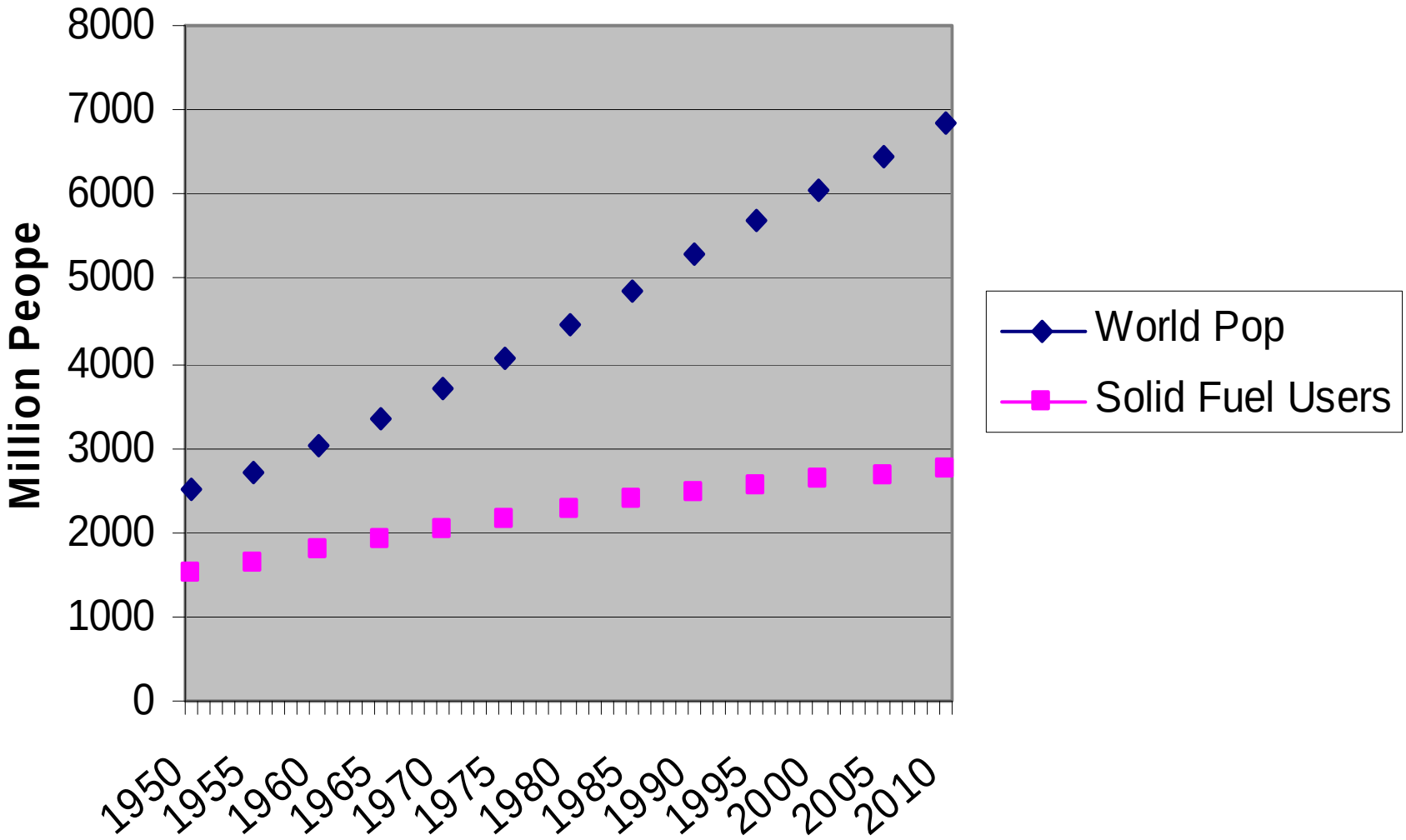
Biomass cooking: intervention programs and health impacts

Kirk R. Smith
UC Berkeley

Workshop on biomass for cooking in Mexican households: towards an integrated program of stove implementation

National Institute of Ecology (INE), Mexico City
Oct 28, 2011

World Population Using Solid Fuels



RESPIRE – Randomized trial in Guatemala
Impact on child pneumonia

Traditional open 3-stone fire

Chimney wood stove, the Plancha, locally made and popular with households

THELANCET-D-09-06268R3

S0140-6736(11)60921-5

Embargo: [add date when known]

Effect of reduction in household air pollution on childhood pneumonia in Guatemala (RESPIRE): a randomised controlled trial

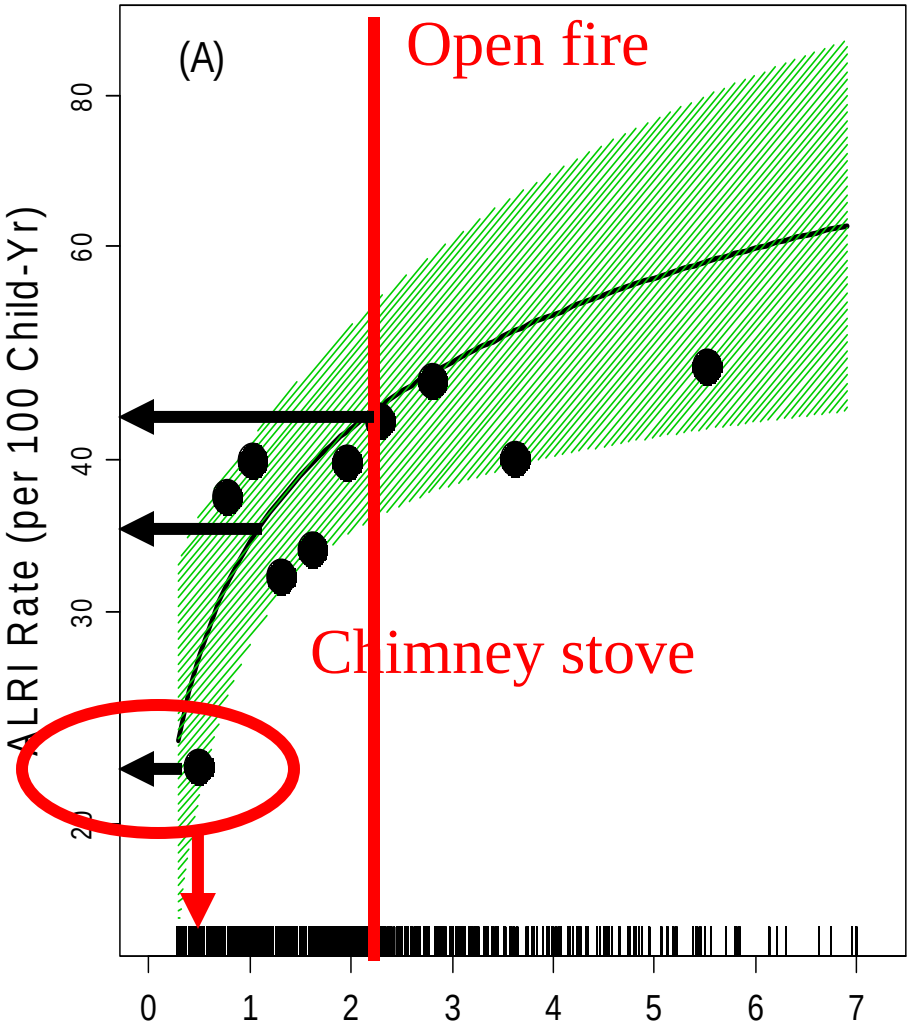
Kirk R Smith, John P McCracken, Martin W Weber, Alan Hubbard, Alisa Jenny, Lisa M Thompson, John Balmes, Anaite Diaz, Byron Arana, Nigel Bruce

27 years since first grant proposal

In press,

Scheduled Nov 12, 2011

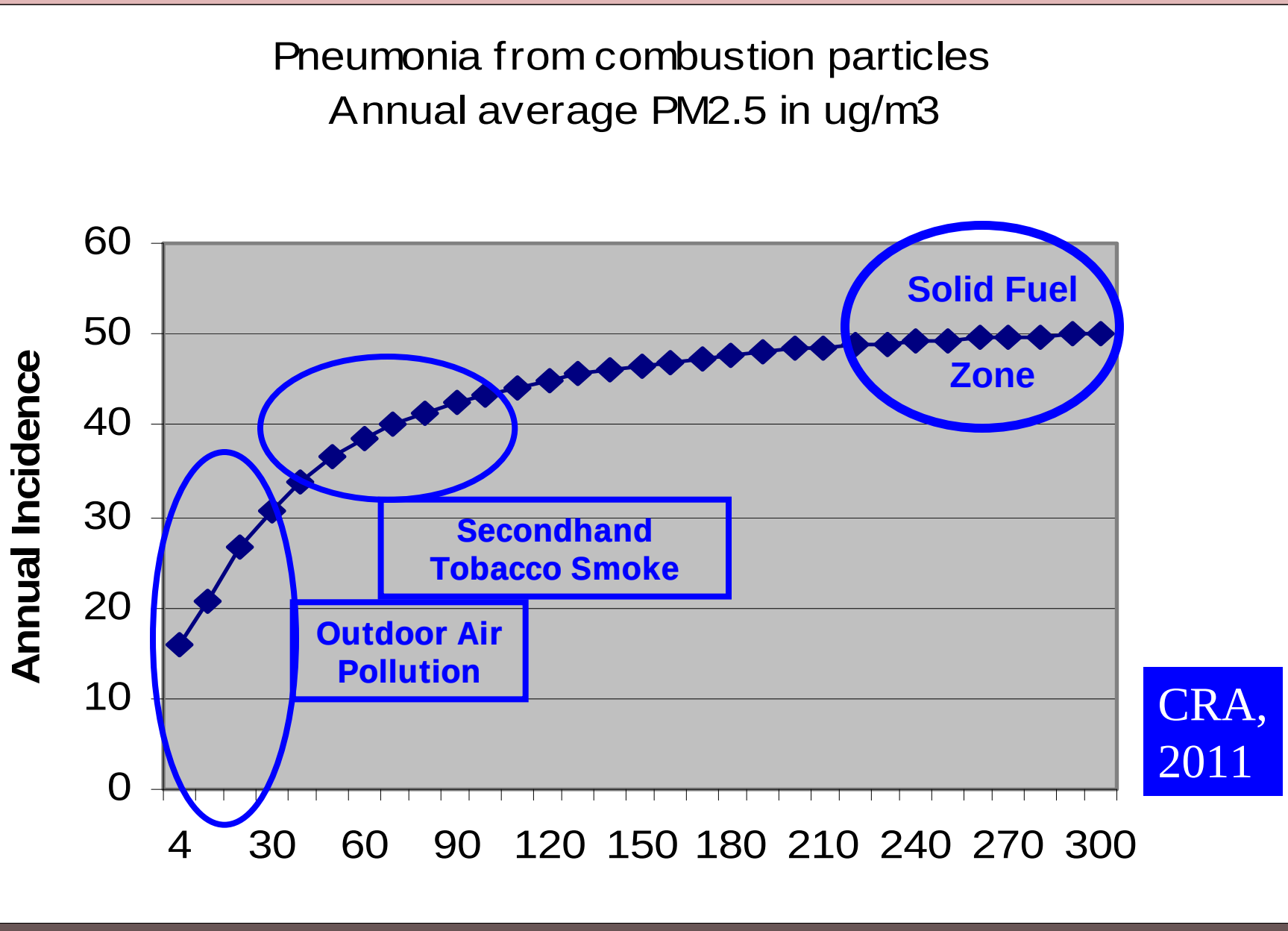
MD-diagnosed Acute Lower Respiratory Infection



Where we Want to Be!

RESPIRE-Guatemala

Generalized Exposure-Response: Outdoor Air, SHS, and HAP



We know about these diseases

- Pneumonia in children
- Chronic lung disease in adults
- Lung cancer in adults
- Low birth weight
- Cataracts
- Heart disease

We suspect these

- IQ loss in children*
- Cervical cancer in young women*
- Tuberculosis
- Birth defects

* All studies done in Latin America

Contents lists available at SciVerse ScienceDirect

NeuroToxicology

Neurodevelopmental performance among school age children in rural Guatemala is associated with prenatal and postnatal exposure to carbon monoxide, a marker for exposure to woodsmoke

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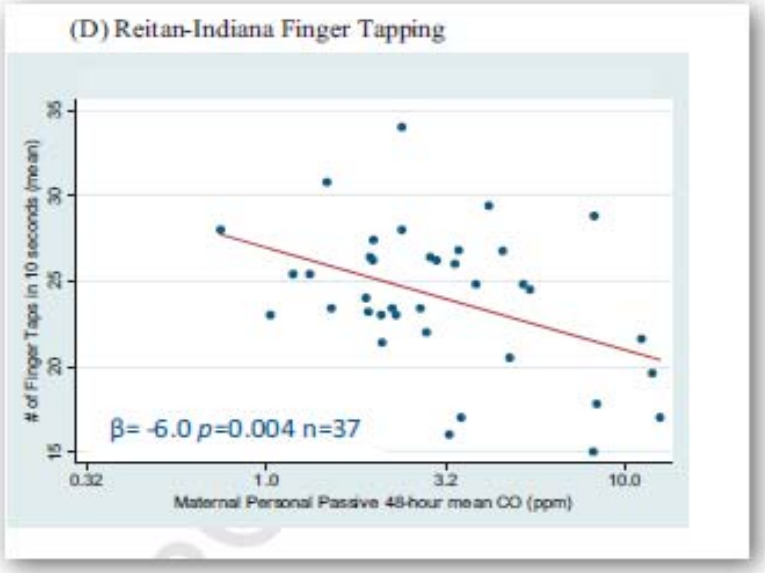
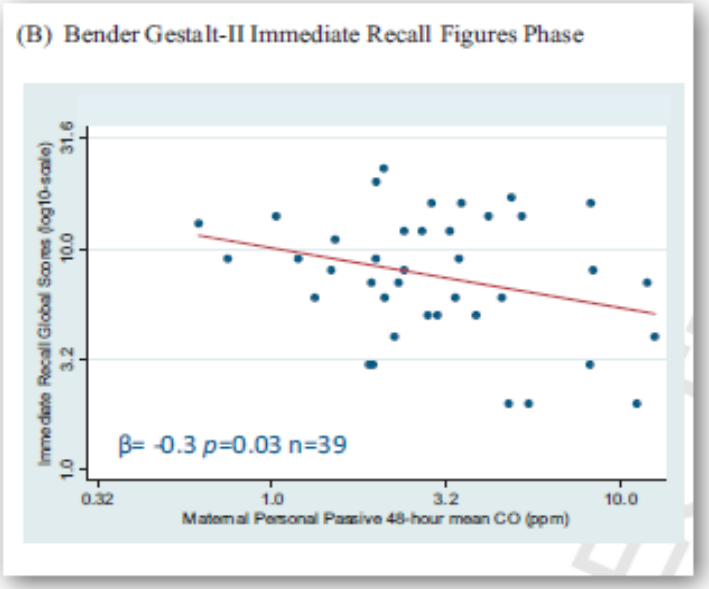


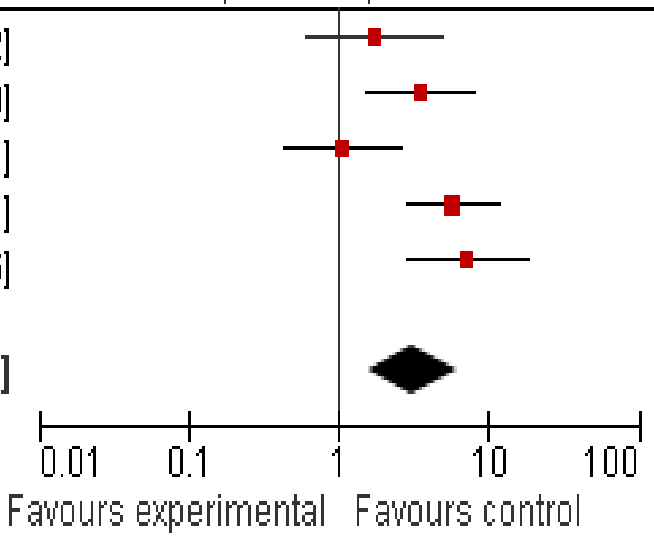


Cervical Cancer and Household Air Pollution

Study or Subgroup	log[Odds Ratio]	SE	Weight	Odds Ratio IV, Random, 95% CI
Ferrera 2000(a)	0.54232429	0.53624989	17.6%	1.72 [0.60, 4.92]
Ferrera 2000(b)	1.24990174	0.41614175	20.9%	3.49 [1.54, 7.89]
Velema 2002(a)	0.06765865	0.45514155	19.8%	1.07 [0.44, 2.61]
Velema 2002(b)	1.75093748	0.36626585	22.4%	5.76 [2.81, 11.81]
Sierra Torres 2006	1.98787435	0.47618897	19.2%	7.30 [2.87, 18.56]
Total (95% CI)			**100.0%**	**3.14 [1.57, 6.30]**

Heterogeneity: $Tau^2 = 0.43$; $Chi^2 = 12.71$, df = 4 (P = 0.01); $I^2 = 69\%$

Test for overall effect: Z = 3.23 (P = 0.001)



Studies in Honduras and Columbia show significant increase in cervical cancer among women who use wood cookfires.

Research to confirm is urgently needed

Poor combustion: the enemy

- Worst thing you can do is put burning stuff in your mouth
- Next worse is having it in your house
- Not so great outdoors either, as in cities
- All the same health effects found in smokers are being found from household air pollution
- But at lower risk levels

Lessons from Previous Stove Programs from a Health Perspective

- Monitoring and Evaluation is key – “you don’t get what you expect, but what you inspect”
- Start with areas most likely to succeed -- then move to more difficult areas
- Strong local support needed – village and district/*municipio*
- Design for local cooking and fuel situation
- Strict criteria on stove selection, including lab and field data
- Quality control in manufacturing with warranty
- Stable long-term program -- 10 years and more.

We no longer use the word "improved"

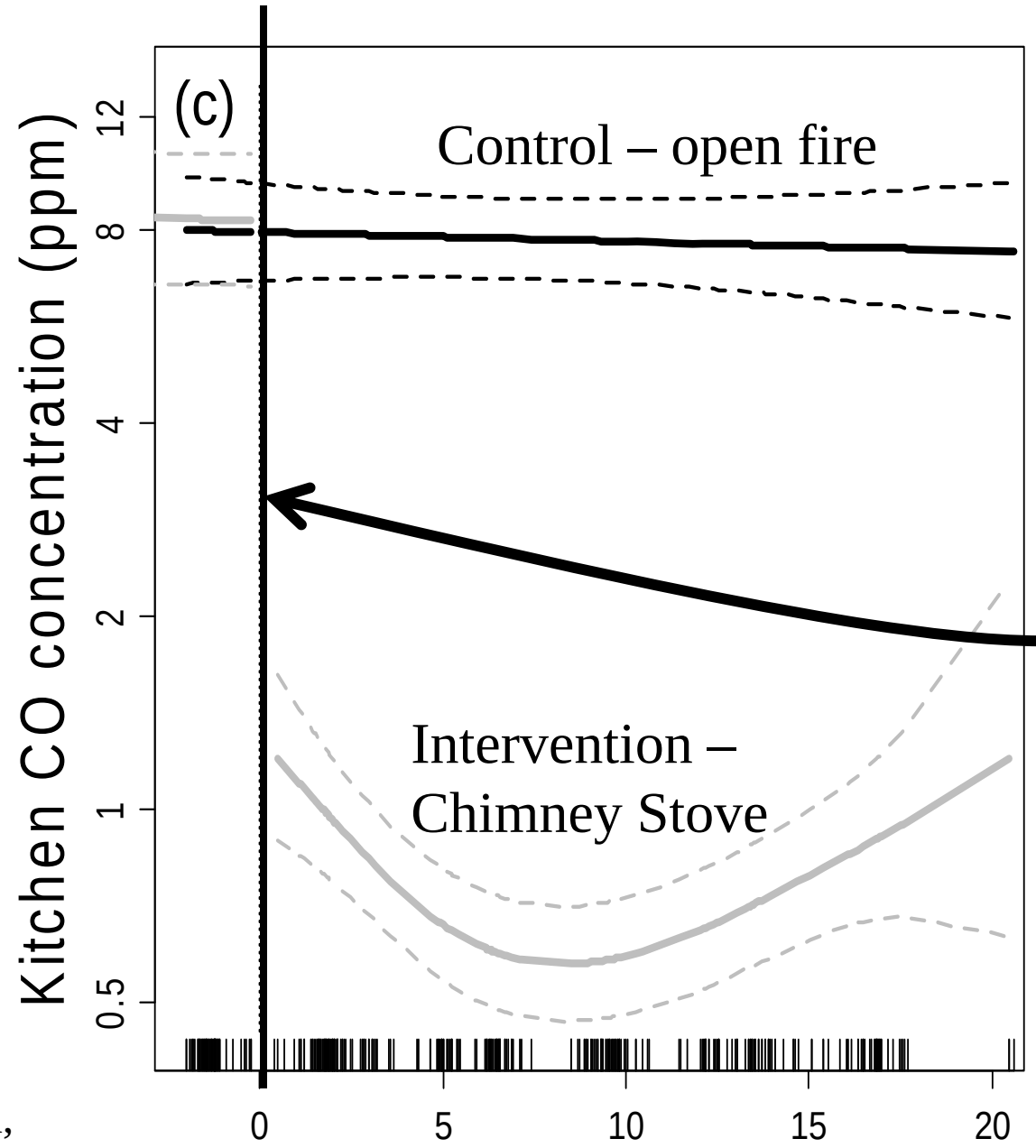
- Means nothing – advertising slogan on thousands of products
- Meant to trick people into thinking that one kind of improvement also applies to other issues
- Most "improved" stoves have only saved fuel, some not very much
- Saving fuel, however, does not translate well into reducing pollution
- Different stove design criteria involved in improving efficiency and reducing emissions.

We avoid the word “indoor” air pollution for overall health problem

- Not all the pollution exposure occurs indoors
- Occurs outdoors near the house
- Outdoors in the village
- In the general outdoor environment
- Can have regional and even global effects through climate
- Problem is poor combustion of fuels and resulting pollution.
- Using a chimney to put smoke out of one place (the kitchen) just puts it into another place where people are
- Certainly better than no chimney, but in the end we
- Need to get rid of the bad combustion


CO monitor
CO monitor

Guatemala RCT: Kitchen Concentrations



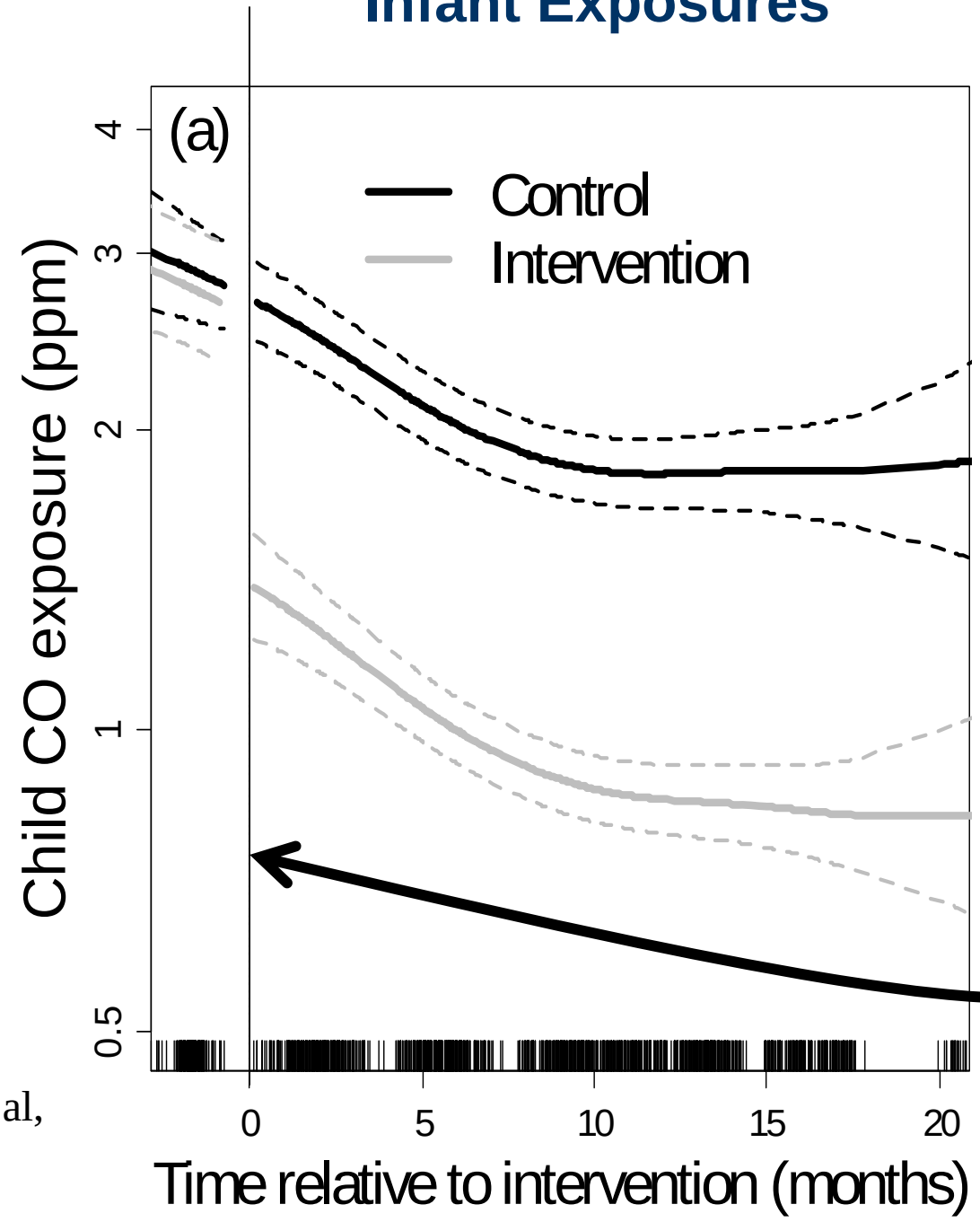
Effect of Chimney Stove On Kitchen CO Levels

Factor of ~10 less

285 48-h measurements

Smith, et al, 2010

Infant Exposures



1888 48-h measurements

Effect of Chimney Stove On Infant Exposures - 2x less

Smith, et al, 2010

New technologies promise very clean burning of biomass

- All have blowers/fans
- But blowers can be powered by the heat of the stove if there is no reliable electricity
- So clean that chimneys may not be needed – less difficult to install and maintain
- Stoves need to be very clean in tests because
  - Performance will not be as good in reality
  - People will not shift 100% to the new stove
- May need separate clean stoves for different tasks
  - Move toward specialized cooking devices
  - Focus first on tasks with high pollution exposure
- High mass, waist-high, chimney stoves are popular in LA
  - But combustion has not been good
  - Initiating research on improving combustion chamber without changing basic nature of the stove.

Separate “combustion” design from “stove” design

- Develop very robust and clean combustion chambers for biomass
- Around which stoves can be built that serve local needs, aspirations, and incomes
- Like vehicles, which have many different sizes, types, prices, and extra features.
- But all need a robust clean engine.
- All stoves do as well.

The Bad News

- Just because we know that a behavior or hazard causes much ill-health, does not mean we know how to reduce it.
- Think of malaria, malnutrition, smoking, unsafe sex, etc.
- Unfortunately, until today, few if any so-called “improved” stove programs have designed, deployed, and evaluated stoves with health in mind.
- But rather have assumed that because a stove is called “improved” for one thing, usually fuel savings, it will automatically mean it helps in all things, including health.
- We now know this is not true.

The Good News

- There are technologies now that show promise for substantially reducing pollution exposures and improving health
- We understand cooking practices better and can target interventions accordingly (most work done in Mexico)
- We have evidence of potentially significant co-benefits in terms of outdoor air pollution and climate
- There is much more international interest in doing something.

Gracias

Publications and presentations on website – easiest to just “google”
Kirk R. Smith