



## Respiratory Symptoms in Non-Smoking Mothers Associated with Indoor Heating Source Use

EW Triche<sup>1</sup>, K Belanger<sup>1</sup>, W Beckett<sup>2</sup>, MB Bracken<sup>1</sup>, JF Gent<sup>1</sup>, TR Holford<sup>1</sup>,  
T Jankun<sup>1</sup>, J McSharry<sup>1</sup>, BP Leaderer<sup>1</sup>

<sup>1</sup>Yale University School of Medicine, New Haven, CT;

<sup>2</sup>University of Rochester School of Medicine and Dentistry, Rochester, NY



### ABSTRACT

Unvented heating appliances are important indoor sources of particulate matter and NO<sub>2</sub>. The objective of this study is to determine whether use of these sources is associated with respiratory symptoms in a group of non-smoking women. Mothers who delivered babies between 1993 and 1996 at 12 hospitals in Connecticut and Virginia were enrolled. Daily respiratory symptom and heating source use information was obtained approximately every two weeks for a one year period. Indoor heating sources included fireplaces, wood stoves, kerosene heaters, and gas space heaters. Lower respiratory symptoms included phlegm; chest tightness, pain or congestion; hoarseness/laryngitis; and wheeze. Upper respiratory symptoms included cough; runny or stuffy nose; and sore throat. Use of the heating appliances was intermittent across the study period. In adjusted Poisson regression models controlling for important confounders, fireplace use was associated with days of lower (phlegm, chest tightness, laryngitis) and upper (cough and sore throat) respiratory symptoms in this group of non-smoking women living in non-smoking households. Use of other sources was not associated with respiratory symptoms in these women. This abstract funded by: NIH ES07456 and ES05410

### INTRODUCTION

- Because of their frequency, respiratory symptoms in adults are an important public health concern in terms of lost productivity and health care expenditures
- Respiratory symptoms have been associated with variations in concentrations of outdoor air contaminants, including NO<sub>2</sub> and particulate matter
- Unvented heating appliances, including fireplaces, wood stoves, and kerosene heaters are among the most important indoor sources of particulate matter
- Unvented gas space heaters are an important indoor source of NO<sub>2</sub>

## METHODS

### **Study population**

- 918 non-smoking women who delivered babies at 12 hospitals in Connecticut and Virginia between 1993 and 1996 were enrolled
- Out of 17,447 mothers screened, all women who used a kerosene heater at least once a week in the winter were invited to participate as well as a random sample of non-users in a ratio of 2:1
- The current analysis includes the 890 women for whom symptom information was available during the winter heating season (Oct 15 - Apr 15, 1994 - 1997)
- Home interview was conducted by trained research assistant. Information on the woman's health history, demographic data, and use of secondary heating appliances was obtained
- Women were contacted by telephone at approx. biweekly intervals for one year (median interval = 16 days; IQR = 13 - 19 days) to obtain information on heating source use and daily respiratory symptoms

### **Exposure assessment**

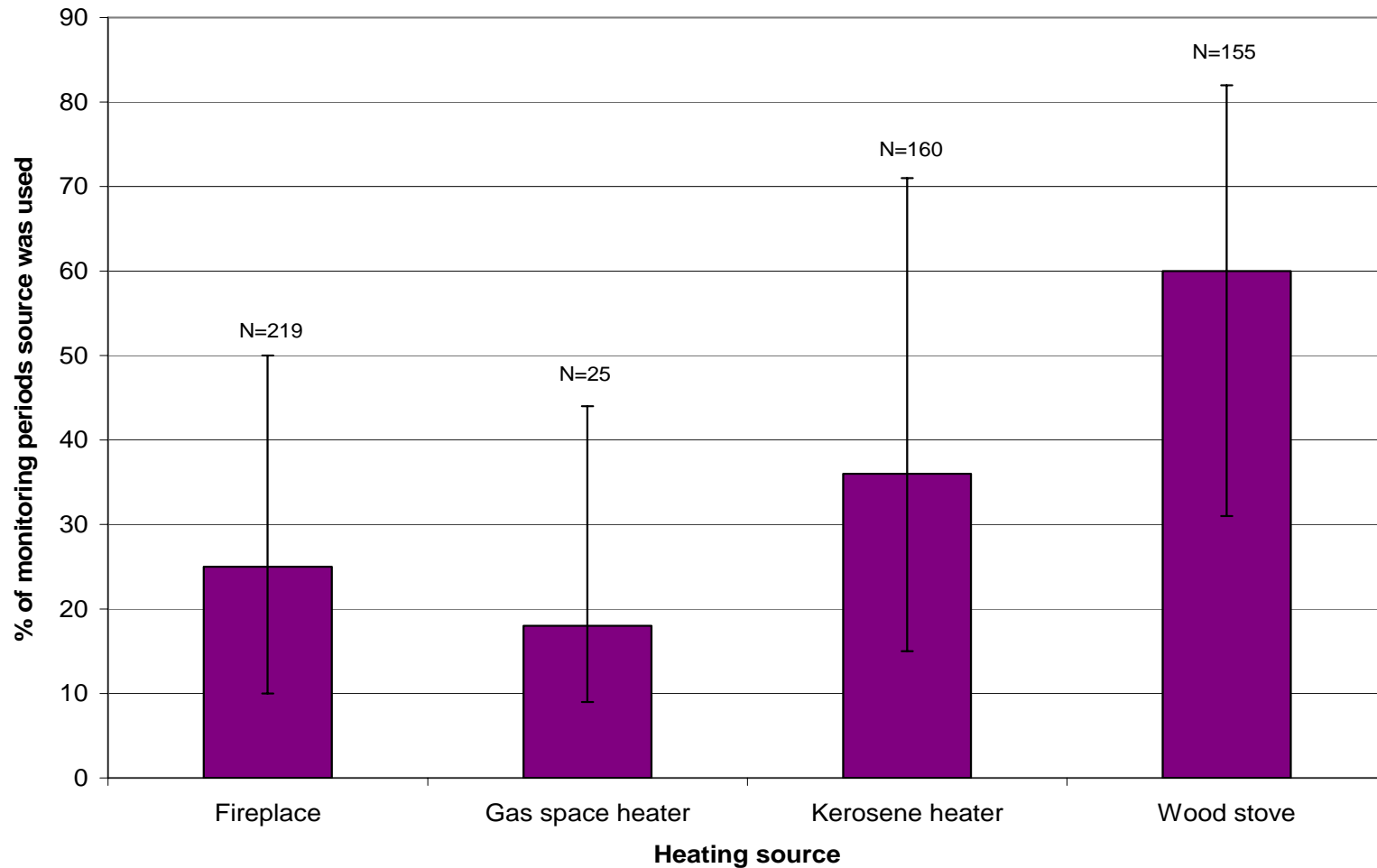
- Heating sources included fireplaces, kerosene heaters, gas space heaters, and wood stoves.
- Women were asked to report whether a heating source was used in the home during that reporting period, as well as the frequency and duration of use. Hours of use multiplied by the number of heating devices was used to calculate average source use in hours per day during the reporting period

### **Health outcomes**

- Mother's respiratory symptoms were measured as counts (i.e., number of days of symptoms) summed over each reporting period. Lower respiratory symptoms included phlegm; chest tightness, pain or congestion; hoarseness/laryngitis; and wheeze. Upper respiratory symptoms included cough; runny or stuffy nose; and sore throat.

## RESULTS

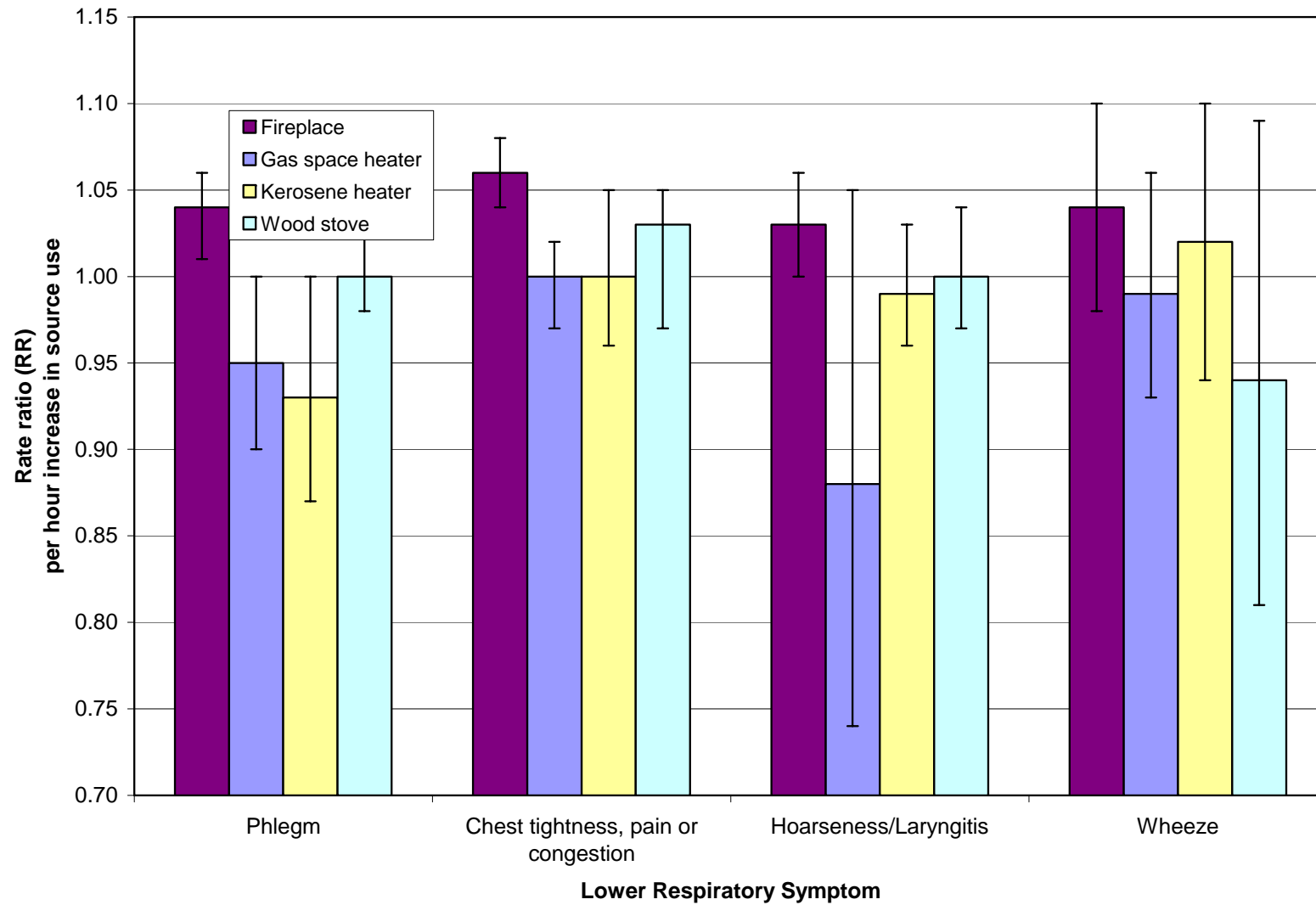
**Figure 1.** Median (and IQR) percentages of monitoring periods heating source was used during the winter heating season (October 15 - April 15, 1994 - 1997), Connecticut and Virginia.



*Note:* N represents the number of women reporting use of each source at least once during the heating season

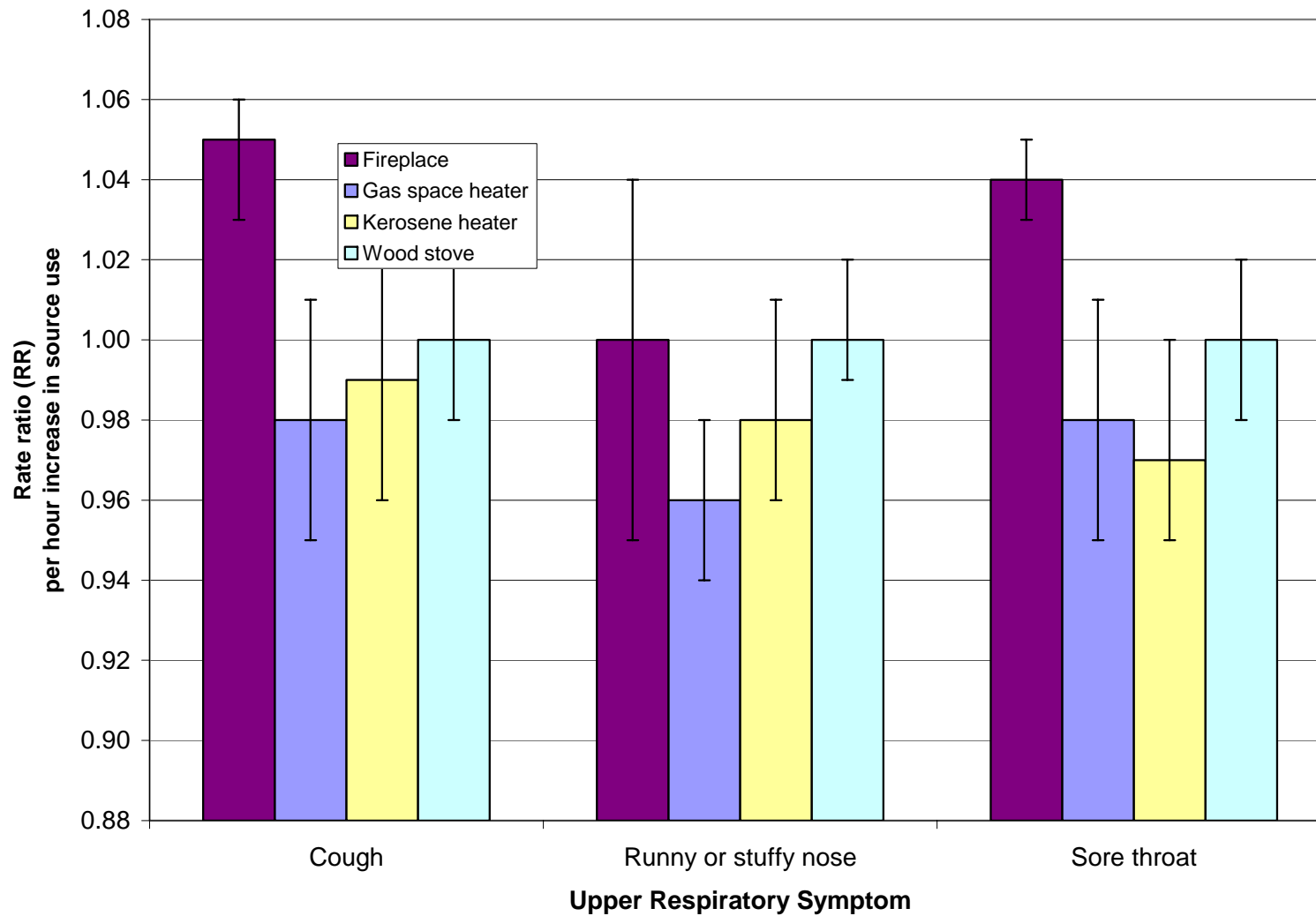
## RESULTS CONT'D

**Figure 2.** Unadjusted associations between hours per day of heating source use and days of mother's lower respiratory symptoms by reporting period



## RESULTS CONT'D

**Figure 3.** Unadjusted associations between hours per day of heating source use and days of mother's upper respiratory symptoms by reporting period



## RESULTS CONT'D

**Table 1.** Percent of monitoring periods mother reported symptom

<b>Symptom</b>	<b>n<sup>a</sup></b>	<b>median % monitoring periods<sup>b</sup></b>	<b>25th - 75th percentile</b>
Phlegm	475	15.4	9.1-25.0
Chest tightness, pain or congestion	289	10.0	8.3-18.2
Hoarseness/Laryngitis	383	9.1	8.3-16.7
Wheeze	81	10.0	8.3-18.2
Cough	608	16.7	9.1-25.0
Runny/stuffy nose	740	20.0	12.5-33.3
Sore throat	634	16.7	9.1-26.7

<sup>a</sup> Number of women reporting at least one day of the symptom during the winter heating season, April 15 - October 15, 1994 - 1997

<sup>b</sup> Among women with at least one day of symptom during winter heating season

## RESULTS CONT'D

**Table 2.** Estimates of rate ratios (RR) and 95% confidence intervals (CI) from Poisson regression models of source use and **lower** respiratory symptoms in non-smoking mothers adjusted for maternal and socioeconomic factors. RR and 95% CI's based on a 1 hr/day increase in source use

	Phlegm days			Chest Tightness days			Laryngitis days			Wheeze days		
	beta	LL	UL	beta	LL	UL	beta	LL	UL	beta	LL	UL
Hrs per day fireplace use	<b>1.03</b>	<b>1.01</b>	<b>1.06</b>	<b>1.05</b>	<b>1.04</b>	<b>1.07</b>	<b>1.03</b>	<b>1.00</b>	<b>1.05</b>	1.03	0.97	1.09
Hrs per day gas space heater use	0.95	0.89	1.01	1.00	0.98	1.03	0.89	0.76	1.05	1.02	0.96	1.09
Hrs per day kerosene heater use	0.95	0.88	1.02	1.02	0.98	1.07	1.01	0.98	1.04	1.07	0.97	1.18
Hrs per day wood stove use	1.01	0.98	1.04	1.02	0.97	1.05	1.00	0.97	1.04	0.97	0.86	1.10
# children in household	1.10	0.94	1.28	0.95	0.78	1.16	1.02	0.85	1.23	0.93	0.59	1.46
Multifamily dwelling	1.05	0.78	1.42	1.30	0.93	1.82	1.14	0.84	1.56	1.75	0.73	4.16
History of allergies	<b>1.71</b>	<b>1.32</b>	<b>2.21</b>	<b>1.79</b>	<b>1.34</b>	<b>2.39</b>	<b>1.64</b>	<b>1.27</b>	<b>2.11</b>	<b>7.90</b>	<b>4.07</b>	<b>15.32</b>
Education												
HS or less	0.88	0.60	1.29	0.97	0.67	1.42	0.88	0.62	1.26	0.73	0.31	1.75
Some college	1.01	0.71	1.46	1.10	0.77	1.57	0.97	0.72	1.32	0.50	0.21	1.18
College graduate +	ref			ref			ref			ref		
Race												
White	ref			ref			ref			ref		
Black or Hispanic	1.60	0.83	3.08	<b>2.67</b>	<b>1.74</b>	<b>4.10</b>	<b>1.56</b>	<b>1.06</b>	<b>2.29</b>	<b>6.01</b>	<b>2.70</b>	<b>13.39</b>

## RESULTS CONT'D

**Table 3.** Estimates of rate ratios (RR) and 95% confidence intervals (CI) from Poisson regression models of source use and **upper** respiratory symptoms in non-smoking mothers adjusted for maternal and socioeconomic factors. RR and 95% CI's based on a 1 hr/day increase in source use.

	Cough days			Nose days			Throat days		
	beta	LL	UL	beta	LL	UL	beta	LL	UL
Hrs per day fireplace use	<b>1.04</b>	<b>1.03</b>	<b>1.06</b>	0.99	0.94	1.04	<b>1.03</b>	<b>1.02</b>	<b>1.05</b>
Hrs per day gas space heater use	0.99	0.96	1.02	0.97	0.95	1.00	0.99	0.95	1.03
Hrs per day kerosene heater use	1.01	0.98	1.04	1.00	0.98	1.03	0.99	0.96	1.02
Hrs per day wood stove use	1.01	0.98	1.03	1.01	0.99	1.02	1.00	0.98	1.02
# children in household	1.09	0.98	1.21	<b>1.11</b>	<b>1.00</b>	<b>1.24</b>	1.03	0.93	1.13
Multifamily dwelling	<b>1.28</b>	<b>1.04</b>	<b>1.58</b>	1.09	0.92	1.30	0.98	0.82	1.17
History of allergies	<b>1.43</b>	<b>1.20</b>	<b>1.69</b>	<b>1.82</b>	<b>1.57</b>	<b>2.11</b>	<b>1.28</b>	<b>1.10</b>	<b>1.48</b>
Education									
HS or less	0.87	0.70	1.08	<b>0.77</b>	<b>0.63</b>	<b>0.94</b>	0.88	0.72	1.06
Some college	0.94	0.76	1.15	<b>0.77</b>	<b>0.64</b>	<b>0.94</b>	1.03	0.85	1.24
College graduate +	ref			ref			ref		
Race									
White	ref			ref			ref		
Black or Hispanic	<b>1.94</b>	<b>1.51</b>	<b>2.50</b>	<b>2.24</b>	<b>1.80</b>	<b>2.80</b>	<b>1.89</b>	<b>1.49</b>	<b>2.40</b>

## SUMMARY

- Use of fireplaces, gas space heaters, kerosene heaters and wood stoves was intermittent during the study period. 219 women used fireplaces, 25 gas space heaters, 160 kerosene heaters, and 155 wood stoves (Figure 1)
- Among the users of these appliances, fireplaces were used during approximately 25% of their reporting periods, gas space heaters 18%, kerosene heaters 36%, and wood stoves 60% (Figure 1)
- Symptoms were also episodic, as expected, with symptomatic women reporting each symptom during between 9% and 17% of their reporting periods (Table 1)
- A much larger percentage of women had upper than lower respiratory symptoms (Table 1)
- The number of symptom days during a reporting period ranged from 0 to the number of reporting period days
- Hours per day of fireplace use increased the rate of phlegm, chest tightness, cough, and sore throat in the unadjusted analyses, while gas space heater use appeared to decrease the rate of runny or stuffy nose (Figures 2 and 3)
- Fireplace use remained significantly associated with rates of phlegm, chest tightness, cough, and sore throat, as well as hoarseness/laryngitis, after controlling for confounders (Tables 2 and 3)
- For most symptoms, there was approximately a 4% increase in the rate of symptoms for every hour increase in fireplace use; for an 8-hour increase in use, this represents a 34% increase in the rate of respiratory symptoms
- None of the other sources was significantly associated with respiratory symptoms after controlling for confounders

## CONCLUSIONS

- Use of fireplaces appears to increase the rate of upper and lower respiratory symptoms in non-smoking women
- There was no evidence that use of gas space heaters, kerosene heaters and wood stoves increased the rate of symptoms in these women; however, these appliances were found to increase the rate of symptoms in their infants (See Poster # 406 [C96])
- Major study strengths include:
  - extensive demographic and household characteristic information,
  - prospective information on respiratory symptoms in these mothers
  - frequent and regular ascertainment of source use information
  - population limited to non-smoking households, thus eliminating the effect of smoking which has been found to be strongly associated with respiratory symptoms,
  - use of repeated measures analysis to account for intermittent source use patterns

## ACKNOWLEDGEMENTS

- This study was funded by grant numbers ES07456 and ES05410 from the National Institute of Environmental Health Sciences