

The **G**hana **R**andomized
Air **P**ollution and **H**ealth **S**tudy
(**GRAPHS**)

*Intervening to Improve Birth Weight
and Infant Respiratory Health*

GACC NCD Indicators meeting
Washington DC
16 December 2014

Collaborating Institutions

(Since 2006)



KHRC

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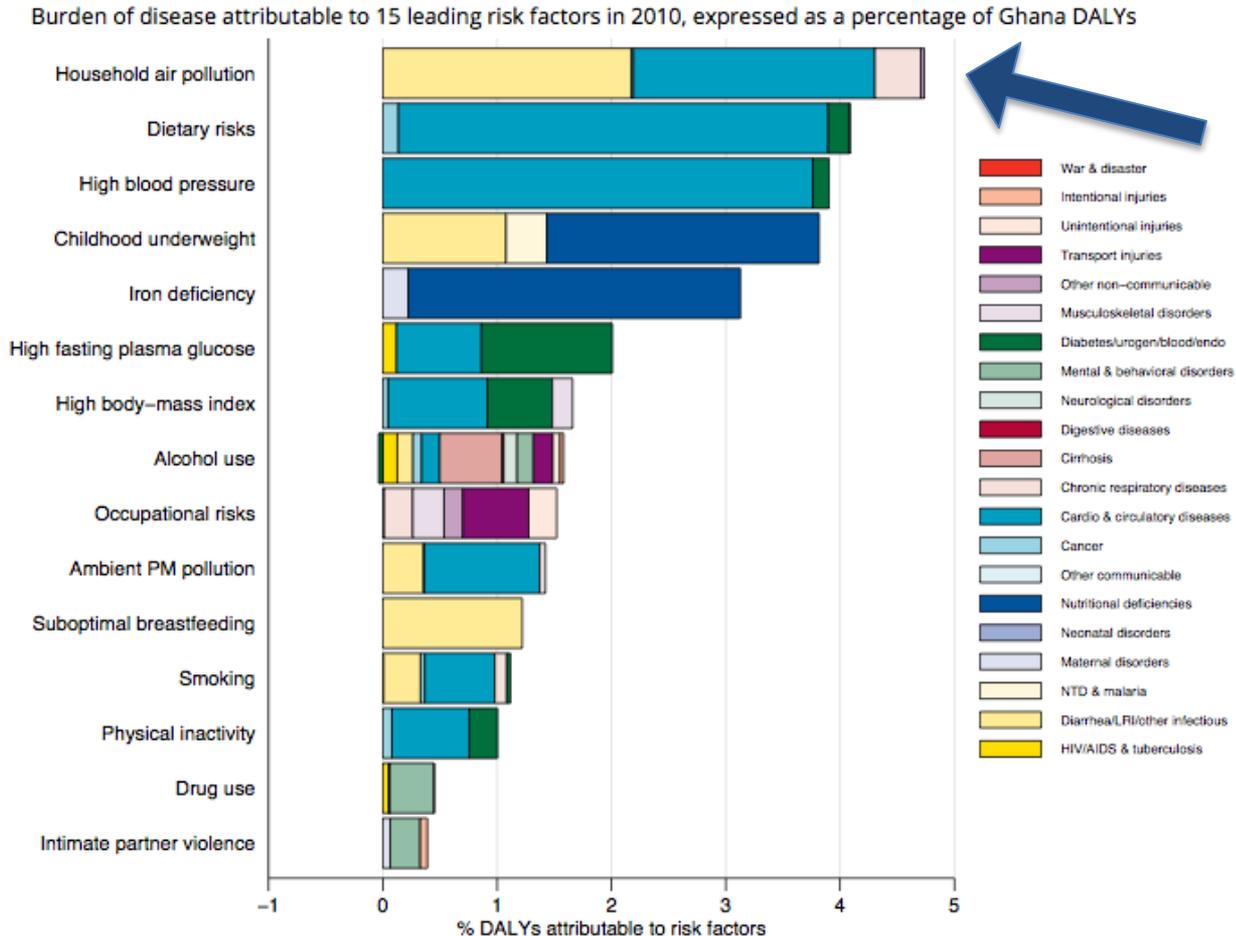
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Ghana-specific GBD profile (2010)



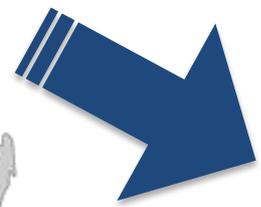
Critical questions:

- How clean is clean enough...
 - what interventions will get us there...
 - and what distribution strategies will deliver equitable, enduring public health results?
- Our study is designed to provide
 - Exposure response data for birth weight and child pneumonia
 - Evidence on the efficacy of stoves delivered to pregnant women (a scalable distribution strategy)
 - Relevant evidence Government of Ghana (efficient biomass cookstoves and clean fuels)

Kintampo, Ghana, West Africa



0 1000 mi
0 1000 km



Design: Cluster-randomized controlled trial (n=1415) involving 35 communities

Biolite



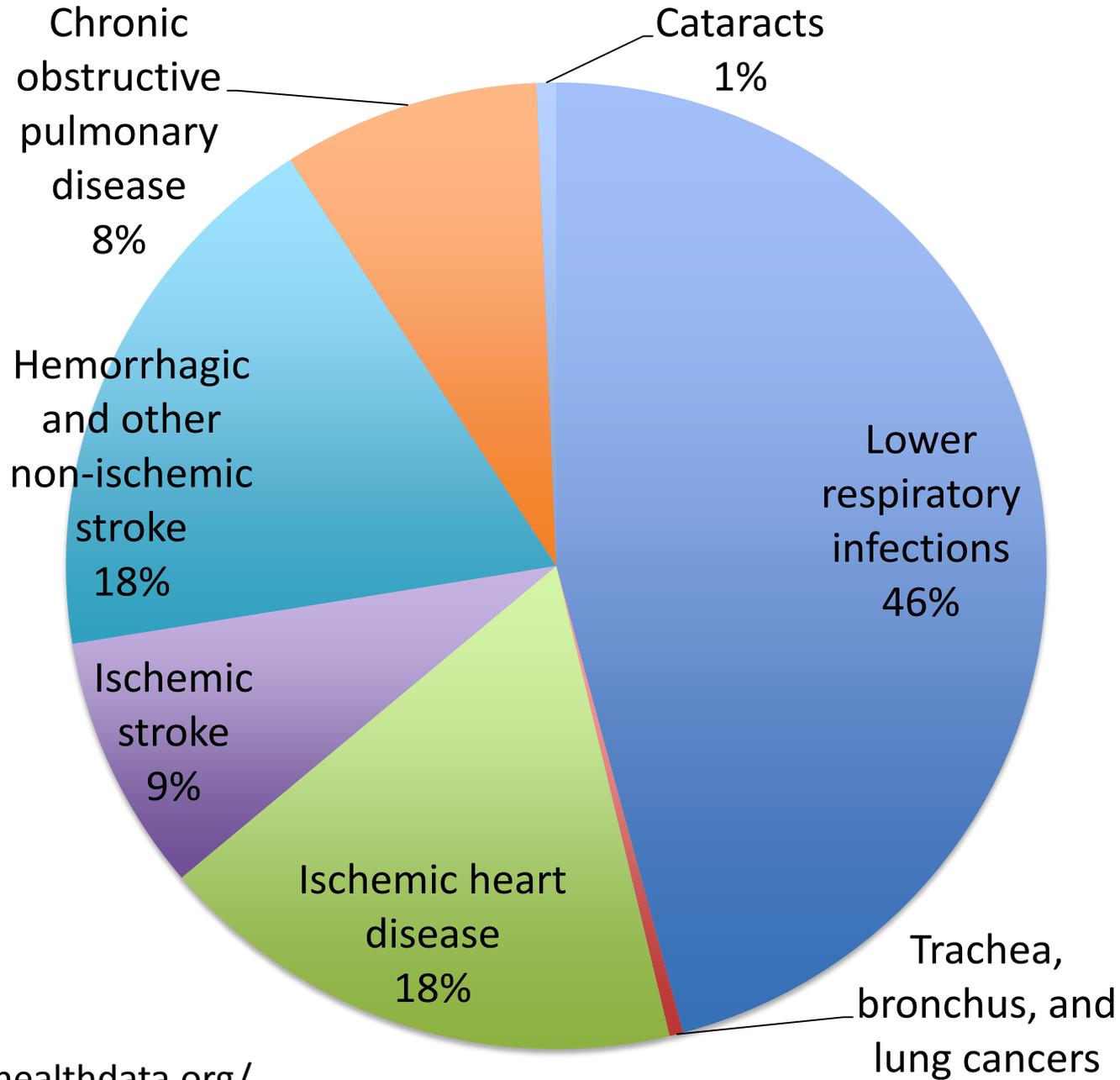
LPG



Control



Burden of disease from HAP in Ghana

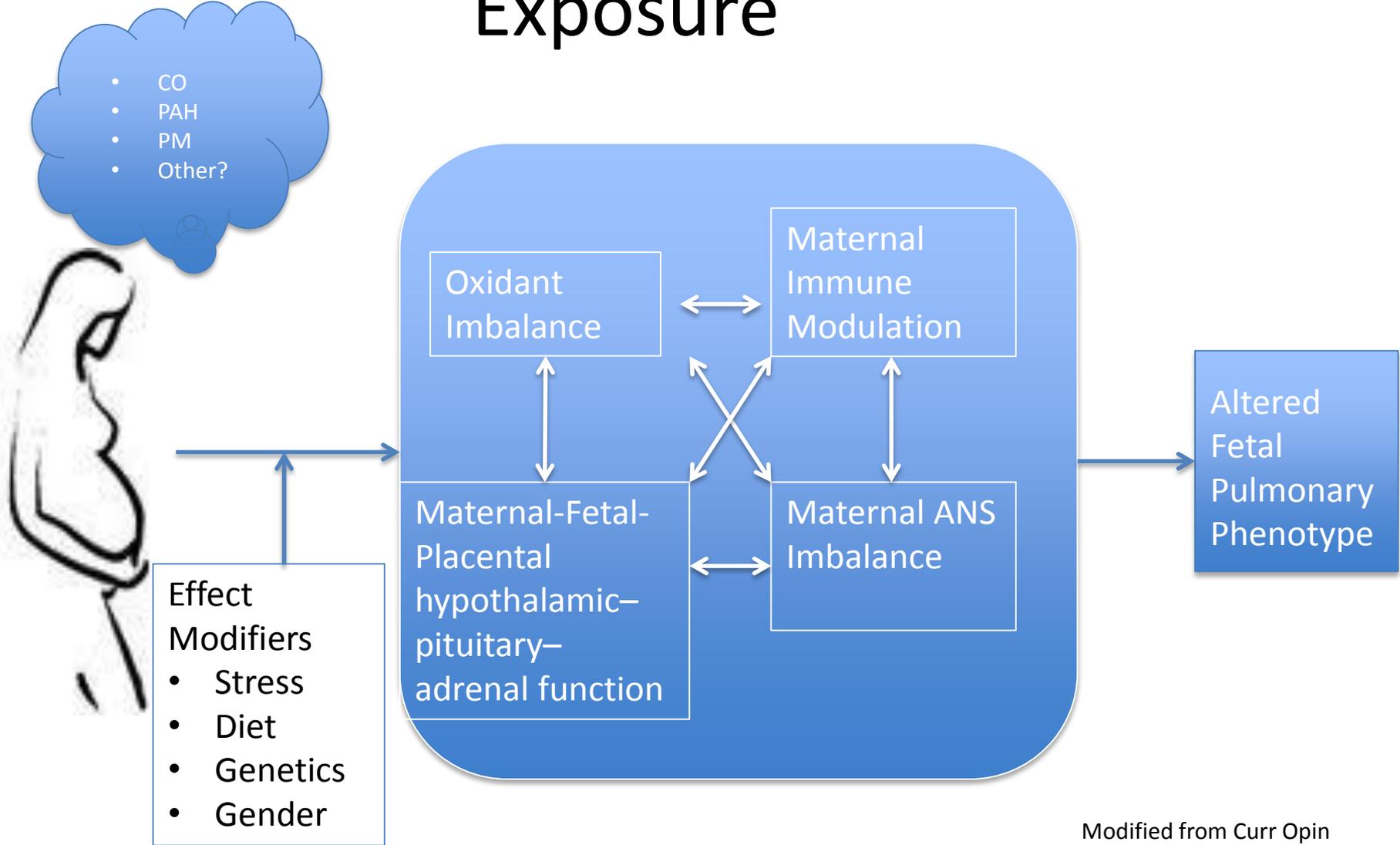


NCD studies in GRAPHS

We are currently developing three relevant studies

- Lung development (neonates, age 6)
- (Cognitive development)
- Blood pressure

Conceptual Model of *in utero* HAP Exposure

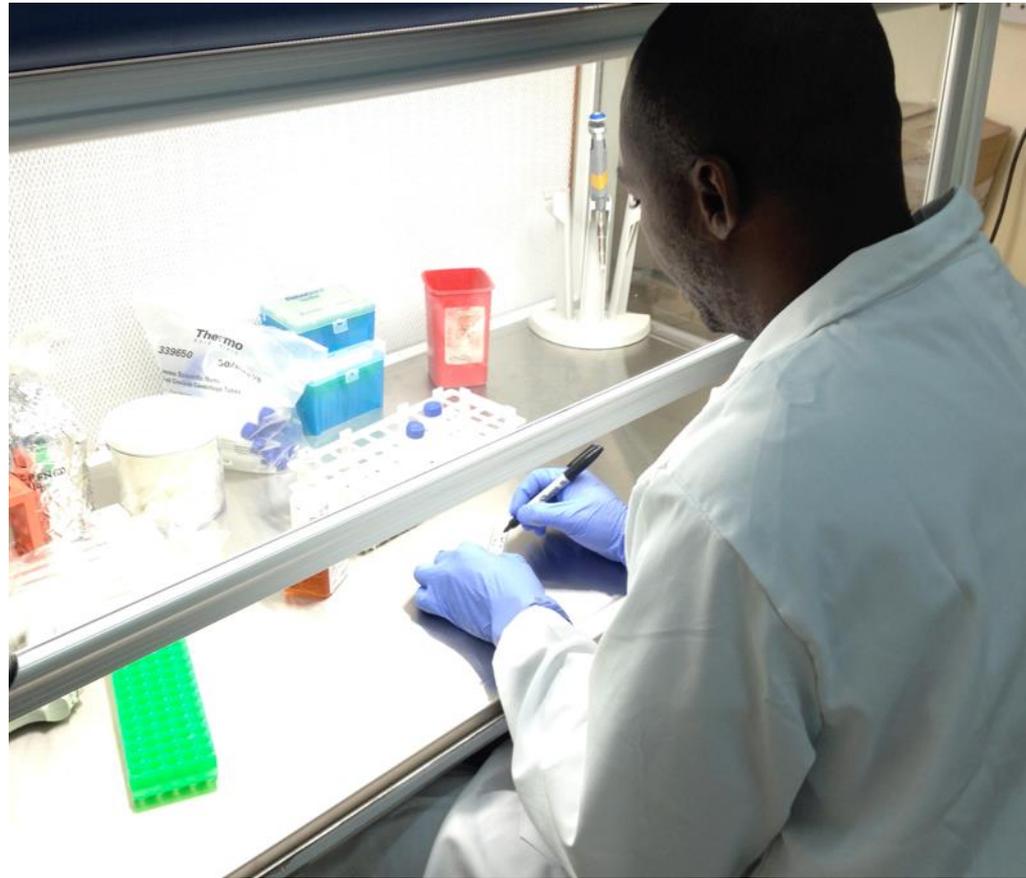


Infant Lung Function Testing

- Lung function at 1 month to detect altered pulmonary phenotype
- Single occlusion test
 - Minute ventilation
 - $t_{PTEF}:t_E$
 - Compliance
 - Resistance

Cord Blood – mechanisms and confounders

- Plasma → Pro-oxidant / anti-oxidant analyses
- CBMCs (cord blood mononuclear cells) → immune function
- Plasma → nutritional status
- CBMC Pellet/placenta → epigenetics
- All samples + whole blood, serum → banking



ABP as a marker of Cardiovascular risk

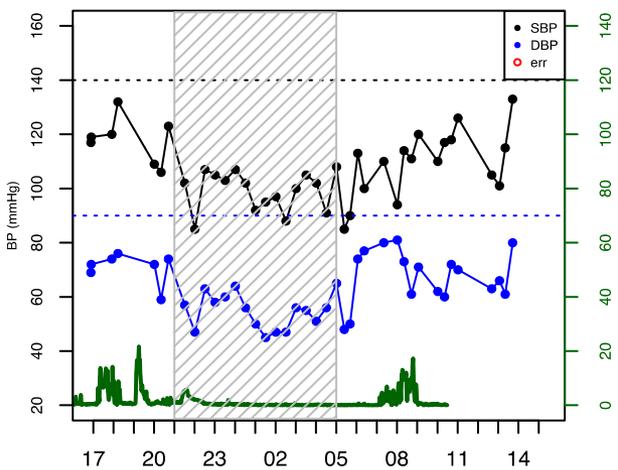
- Most accurate method for assessing BP (avoid white coat & masking effects)
- ABP measurements have been shown empirically to be better predictors of future CVD risk (compared to clinic and home BP)
- Assess response contemporaneously with exposure – “hyperacute effects”

Pilot ABP study in GRAPHS

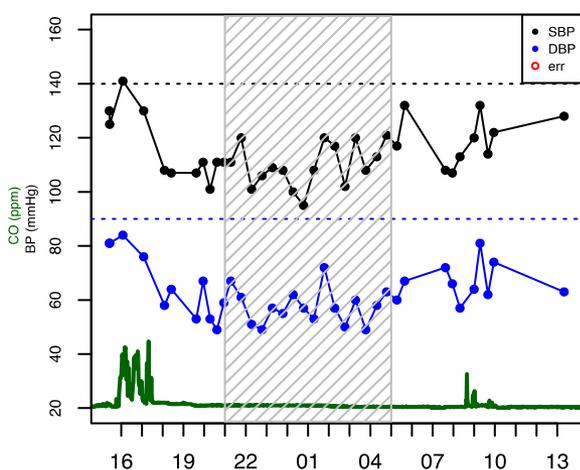
- Feasibility Pilot study – 15 home BP and 20 ABP measurements.
- 24 hour deployments before and after intervention



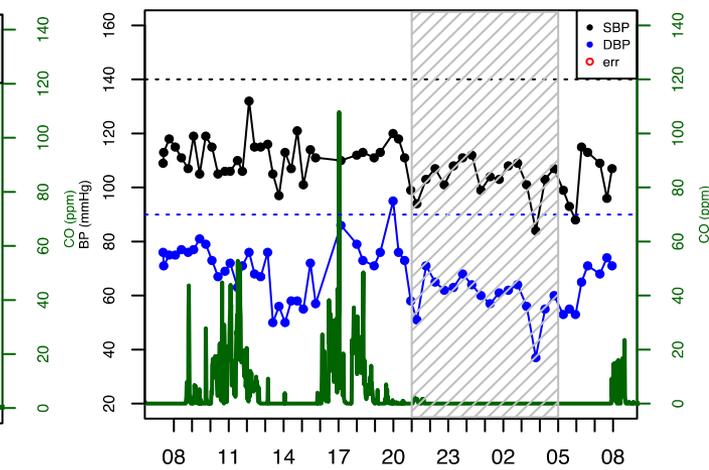
Example data: contemporaneous exposure (CO) and BP data



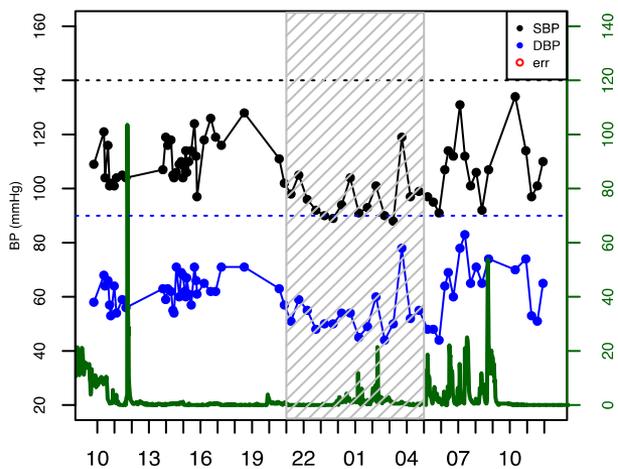
Time (22.5 hours, 93 readings)



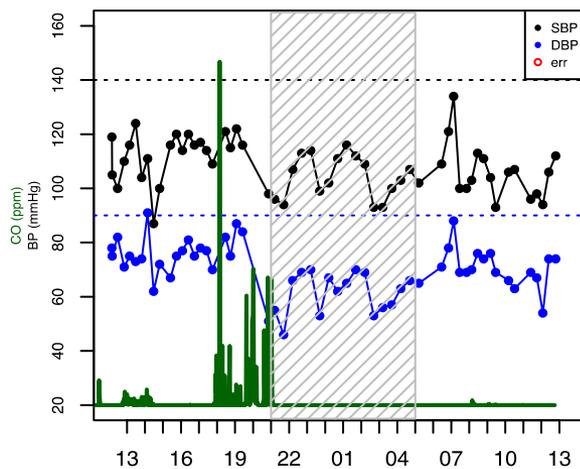
Time (21.9 hours, 83 readings)



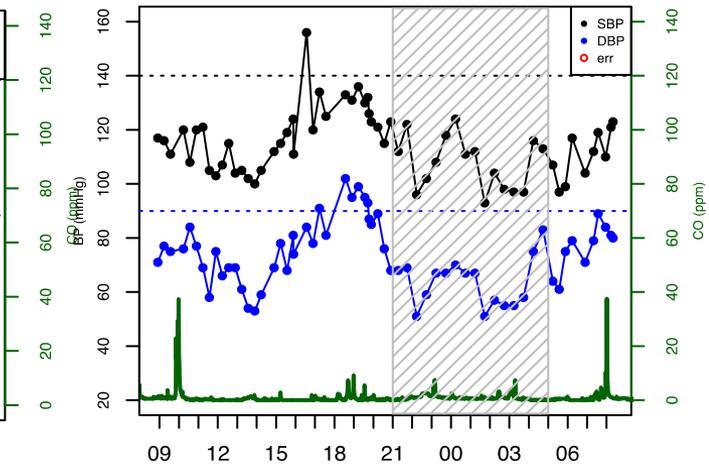
Time (24.9 hours, 86 readings)



Time (26.5 hours, 92 readings)

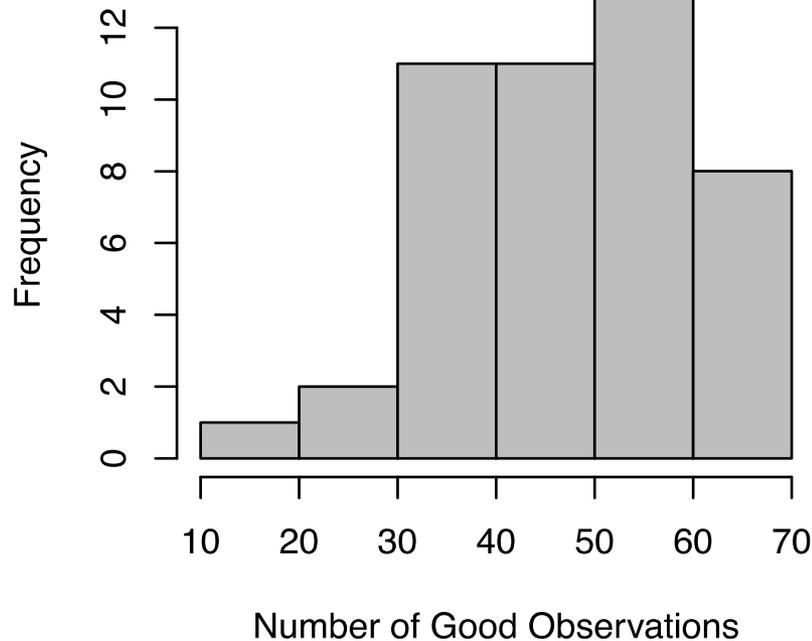


Time (25.2 hours, 72 readings)



Time (23.4 hours, 79 readings)

ABP: Data quality is high



- Based on prior definitions of a valid ABPM 24-hour recording [30,31], 47/54 (87%) of the ABP sessions were valid
- Mean 24-hour systolic/diastolic ABP: 106.2 SBP; 62.2 DBP
- Mean awake systolic/diastolic ABP: 110.2 SBP; 66.5 DBP
- Mean sleep systolic/diastolic ABP: 98.6 SBP; 54.2 DBP

Aspirations:

KHRC led GEOHealth proposal

- Quantify acute blood pressures response to air pollution exposure in a tightly controlled experimental setting
- Long term exposure and ABP surveillance of GRAPHS adult cohort as exposures converge post-study.
- Mechanistic aim
 - Two major systems in the body are responsible for BP regulation: (1) the autonomic nervous system (ANS), and (2) the renin-angiotensin-aldosterone system (RAAS)
 - To assess the RAAS, we will measure Renin, Angiotensin II, and Aldosterone in blood samples collected at the beginning and end of each monitoring session both in controlled cooking and in the field.
 - To assess the ANS, we will measure catecholamines, including adrenalin and noradrenalin (blood samples in the lab; 12- or 24-hour urine catecholamines in the natural environment).

Acknowledgements

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