

Supplementary material

HOUSEHOLD AIR POLLUTION EXPOSURE AND ASSOCIATIONS WITH HOUSEHOLD CHARACTERISTICS AMONG BIOMASS COOKSTOVE USERS IN PUNO, PERU

Authors: Magdalena Fandiño-Del-Rio [mfandin2@jhu.edu] (a,b), Josiah L Kephart [jlk465@drexel.edu] (a, b), Kendra N Williams [kendra.williams@jhu.edu] (b, c), Lawrence H Moulton [lmoulto1@jhu.edu] (d), Kyle Steenland [nsteenl@emory.edu] (e), William Checkley* [wcheckl1@jhmi.edu] (b, c, d), Kirsten Koehler* [kkoehle1@jhu.edu] (a); Cardiopulmonary outcomes and Household Air Pollution trial (CHAP) Trial Investigators**.

- a) Department of Environmental Health and Engineering, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, 21205, USA.
- b) Center for Global Non-Communicable Disease Research and Training, Johns Hopkins University, Baltimore, MD, 21205, USA.
- c) Division of Pulmonary and Critical Care, School of Medicine, Johns Hopkins University, Baltimore, MD, 21205, USA.
- d) Program in Global Disease Epidemiology and Control, Department of International Health, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, 21205, USA.
- e) Department of Environmental Health, Rollins School of Public Health, Emory University, Atlanta, GA, 30322, USA.

Supplementary Information

Table S1. Linear regression results of household variables in relation to kitchen area concentrations

Variable	Kitchen PM _{2.5}				Kitchen CO				Kitchen BC			
	SLR		MLR		SLR		MLR		SLR		MLR	
	R ²	Ratio (95% CI)	Ratio (95% CI)	Ratio (95% CI)	R ²	Ratio (95% CI)	Ratio (95% CI)	Ratio (95% CI)	R ²	Ratio (95% CI)	Ratio (95% CI)	Ratio (95% CI)
N	N = 178				N = 169				N = 178			
Kitchen roof material	0.12	Reference		Reference		0.16	Reference		Reference		Reference	
Corrugated metal roof or similar		Reference		Reference			Reference		Reference		Reference	
Natural: straw, totora, reed or similar		Reference		Reference			Reference		Reference		Reference	
(95% CI)		2.18 (1.60 2.96)	1.99 (1.45 2.72)			2.48 (1.80 3.43)	2.39 (1.74 3.30)			1.55 (1.18 2.02)	1.59 (1.24 2.03)	
Rainy season	0.01	0.86 (0.61 1.20)			0.05	0.59 (0.42 0.84)	0.59 (0.42 0.81)		0.15	0.48 (0.37 0.62)	0.53 (0.42 0.69)	
Stove with no ventilation		Reference		Reference			Reference		Reference		Reference	
Stove with chimney	0.04	0.47 (0.27 0.82)			0.03	0.72 (0.40 1.28)			0.01	0.85 (0.54 1.36)		
Stove in a recessed area		0.76 (0.54 1.07)				1.27 (0.88 1.83)				1.14 (0.85 1.51)		
Wealth Quintile 1		Reference		Reference			Reference		Reference		Reference	
Wealth Quintile 2	0.06	0.66 (0.48 0.92)	0.72 (0.52 0.99)		0.06	0.62 (0.43 0.89)	0.71 (0.51 0.98)		0.03	0.70 (0.53 0.93)		
Wealth Quintile 3		0.40 (0.20 0.80)	0.55 (0.28 1.08)			0.45 (0.22 0.93)	0.55 (0.28 1.08)			0.78 (0.43 1.41)		
Use of wood	0.01	0.77 (0.55 1.06)			0.04	0.65 (0.46 0.92)			0.09	0.57 (0.44 0.74)	0.78 (0.60 1.01)	
Number of pigs	<0.01	1.02 (0.91 1.14)			0.01	1.09 (0.96 1.23)	1.12 (1.01 1.25)		0.01	1.05 (0.95 1.15)		
Having dogs	0.01	1.26 (0.89 1.78)			0.01	1.32 (0.91 1.91)			0.03	1.40 (1.05 1.86)	1.29 (1.00 1.65)	
Secondary stove: LPG gas	<0.01	0.88 (0.61 1.27)			0.01	0.75 (0.51 1.09)			0.01	0.82 (0.60 1.11)		
Number of open windows	0.01	1.16 (0.92 1.46)	1.21 (0.97 1.50)		<0.01	1.10 (0.87 1.41)			0.02	1.20 (0.99 1.46)	1.20 (1.01 1.42)	
24 hrs vs 48 hrs sample	<0.01	1.12 (0.69 1.84)			<0.01	1.25 (0.69 2.29)			0.03	0.62 (0.41 0.93)	0.68 (0.47 0.97)	

SLR: single variable linear regression results; MLR: multivariable linear regression model results selecting the variables that most robustly explained variability of each pollutant; R^2 : partial correlation coefficients resulting from single variable linear regression models. **Bold values**: highlight significant results with p -value <0.05 ; Each of the regression model coefficient represents the ratio of the impact on the pollutant compared to the reference category. For example, a ratio of 1.1 translates to a 10% increase and a value of 0.9 translates in a 10% decrease compared to the reference category. Multivariable model covariates of each kitchen area pollutant: $PM_{2.5}$ includes roof type, wealth quintile and number of open windows; CO covariates include roof type, wealth quintile, rainy season and number of pigs; BC covariates include: roof type, rainy season, use of wood, number of open windows and samples with only the first 24 hours.

Table S2. Linear regression results of household variables in relation to personal exposure concentrations

Variable	Personal PM _{2.5}			Personal CO			Personal BC		
	R ²	SLR	MLR	R ²	SLR	MLR	R ²	SLR	MLR
		Ratio (95% CI)	Ratio (95% CI)		Ratio (95% CI)	Ratio (95% CI)		Ratio (95% CI)	
N		N = 180			N = 160			N = 180	
Kitchen roof material	0.08			0.03			0.09		
Corrugated metal roof or similar			Reference						
Natural: straw, totora, reed or similar (95% CI)		1.64 (1.28 2.11)	1.37 (1.07 1.76)		1.46 (1.06 2.02)	1.36 (0.99 1.88)		1.68 (1.32 2.14)	1.57 (1.23 1.99)
Stove with no ventilation			Reference						
Stove with chimney (95% CI)	0.05	0.50 (0.32 0.77)	0.65 (0.43 0.98)	0.01	0.66 (0.39 1.13)		0.05	0.52 (0.34 0.79)	0.60 (0.40 0.91)
Stove in a recessed area (95% CI)		0.80 (0.61 1.05)	0.82 (0.64 1.05)		0.90 (0.64 1.26)			0.88 (0.68 1.14)	0.89 (0.70 1.14)
Number of bedrooms (95% CI)	0.07	0.75 (0.64 0.88)	0.80 (0.69 0.93)	0.02	0.82 (0.67 1.00)		0.04	0.82 (0.70 0.96)	
Wealth Quintile 1			Reference						
Wealth Quintile 2 (95% CI)	0.04	0.76 (0.58 0.99)		0.04	0.72 (0.52 1.01)	0.78 (0.56 1.08)	0.02	0.79 (0.61 1.02)	
Wealth Quintile 3 (95% CI)		0.57 (0.33 1.01)			0.46 (0.21 0.99)	0.49 (0.23 1.07)		0.73 (0.42 1.26)	
Secondary stove: LPG gas stove (95% CI)		0.93 (0.70 1.24)	0.79 (0.60 1.02)	0.02	0.71 (0.50 1.02)	0.72 (0.50 1.02)	0.02	0.78 (0.59 1.04)	0.72 (0.55 0.93)
Kitchen separation from the main residence	0.03			<0.01			0.02		
with adjacent walls			Reference						
without adjacent walls (95% CI)		1.34 (1.04 1.73)	1.31 (1.03 1.66)		1.15 (0.83 1.58)			1.34 (1.04 1.72)	1.31 (1.03 1.66)
24 hrs vs 48 hrs sample (95% CI)	0.04	2.04 (1.18 3.54)	2.19 (1.33 3.60)	<0.01	0.99 (0.54 1.81)		0.01	1.46 (0.85 2.51)	1.69 (1.03 2.79)
Having of dogs (binary) (95% CI)	0.04	1.45 (1.11 1.90)	1.38 (1.08 1.78)	0.01	1.24 (0.88 1.75)		0.01	1.22 (0.93 1.59)	
Number of open windows (95% CI)	0.01	1.13 (0.95 1.36)		<0.01	0.99 (0.79 1.24)		0.02	1.20 (1.01 1.43)	1.19 (1.01 1.40)

SLR: single variable linear regression results; MLR: multivariable linear regression model results selecting the variables that most robustly explained variability of each pollutant; R^2 : partial correlation coefficients resulting from single variable linear regression models. **Bold values**: highlight significant results with p -value <0.05 ; Each of the regression model coefficient represents the ratio of the impact on the pollutant compared to the reference category. For example, a ratio of 1.1 translates to a 10% increase and a value of 0.9 translates in a 10% decrease compared to the reference category. Multivariable model covariates of each pollutant: $PM_{2.5}$ includes roof type, number of bedrooms, LPG stove, stove ventilation, kitchen with adjacent wall to the main residence, having dogs and samples with the first 24 hours; CO covariates include roof type, wealth quintile and LPG stove; BC covariates include: LPG stove, stove ventilation, kitchen with adjacent wall to the main residence, having dogs and samples with only the first 24 hours.



Figure S1. Metal roofs and natural material roof pictures of kitchen households from participants. Top pictures: metal roofs highlighting the space from the eaves; bottom pictures: kitchens with natural roof materials.