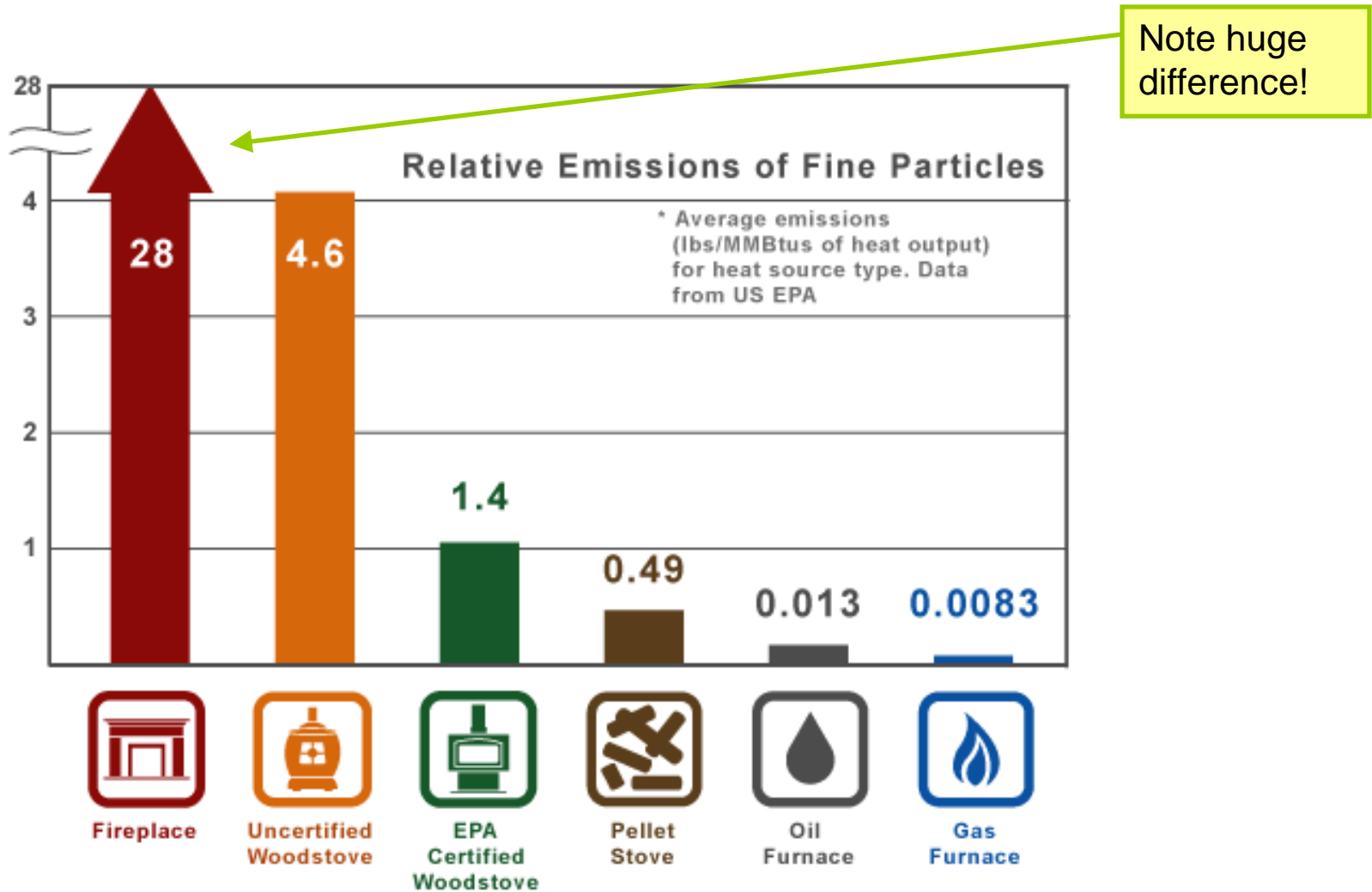
³ McCracken JP, et al. Chimney stove intervention to reduce long-term wood smoke exposure lowers blood pressure among Guatemalan women. Environmental Health Perspectives, 115(7):996-1001, 2007.

⁴ Moran-Mendoza O, et al, Wood smoke-associated lung disease: a clinical, functional, radiological and pathological description. The International Journal of Tuberculosis and Lung Disease, 12(9):1092-1098, 2008.

Don't all fuels contribute to air pollution?

- Yes. But the amount of particulate matter (PM) emitted varies depending on ***fuel source***.
 - **Gas** (Natural or Propane)
 - **Heating Oil**
 - **Wood** (*listed in order of emissions*)
 - Pellets
 - Manufactured logs
 - Dry hardwoods
 - Unseasoned woods/softwoods
- **And** some types of wood-burning equipment are more efficient than others...that is they emit less particulate matter (PM).

Relative Emissions of Fine Particles (PM2.5)



Source:
<http://www.epa.gov/air/woodstoves/refp.html>

The Data

- 2007 WA Behavioral Risk Factor Surveillance Survey (BRFSS), an annual random digit statewide telephone survey for adults ages 18 and older.
- Five state-added questions on home heating using wood-burning equipment
 - 11,559 people participated in the module
 - 3,409 used a woodstove
 - 1,941 used a fireplace

Text of Home Heating Questions

Do you currently have a stove that you use for heating or for pleasure in your home, such as a wood-burning stove, a pellet stove or a wood-burning insert in a fireplace?

1 = Yes, wood burning stove

2 = Yes, pellet stove

3 = Yes WOOD-BURNING fireplace insert

4 = No, no wood or pellet stove or WOOD-BURNING fireplace insert

How often do you use your <wood burning stove, pellet stove, wood-burning fireplace insert> during the winter, that is, from November to March?

1 = Every day

2 = Every other day

3 = Once or twice a week

4 = Less than once a week, more than once a month

5 = Once a month or less

6 = Never

Text of Home Heating Questions (continued)

Is the stove certified? [IF NEEDED: Was it purchased new in 1992 or later?]

1 = Yes, know that it's certified

2 = Don't know if certified, but it is new since 1992

3 = No, not certified/not new since 1992

Do you currently have a wood-burning fireplace that you use in your home?

1 = Yes

2 = Only the one with insert (covered in previous questions)

3 = No fireplace, fireplace not useable

How often do you use your wood-burning fireplace during the winter, that is, from November to March?

1 = Every day (6 or 7 times a week)

2 = Every other day (3-5 times a week)

3 = Once or twice a week

4 = Less than once a week, more than once a month

5 = Once a month or less

6 = Never

Findings from DOH study:

Patterns of use were not uniform throughout the state. There were differences in type of equipment used and frequency of burning by

- age of respondent
- income
- county
- community type

Overall prevalence of use:

About **40%** of respondents used some type of wood-burning equipment during the winter months (November-March).

Woodstoves	25%
Woodstove	14%
Wood-burning fireplace insert	8%
Pellet Stove	3%
Wood-burning Fireplaces	22%

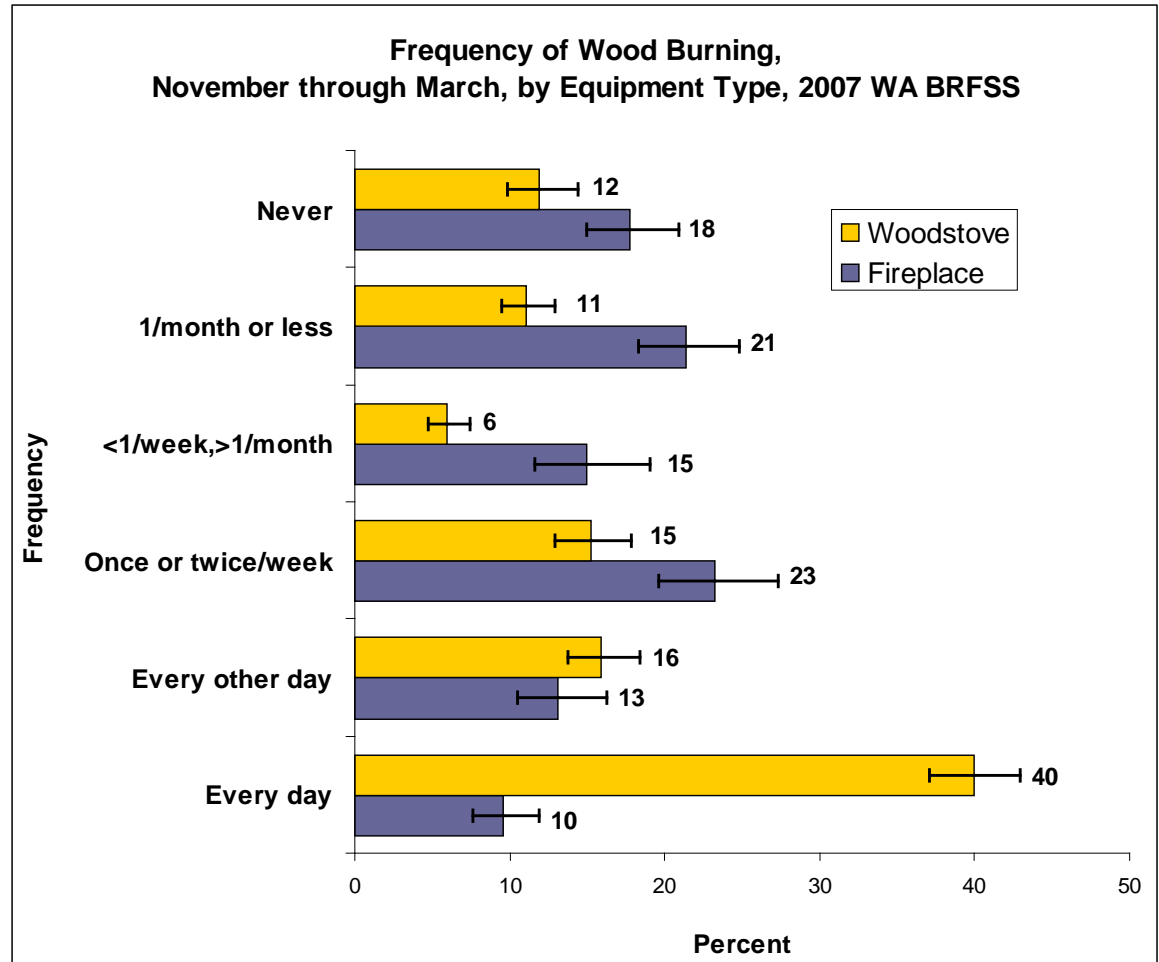
About **17%** of households used both woodstove and fireplace.

Burn Frequency Patterns

Fireplaces versus Woodstoves

Well over half (56%) of woodstove* users burn every day or every other day.

Only about 23% of fireplace users burn every day or every other day. Another 23% use their fireplaces once or twice per week. Over half use their fireplaces less often.



Data Analysis:

Because the difference in emissions between woodstoves and fireplaces is so large and their patterns of use are very different, they were analyzed separately to provide the most accurate information possible.

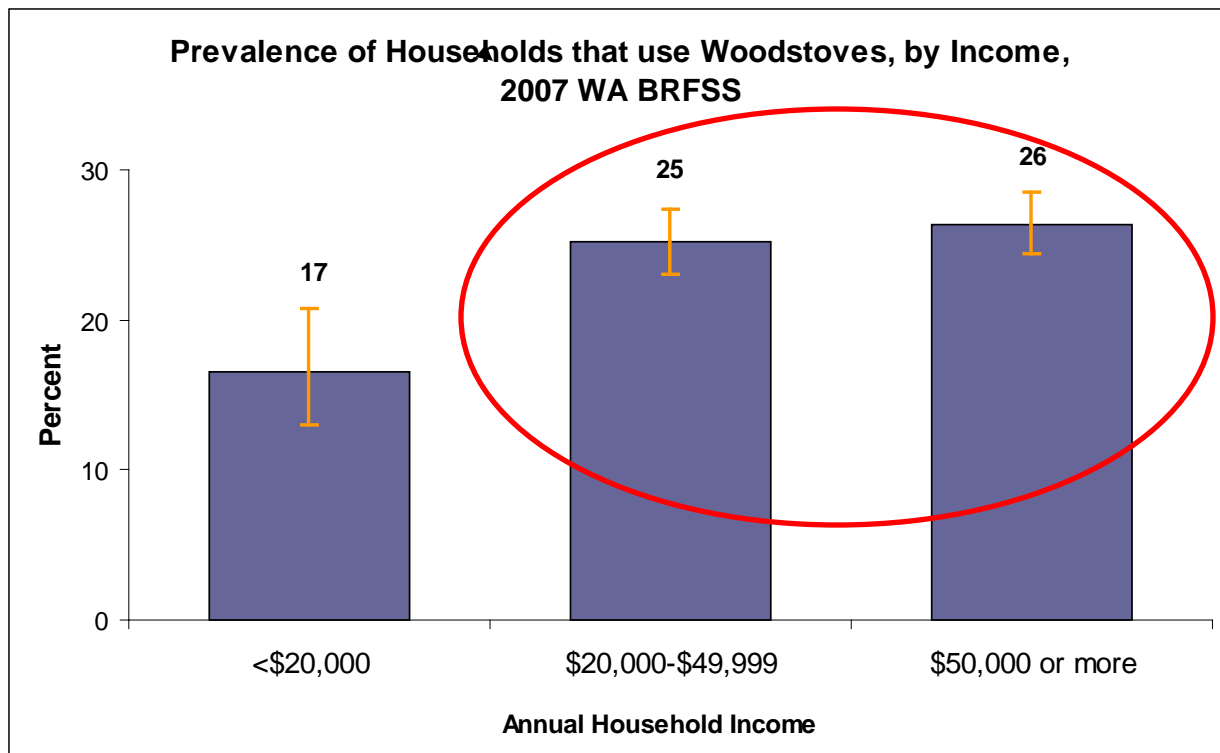
WOODSTOVES



Including wood-burning stoves, fireplace inserts and pellet stoves

Woodstove user demographics: Income

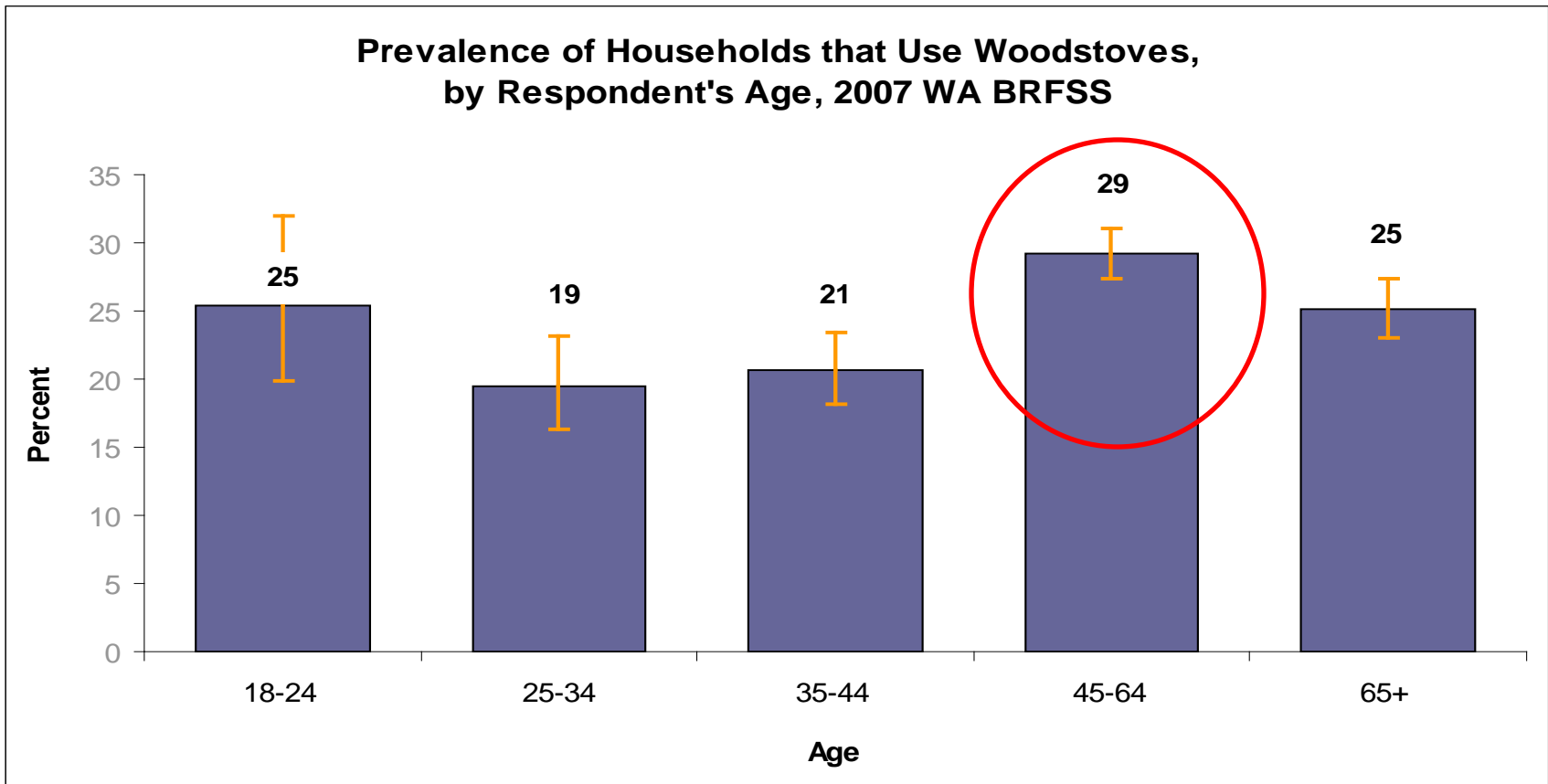
Households with annual incomes of \$20,000 or more were significantly more likely than lower income households to have a woodstove* that was used.



Differences in educational attainment were not significant.

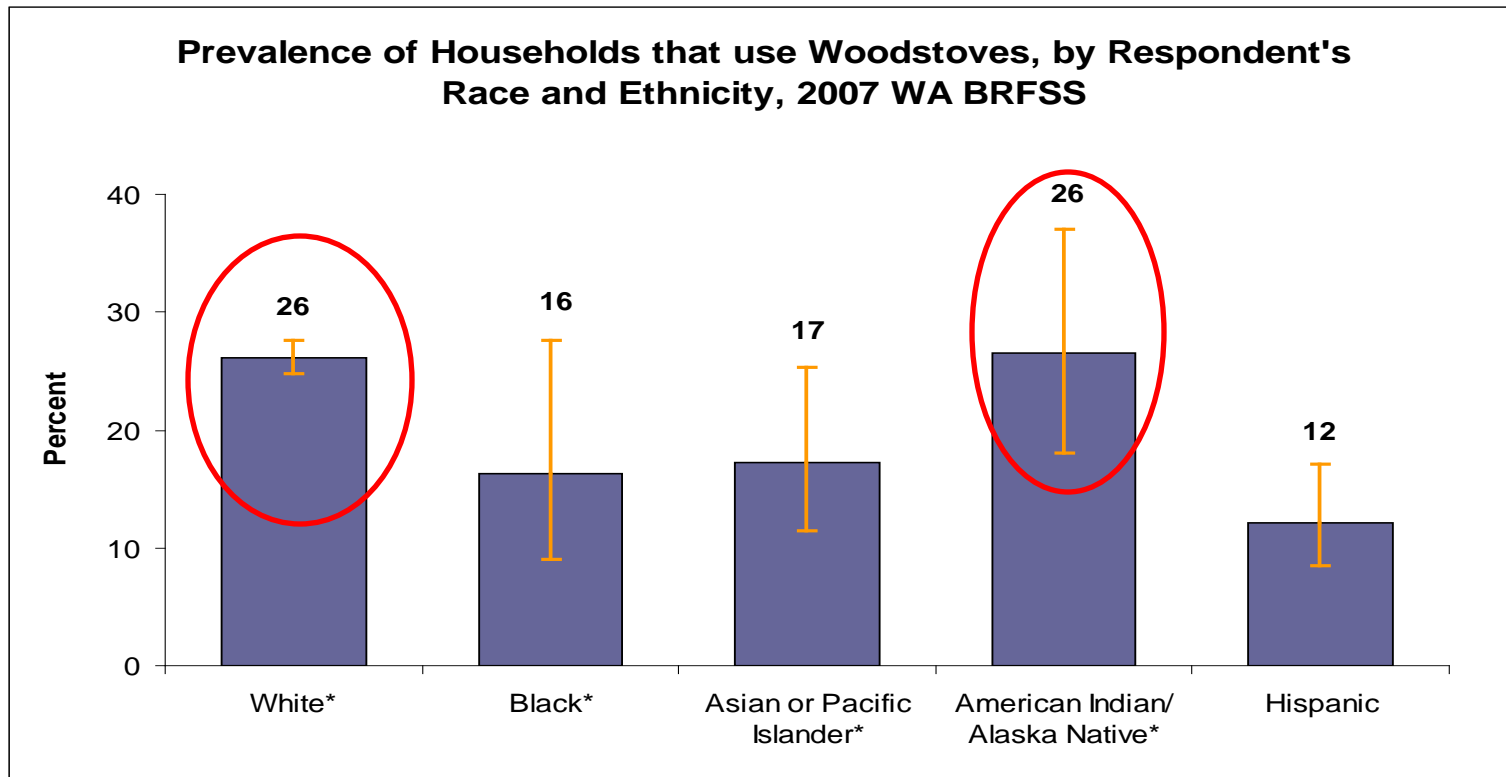
Woodstove user demographics: Age

Respondents ages 45 to 64 were significantly more likely to have a woodstove* that was used than those ages 25-44.



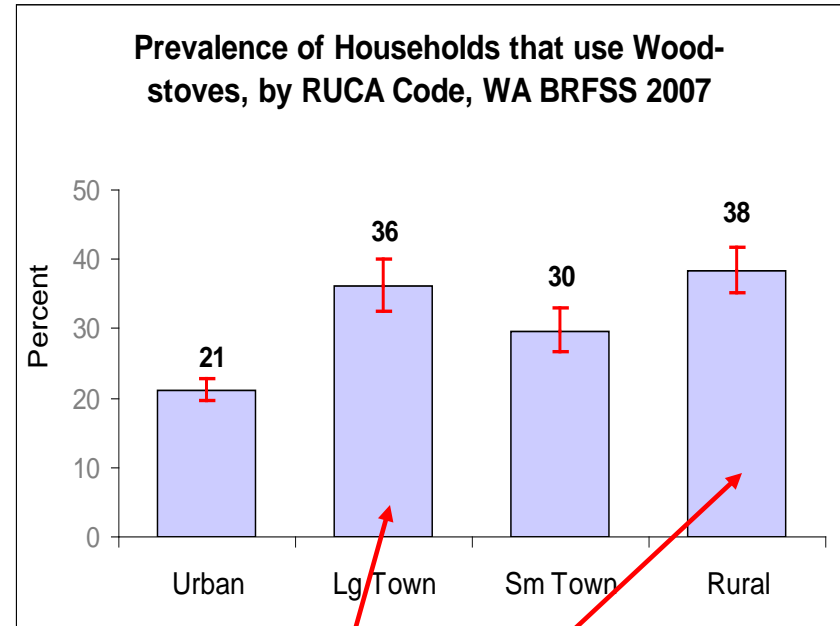
Woodstove user demographics: Race/Ethnicity

Prevalence of having a woodstove that was used was significantly higher among Non-Hispanic whites and or American Indians/Alaska Natives than among Hispanics.**



*non-Hispanic

Rural-Urban Differences



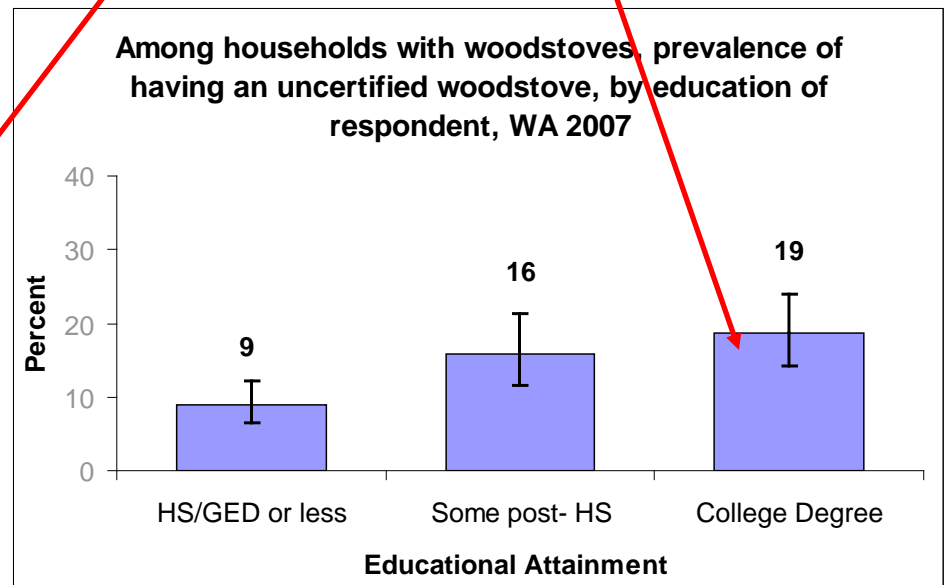
Prevalence of having a **woodstove*** that was used was highest in rural areas and large towns.

*wood-burning stove, fireplace insert or pellet stove.

Uncertified Woodstoves:

About one out of every eight (12.6%) households where woodstoves were used had *uncertified* stoves.

Highest likelihood of having an uncertified stove was among respondents who were older and more educated.



Differences by household income were not significant.

“Relative smoke emission scores”
were computed for each respondent based on equipment type and frequency of use, and prevalence was re-computed.

- This means that, in addition to what percent of households had woodstoves, we were able to **weight** that information according to the type of equipment they were using and how often they burned.

Assigning relative smoke emission scores

Woodstoves: Has a woodstove* - 1 Pt

Multiply by:

Frequency

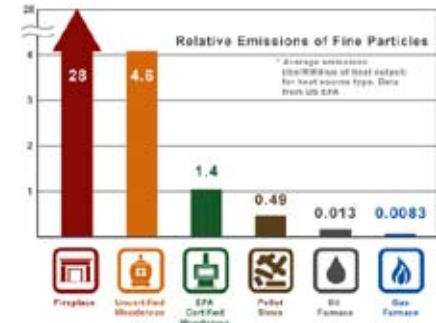
Every day / every other day - 3 Pts

Once / twice a week - 2 Pts

Less than once a week - 1 Pt

Never - 0 Pts

Relative Emissions of Fine Particles (PM2.5)



Source:
<http://www.epa.gov/air/woodstoves/refp.html>

Stove is uncertified - Multiply by 3.2

(the ratio of difference in emissions between certified and uncertified stoves).

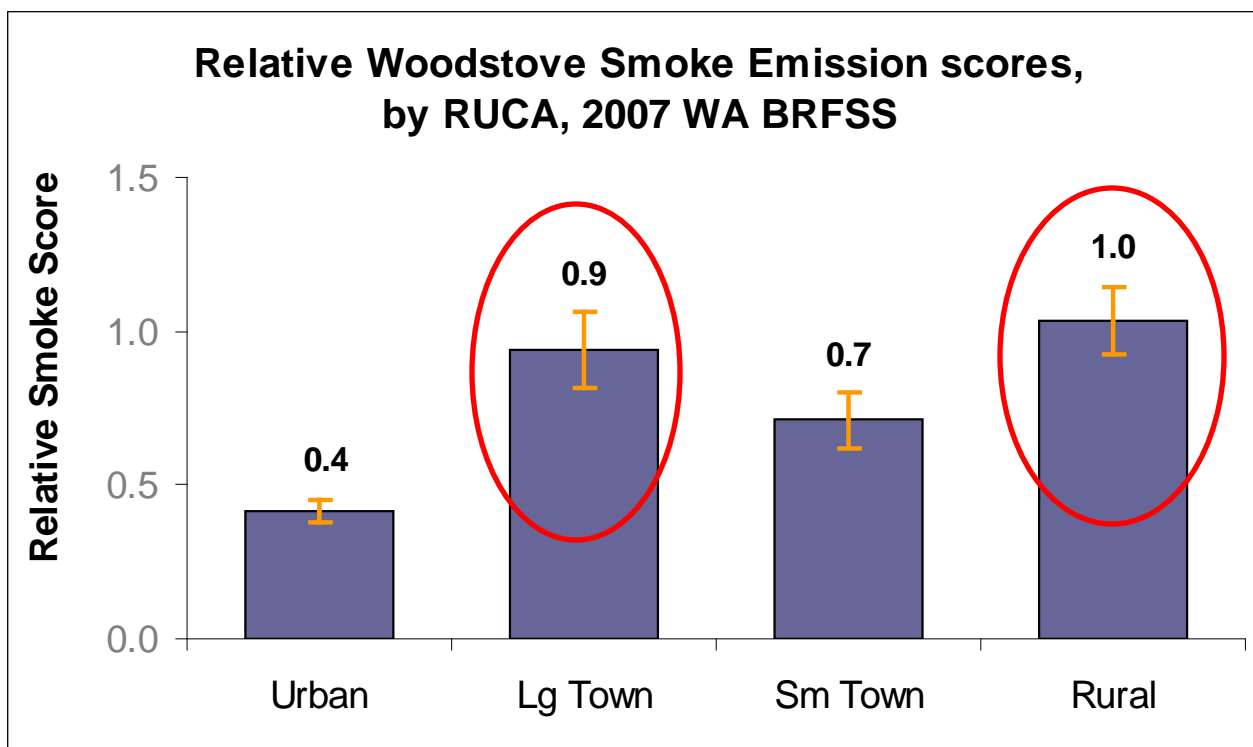
Stove is pellet stove - Multiply by 0.35

(the ratio of difference in emissions between certified and pellet stoves).

Range of woodstove smoke scores: 0.0 - 9.9.

Relative Woodstove Smoke Emission Scores by Rural-Urban Classification

- Woodstove* relative smoke emission scores were significantly higher in large towns and rural areas than in small towns and urban areas.



FIREPLACES

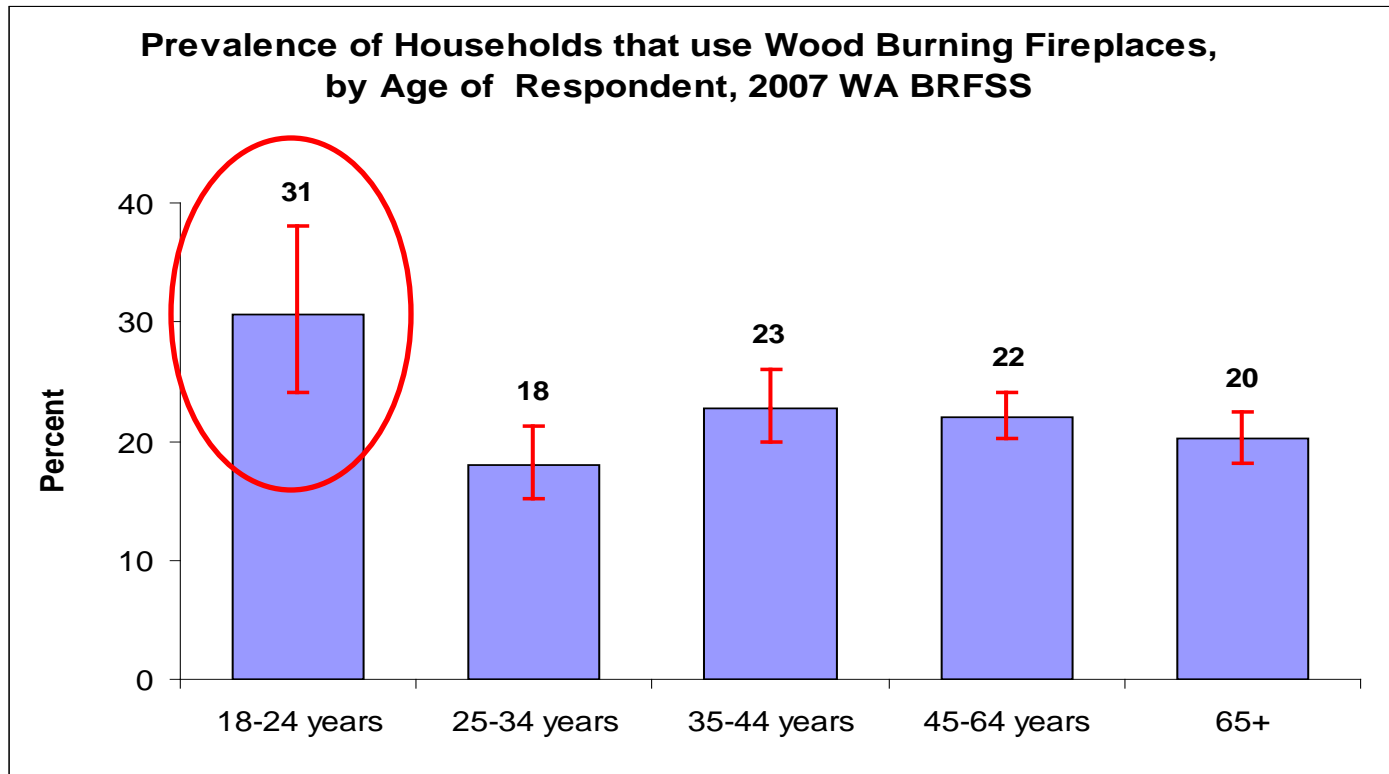
Wood-burning open fireplaces, not including fireplace inserts previously discussed.



NOTE: It's important to remember that fireplaces emit much more PM_{2.5} than woodstoves.

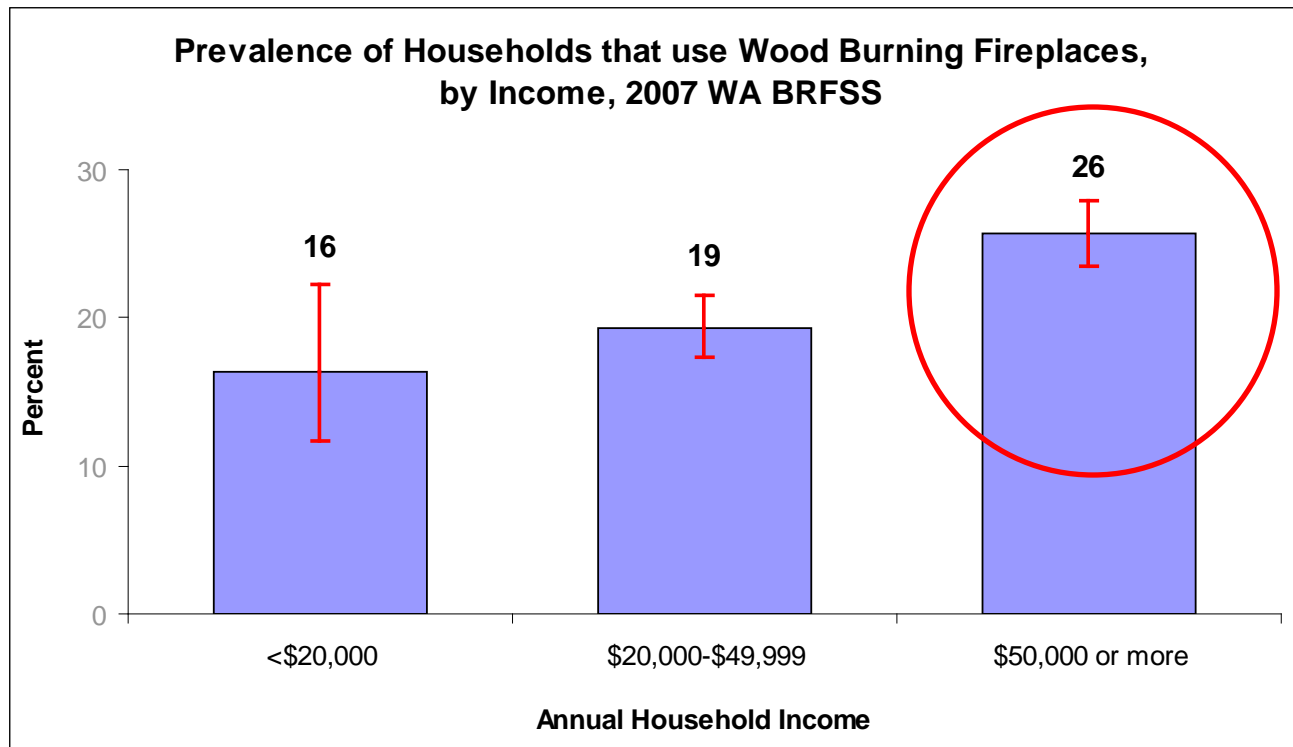
Fireplace user demographics: Age

Prevalence of having a wood-burning fireplace that was used was significantly higher among respondents who were ages 18-24 than among every other age group except those who were 35-44.



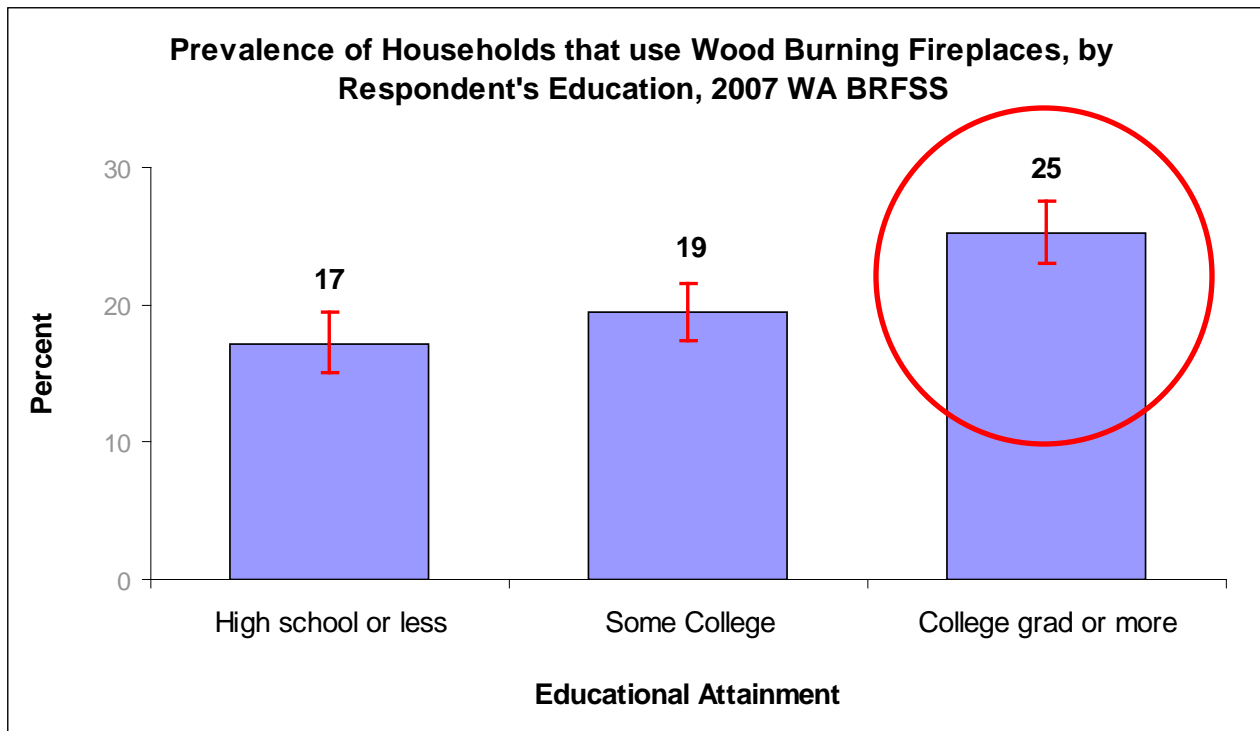
Fireplace user demographics: Income

Respondents with annual household incomes of \$50,000 or more were significantly more likely to have a wood-burning fireplace that was used than those with less income.

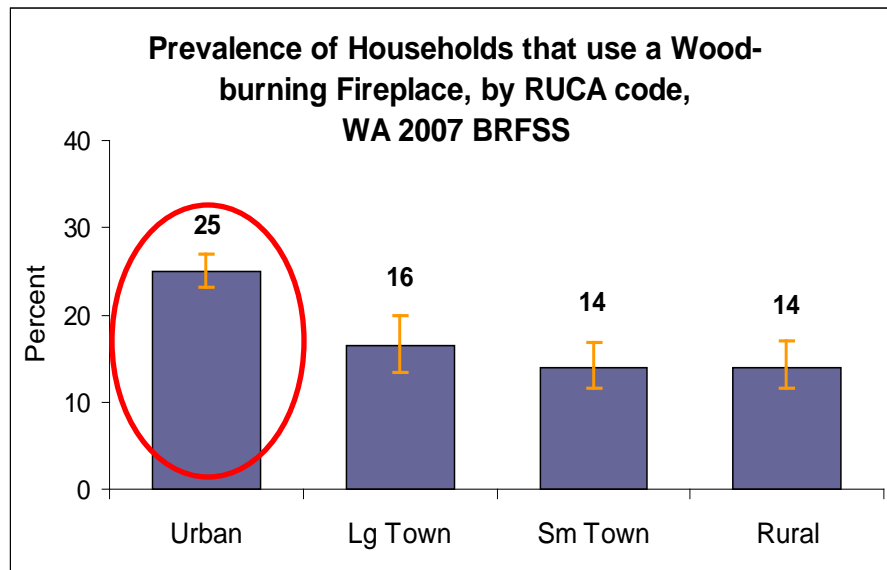


Fireplace user demographics: Education

College graduates were significantly more likely to use wood-burning fireplaces than respondents with less education.



Rural-Urban Differences



Prevalence of using a wood-burning **fireplace** was highest in urban areas.



Assigning Relative FP Emissions

Fireplaces:

Has a Fireplace - 1 Pt

Multiply by:

Frequency

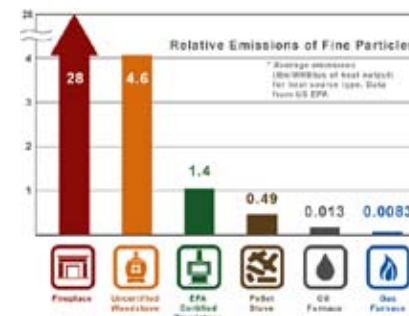
Every day / every other day - 3 Pts

Once / twice a week - 2 Pts

Less than once a week - 1 Pts

Never - 0 Pts

Relative Emissions of Fine Particles (PM2.5)

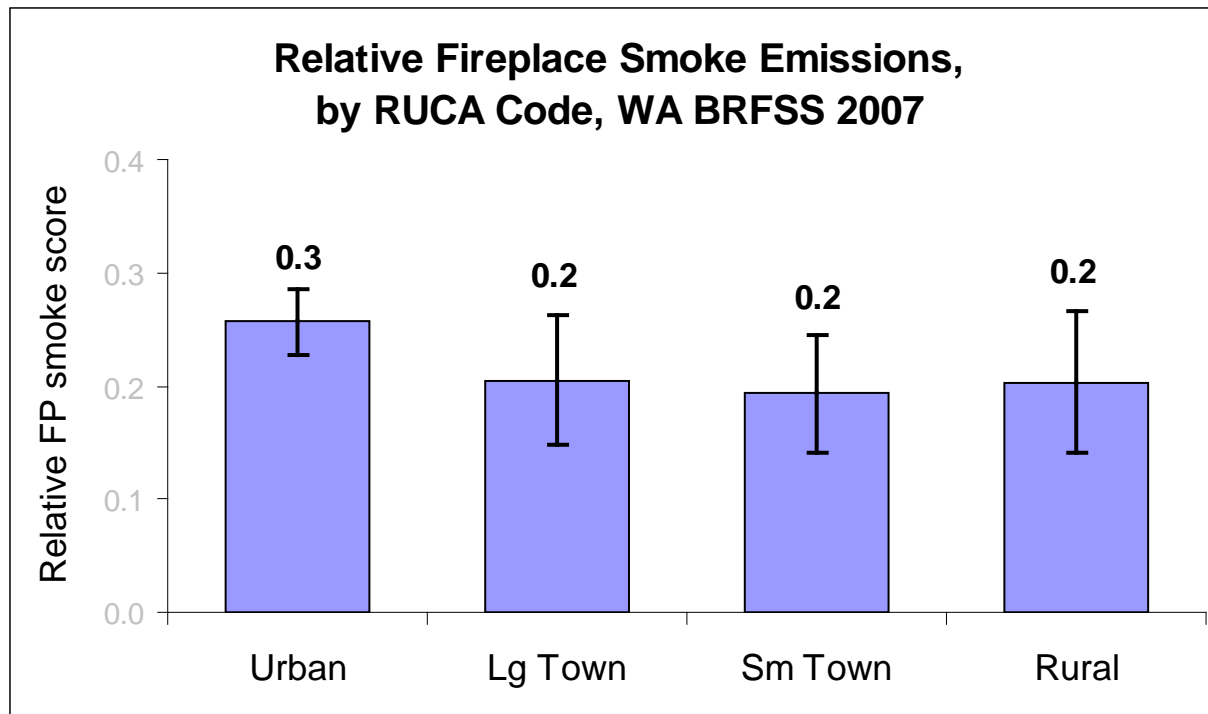


Source:
<http://www.epa.gov/air/woodstoves/refp.html>

Range of individual Fireplace smoke scores: 0 – 3

Relative Fireplace Smoke Emission Scores by Rural-Urban Classification

Although fireplace smoke emissions appeared to be higher in urban areas the difference was **not statistically significant**.



Summary:

- **About two out of five households surveyed used wood-burning fireplaces or woodstoves during the winter months.**
 - About 17% of households used both fireplace and woodstove.
- **Over half of woodstove users burned every day or every other day.**
 - About 12.6% of woodstoves were *uncertified*.

Summary (continued):

- Woodstove users were most likely to be non-Hispanic whites or Native Americans, ages 45-64, with annual household incomes of \$20,000 or more.
- Users of *uncertified* woodstoves were most likely to be age 65 or older and have some college education.

Summary (continued):

- Fireplace users were most likely to be ages 18-24, college graduates, with annual household incomes of \$50,000 or more.
- Fireplace users were also more likely to live in urban areas.
- About one in four fireplace users burned every day or every other day.

Limitations:

We did not collect information on:

- **Type of fuel used or other burning habits**
 - Manufactured logs or seasoned hardwoods versus green, unseasoned fuel.
 - Clean, hot fires versus smokier, smoldering fires.
- **Attitudes about wood burning.**
 - How willing are people to change their burning habits

Limitations *(continued)*:

This analysis does NOT measure actual emissions.

A variety of other factors influence the actual amount of particulate matter air pollution. For example,

Population density: A sparsely-populated county with a high prevalence of wood-burning stoves in use might have less ambient smoke than a more densely-populated county with the same prevalence.

Topography and weather patterns can also have a profound influence on smoke dispersion.

Nonetheless, this study provides new information that could help target educational campaigns.

If people whose burning habits cause high levels of particulate matter to be released could be convinced to change their burning patterns or upgrade to cleaner equipment,

*we could all **breathe easier.***



Next Steps:

Support policies and interventions that could reduce emissions from burning wood, thereby minimizing health effects related to poor air quality.

Education campaigns to teach people how to use clean burning techniques and encourage upgrading to cleaner alternatives, such as:

- using the cleanest possible fuel,
- replacing older uncertified woodstoves and inserts with EPA certified appliances and
- replacing wood-burning fireplaces with gas log fireplaces.

Wood Smoke Related Legislation 2008-2009

- SB6753 - Reduces the threshold for calling burn bans
 - Burn bans can be called for lower levels of fine particle pollution (PM_{2.5})
 - May result in more burns bans being called
- SHB 1420 -Revised real estate disclosure form
 - Must disclose if there is an uncertified stove or fireplace insert
- SSB 5565 - Prohibition of the use of uncertified stoves in certain circumstances
 - Area not meeting federal standards for PM_{2.5} and wood stoves are a major factor
 - Funds available for replacing uncertified stoves to assist low income
 - County, city, and local health jurisdiction have input into process

Additional Resources

- **Washington Department of Ecology**
 - <http://www.ecy.wa.gov/air.html>
- **Local Clean Air Agencies**
 - **Benton Clean Air Agency** - Benton County
 - **Northwest Clean Air Agency** - Whatcom, Island, & Skagit counties
 - **Olympic Region Clean Air Agency** - Thurston, Mason, Pacific, Grays Harbor, Jefferson, & Clallam counties
 - **Puget Sound Clean Air Agency** - King, Snohomish, Pierce, & Kitsap counties
 - **Southwest Clean Air Agency** - Lewis, Skamania, Clark, Cowlitz, & Wahkiakum counties
 - **Spokane Regional Clean Air Agency** - Spokane County
 - **Yakima Regional Clean Air Agency** - Yakima County
- **American Lung Association Breathe Easy Network**
 - http://www.alaw.org/air_quality/e-forecast_service



Clean air is essential for good health



We all must breathe the air.

Let's work to keep it clean.

Thank you!

Comments and feedback are always welcome

The logo for Healthy Communities Washington features the words "Healthy Communities" in a large, bold, black sans-serif font, with "Washington" in a smaller, black sans-serif font below it. Two blue curved lines, one above and one below, arch over the text.

Healthy Communities

Washington

Healthy people in healthy places

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