CDC's Role in Evaluating the Impact of Biomass Burning on Human Health

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SAFER HEALTHIER PEOPLE

Biomass Burning

- Activities can include:
  - The clearing of lands for agricultural and grazing use
  - Forest fires
  - Domestic use of biomass matter
- Source of smoke:
  - The burning of living and dead vegetation
  - Wood; food crops; grassy and woody plants; residues from agriculture and forestry; charcoal, coal, and animal dung

Combustion Products of Biomass Burning

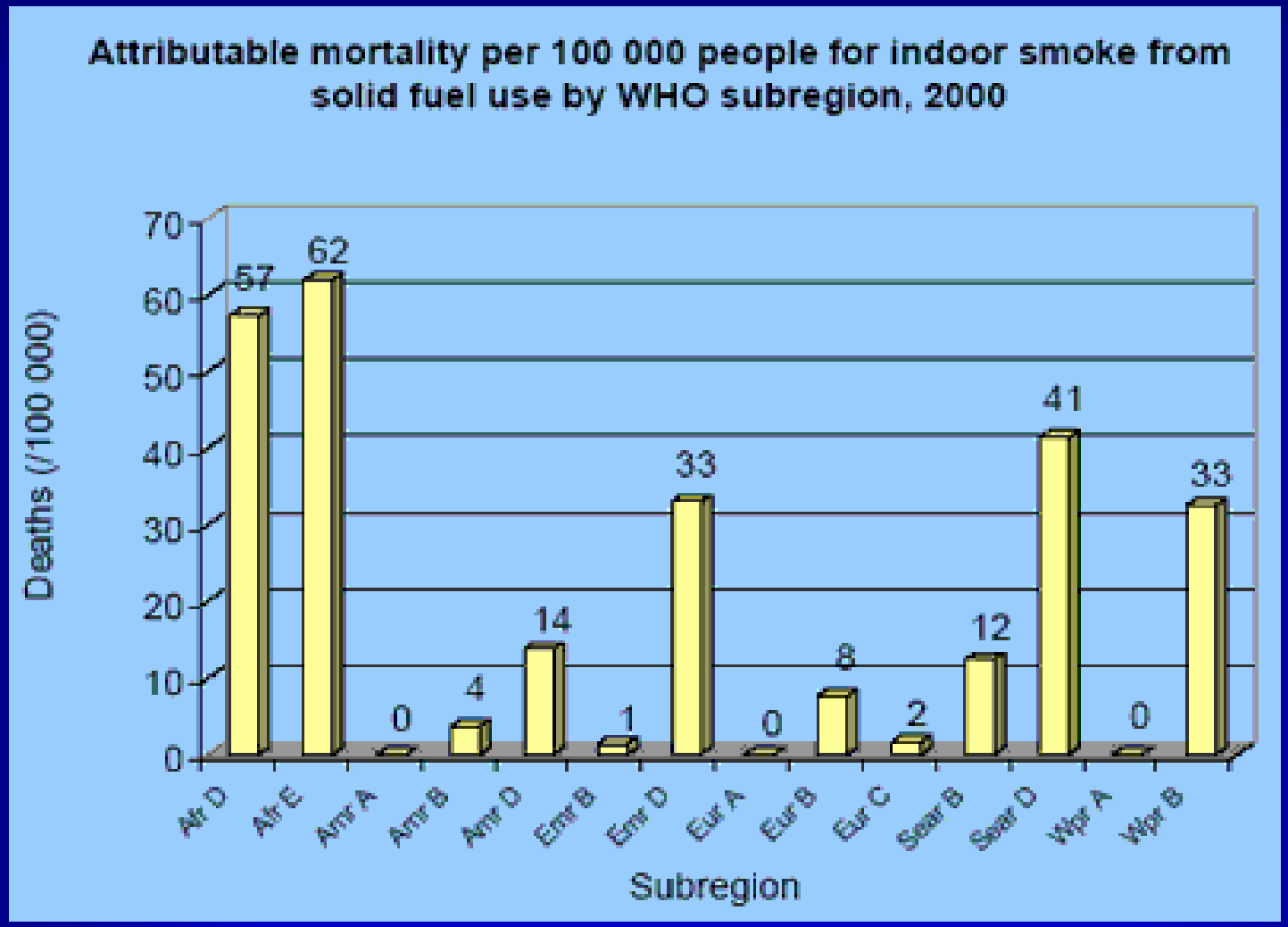
- Gases such as CO and CO_2
- Carbon monoxide
- Hydrocarbons
- Oxygenated organics
- Chlorinated organics
- Free radicals including metals
- Particulate matter both Fine and Coarse

Impact of Biomass Smoke

- Billions of people worldwide exposed daily to indoor biomass smoke from cooking fires or wood stoves

- Most harmful indoor air problem worldwide

- WHO estimate: 8th leading cause of disability adjusted life years lost



Source: WHO, *Global Estimates of the Burden of Disease Caused by the Environment*, 2002

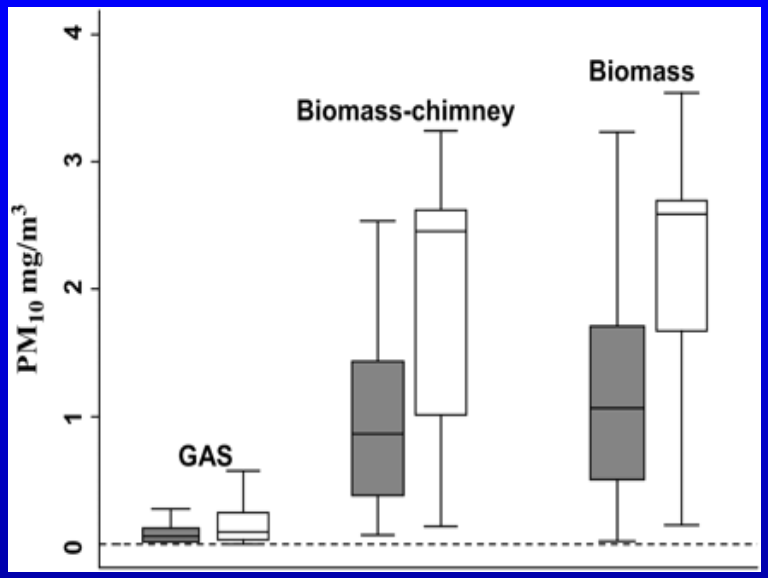
Subregions: AFR=Africa; AMR=Americas; EMR=Eastern Mediterranean; EUR=Europe; SEAR=South-East Asia; WPR=Western Pacific; A: very low child, very low adult mortality; B Low child, low adult mortality; C: Low child, high adult mortality; D: High child, high adult mortality; E: High child, very high adult mortality

Developing Countries- Adults

- Several hospital based studies and cohort studies have focused on lung function in women

- Common health outcomes studied are chronic obstructive pulmonary disease, chronic bronchitis, decreased lung function, cataract formation

Studies of Women in Mexico



Regalado J *et al.* The Effects of Biomass Burning on Respiratory Symptoms and Lung Function on Rural Mexican Women. *Am J Respir Crit Care Med* 2006; 174:901-905.

Cohort of study of COPD Patients:

" Women exposed domestically to biomass develop COPD with clinical characteristics, quality of life, and increase mortality similar in degree to that of tobacco smokers"

(Ramirez-Venegas *et al*. *Am J Respir Crit Care Med* 2006; 173:393-397)

Large Study of Women in Two Counties in China

- One urban area, one rural area
- Approximately 1600 women were enrolled
- Followed from September 2002 through March 2003
- Indoor PM levels measured
- Detailed questionnaire
- Spirometry

Figure 1 Yunyan and Liwang communities in Guangdong province of China.

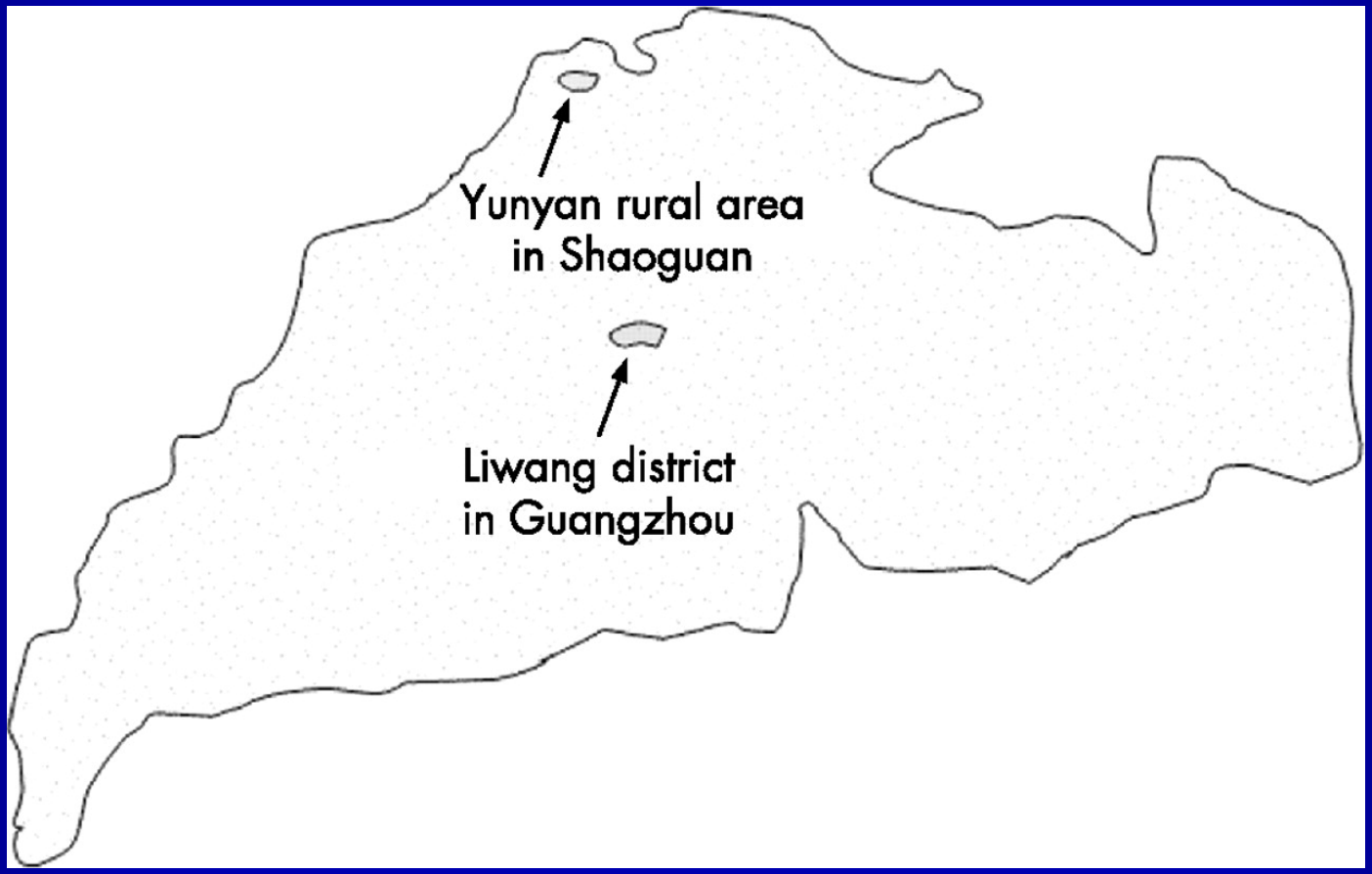


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Figure 2 Cooking in (A) rural Yunyan and (B) urban Liwang.

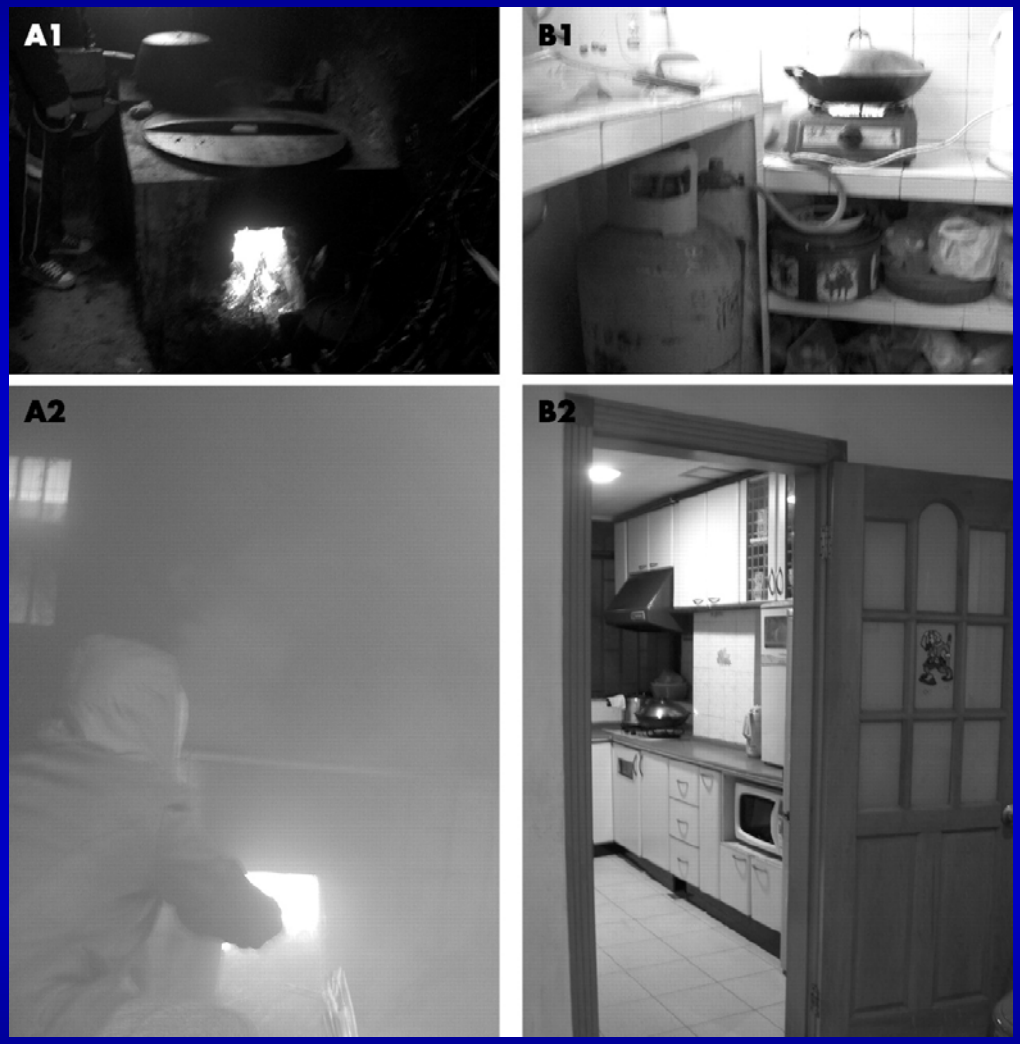

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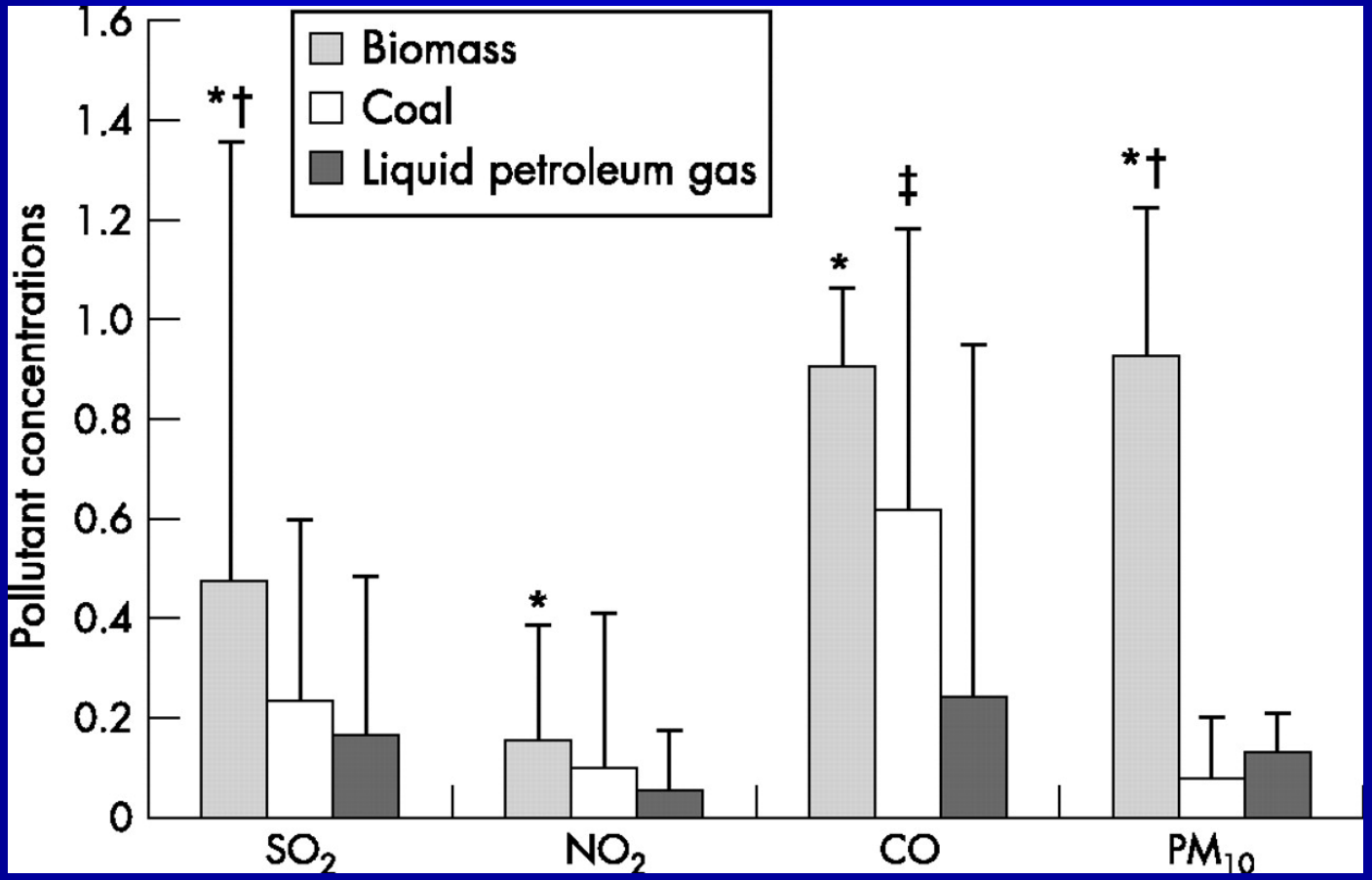
Figure 3 Comparison of pollutant concentrations in the kitchen from burning biomass, coal and liquid petroleum gas (LPG) in rural Yunyan and urban Liwang. Data presented as geometric mean (SD). The total number of samples is 194 with 120 for biomass, 14 for coal and 60 for LPG. Pollutant concentrations are in mg/m3 except for CO which is in 10xmg/m3. SO2, sulphur dioxide; NO2, nitrogen dioxide; CO, carbon monoxide; PM10, particulate matter with aerodynamic diameter <=10 {micro}m. *p



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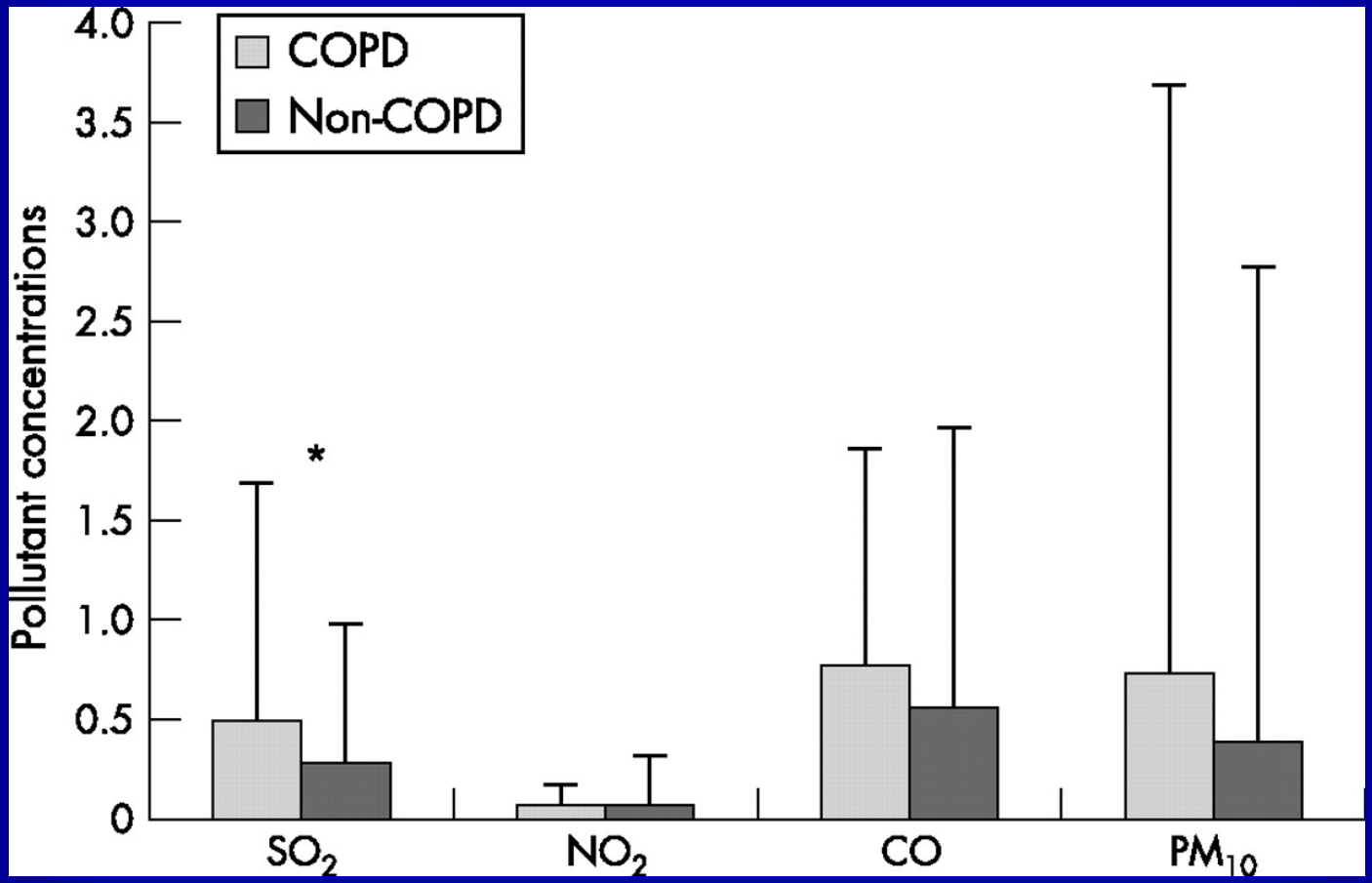
Health Outcomes

- Overall prevalence in rural county for COPD among women was statistically higher than for urban women (12.0 % vs 7.4%)
- Controlling for smoking, the COPD levels were still higher in the rural province (7.2% vs 2.54 %)
- Univariate and Multivariate statistics demonstrated a positive association between COPD and use of biomass for cooking

Figure 5 Pollutant concentrations in the kitchen of subjects with and without chronic obstructive pulmonary disease (COPD). Data presented as geometric mean (SD); number of samples 20 and 174 respectively. Pollutant concentrations are in mg/m3 except for CO which is in 10xmg/m3. SO2, sulphur dioxide; NO2, nitrogen dioxide; CO, carbon monoxide; PM10, particulate matter with aerodynamic diameter <=10 {micro}m. *p



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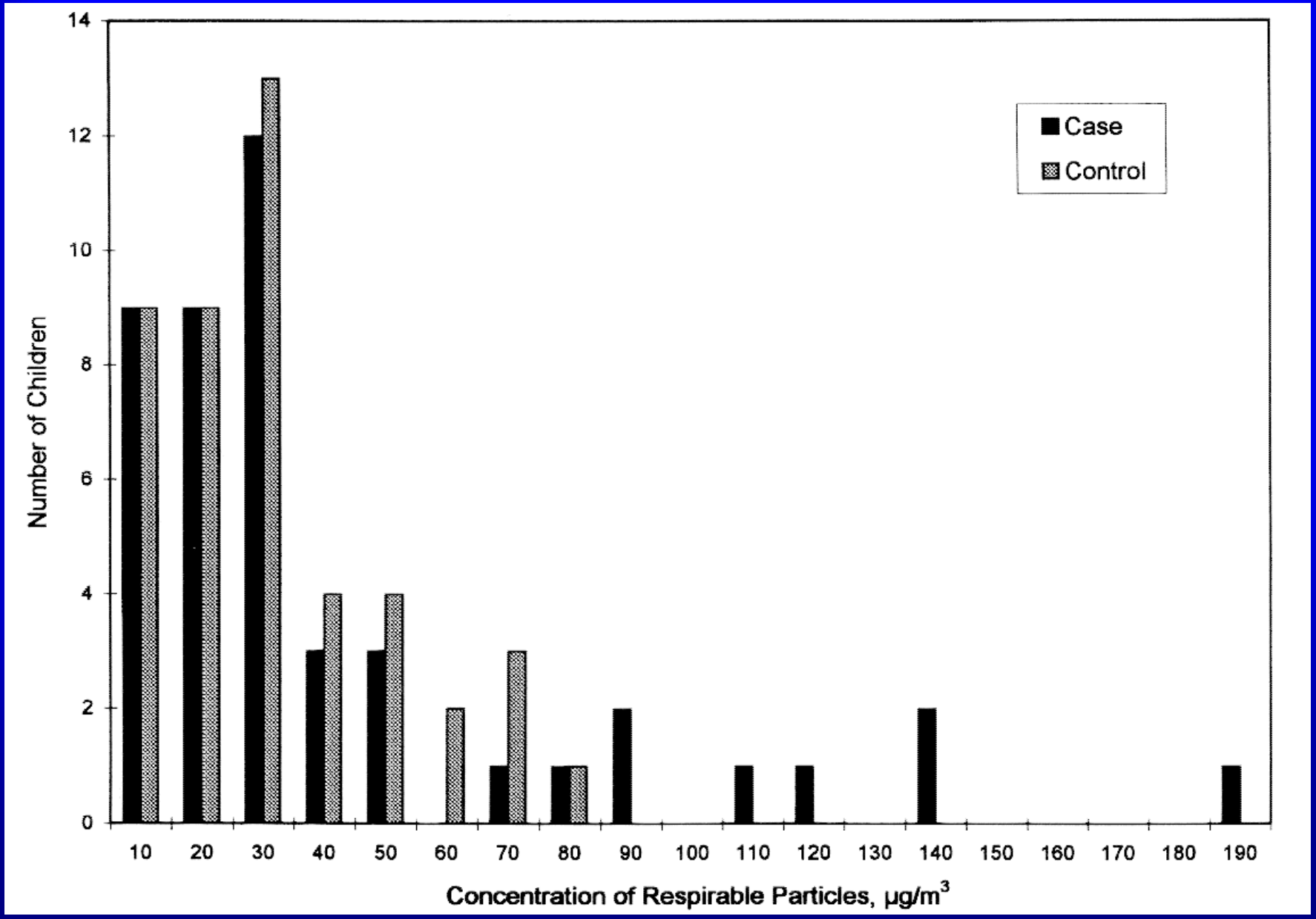
Developing Countries-Children

- Increase in acute respiratory infections in children exposed to wood smoke
- Increase in risk of development of asthma
- Increase in otitis media in chidlren

Developed Countries

- Study of 45 Navajo children who were exposed to biomass through heating and cooking
- Homes were sampled for particulate matter and other air pollutants
- Robin LF *et al.,* Wood Burning Stoves and Lower Respiratory Illness in Navajo Children. *Ped Inf Dis J* 1996; 15:859-865

Fuels	Cases		Controls	
	No.	%	No.	%
Heating				
Total	45	50.0	45	50.0
Gas/electricity alone	16	17.8	19	21.1
Wood alone	8	8.9	5	5.6
Kerosene alone	0	0.0	1	1.1
Gas/electricity + wood	5	5.6	2	2.2
Gas/electricity + wood + coal	3	3.3	5	5.6
Gas/electricity + wood + coal + kerosene	0	0.0	1	1.1
Wood + coal	8	8.9	8	8.9
Wood + kerosene	2	2.2	1	1.1
Wood + coal + kerosene	2	2.2	1	1.1
None	1	1.1	2	2.2
Cooking				
Total	45	50.0	45	50.0
Gas/electricity alone	24	26.7	29	32.2
Wood alone	5	5.6	2	2.2
Gas/electricity + wood	4	4.4	2	2.2
Gas/electricity + wood + coal	1	1.1	0	0.0
Wood + coal	3	3.3	1	1.1
Wood + kerosene	2	2.2	0	0.0
None	6	6.7	11	12.2


Case
Control
Number of Children
0
2
4
6
8
10
12
14
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
Concentration of Respirable Particles, µg/m3

Outcome

- Cooking with wood burning stoves was associated with higher indoor air concentrations of respirable particles and with an increased risk of ALRI in Navajo children

Impact of Biomass Smoke

- Growing body of literature also implicates adverse health effects from outdoor exposures
- Approximately one-third of the CO_2 contributed by humans is from the burning of biomass
- Implicated in contributing to climate change
  - Can potentially modify atmospheric chemistry
  - Can influence regional temperatures and precipitation

Impact of Biomass Smoke

- Prescribed burns in agricultural land: Canada

- Forest fires: California

Impact from Biomass Smoke

- Urban haze from forest fires in Indonesia and Malaysia

Impact of CA Wildfires on Emergency Room Visits and Admissions

- Oct 21-26, 2007
- Southern CA evacuated over 500,000 people
- Over 500,000 acres burned

Outdoor Biomass Exposures Health Effects

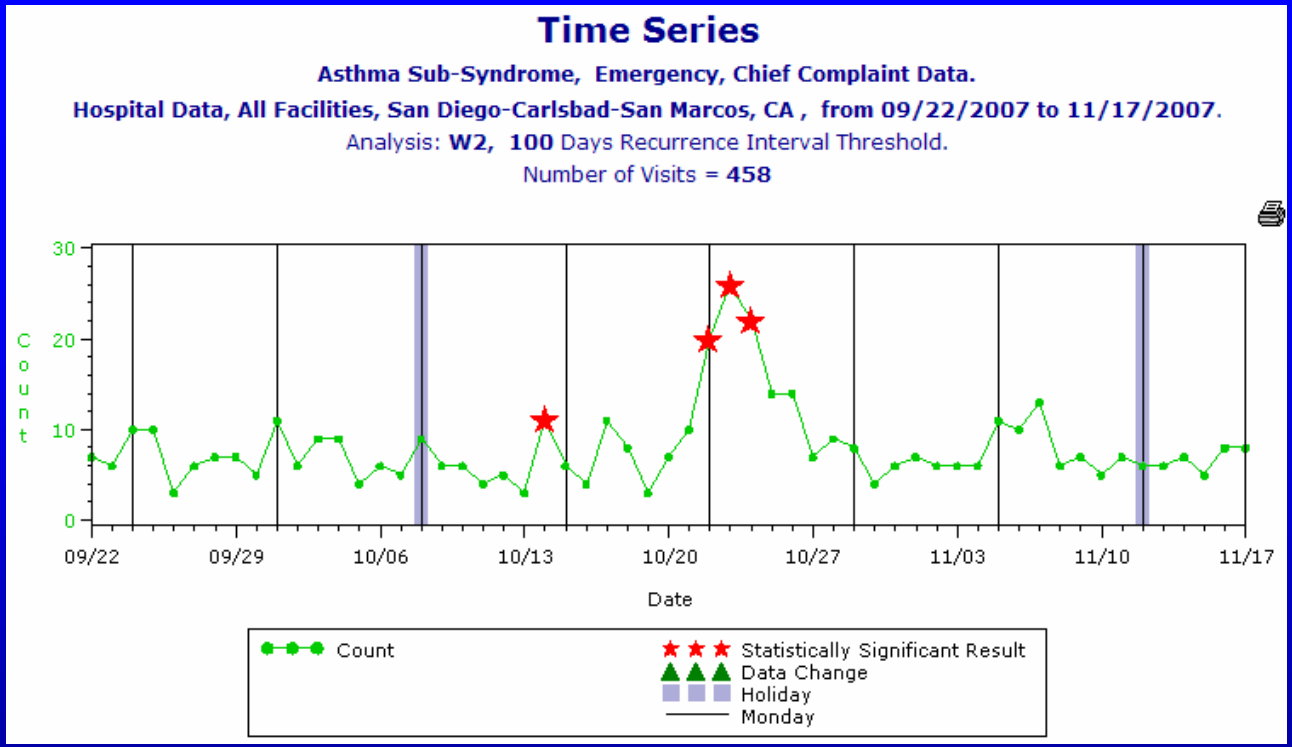
- Effects on COPD and asthma hospitalizations
- Effects on cardiovascular admissions
- Effects on mortality

Table 1. Emergency Department Visits for Selected Respiratory Indicators at Six Hospitals, San Diego, CA, September 23-October 21, 2007

Data Type Disease Indicator	Pre-Fire Period* Visits with Indicator/Total Visits (% with Indicator)	Fire Period* Visits with Indicator/Total Visits (% with Indicator)	Relative Risk (95% CI)	Risk Difference (95% CI)
Chief Complaints				
Respiratory Syndrome	3,684/18,447 (19.97)	813/3,393 (23.96)	1.20 (1.12, 1.28)	3.99% (2.44, 5.54)
Asthma	197/18,447 (1.07)	96/3,393 (2.83)	2.65 (2.08, 3.37)	1.76% (1.18, 2.34)
Bronchitis	9/18,447 (0.05)	4/3,393 (0.12)	2.42 (0.74, 7.84)	0.07% (-0.05, 0.19)
Chest pain	1,628/18,447 (8.83)	305/3,393 (8.99)	1.02 (0.91, 1.15)	0.16% (-0.88, 1.21)
Cough	457/18,447 (2.48)	73/3,393 (2.15)	0.87 (0.68, 1.11)	-0.33% (-0.86, 0.21)
Dyspnea	1,301/18,447 (7.05)	360/3,393 (10.61)	1.50 (1.35, 1.68)	3.56% (2.46, 4.66)
Diagnoses				
Respiratory Syndrome	3,329/16,623 (20.03)	733/2,998 (24.45)	1.22 (1.14, 1.31)	4.42% (2.77, 6.08)
Asthma	628/16,623 (3.78)	196/2,998 (6.54)	1.73 (1.48, 2.02)	2.76% (1.83, 3.69)
Bronchitis	355/16,623 (2.14)	81/2,998 (2.70)	1.27 (1.0, 1.61)	0.57% (-0.05, 1.19)
Chest pain	1,192/16,623 (7.17)	220/2,998 (7.34)	1.02 (0.89, 1.18)	0.17% (-0.85, 1.18)
Cough	255/16,623 (1.53)	42/2,998 (1.40)	0.91 (0.66, 1.26)	-0.13% (-0.59, 0.33)
Dyspnea	454/16,623 (2.73)	116/2,998 (3.87)	1.42 (1.16, 1.73)	1.14% (0.40, 1.87)

* Pre-fire period (4 week baseline period), September 23-October 21, 2007; fire period, October 22-26, 2007

Screen Shot of Rapid Monitoring Software



Public health issues: wood stoves

- Health effects:
  - Immediate and long-term effects
  - Effects on children
  - Contributions to other diseases
  - Health effects of alternative cooking or heating mechanisms
  - Exposure assessment
- Communications
  - Level of understanding of health effects
- Interventions
  - Woodstove replacement programs

Public health issues: forest fires

- Health effects:
  - Effects of prolonged exposure to smoke
  - Relationship of smoke levels to health
- Communication
  - Timing of messages
  - Developing messages to target at-risk populations
- Interventions:
  - Home characteristics that modify exposure
  - Role of air cleaners in reducing exposure

Why Is CDC Involved?

- CDC's National Center for Environmental Health is home to the CDC's National Asthma Control Program
  - Biomass burning has a direct impact on asthma and respiratory disease

- CDC mission is to assist state health departments
  - Limited by exposure assessment methods
  - Limited large scale public health interventions and communication tools

Questions or Comments

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