Air Pollutant Exposure and Respiratory Health Among Adolescents in Nairobi, Kenya

C. Sung[1], E. Maleche-Obimbo[2], J. S. Zifodya[3], J. J. Hess[4], M. Nderitu[5], J. Lukorito[5], D. Silas[5], A. Cagle[1], S. Gupta[1], S. Eskander[5], M. H. Chung[6], K. A. Crothers[1], E. F. Attia[1]; [1]Pulmonary/Critical Care Medicine, University of Washington, Seattle, WA, United States, [2]Paediatrics and Respiratory Medicine, University of Nairobi, Nairobi, Kenya, [3]Pulmonary and Critical Care, Tulane University School of Medicine, New Orleans, LA, United States, [4]Emergency Medicine, Env & Occ Health Sciences, and Global Health, University of Washington, Seattle, WA, United States, [5]Coptic Hope Center for Infectious Diseases, Nairobi, Kenya, [6]Department of Medicine, Emory University, Atlanta, GA, United States.

Corresponding author's email: csung1@uw.edu

RATIONALE: Indoor and ambient air pollutants are major modifiable drivers of lung disease in low- and middle-income countries (LMICs). Links between exposure to pollutants and lung disease are reported for multiple outcomes, but remain understudied among adolescents. We hypothesized that indoor and ambient pollutants would be associated with respiratory symptoms and abnormal spirometry among adolescents living with HIV (ALWH) and uninfected adolescents in Nairobi, Kenya, and examined whether these associations differed in ALWH. METHODS: We analyzed data from the BREATHE II study, which includes 343 adolescents (n=168 ALWH) recruited from the Coptic Hope Center for Infectious Diseases and surrounding catchment area in Nairobi. Participants underwent post-bronchodilator spirometry and completed questionnaires that included respiratory symptoms, self-reported indoor fuel use, tobacco smoke exposure, home proximity to highly trafficked roads, and household income. Abnormal spirometry was defined as z-score <-1.64 for FEV1, FVC, or FEV1/FVC (GLI 2012). Logistic regression models adjusted for age, sex, and HIV status determined associations of pollutant exposure with abnormal spirometry and respiratory symptoms. We generated similar models restricted to ALWH. RESULTS: Overall, 53% of participants were male, and median age was 14 years (IQR 12-17; Table). ALWH had well-controlled HIV. The majority (81%) of participants burned fuels indoors; 21% had exposure to secondhand tobacco smoke. Compared to uninfected participants, ALWH had a higher prevalence of prior pneumonia, respiratory symptoms and abnormal spirometry. In adjusted models, the following pollutant exposures were associated with abnormal spirometry: kerosene use (zFEV1/FVC<-1.64 (aOR 5.78 [95%CI 1.45-23.1], p=0.01)); wood use (zFEV1<-1.64 (3.26 [1.04-10.2], p=0.04)); secondhand smoke exposure (zFEV1<-1.64 (3.46 [1.27-9.45], p=0.02)). Secondhand smoke exposure was associated with cough (1.79 [1.00-3.20], p=0.05) and activity limitation (3.74 [1.28-11.0], p=0.02). Living <100m from a highly trafficked road was associated with breathlessness (1.79 [1.02-3.17], p=0.04) and chest tightness (1.67 [1.02-2.73], p=0.04). In models restricted to ALWH, associations of kerosene, wood, and secondhand smoke with abnormal spirometry and respiratory symptoms persisted, and although point estimates were generally larger, confidence intervals were wider. CONCLUSION: Air pollutant exposures and respiratory symptoms are highly prevalent among adolescents in Nairobi. Indoor kerosene and wood burning, living with a smoker, and home proximity to heavily trafficked roads were associated with impaired spirometry and respiratory symptoms. Associations persisted in analyses restricted to ALWH. Our findings support that adolescents in LMICs are at increased risk of harm related to unsafe air quality, and ALWH may represent a particularly vulnerable population.

Table. Select Characteristics of BREATHE II Study Participants

	All participants (n=343)	ALWH (n=168)		HIV-uninfected (n=175)		p-value
		n		n		
Age (median, IQR)	14 (12-17)	168	15 (13-18)	174	13 (11-16)	<0.001
Male, n (%)	180 (53.2)	168	74 (44.0)	174	106 (62.3)	0.001
Prior pneumonia, n (%)	94 (27.4)	168	54 (32.1)	175	40 (22.9)	0.08
Prior pulmonary TB, n (%)	22 (6.5)	168	21 (12.5)	169	1 (0.6)	<0.001
Household monthly income <15,000 KSH, n (%)	131 (38.2)	120	51 (30.4)	141	80 (47.1)	0.02
HIV-related variables (median, IQR)						
Age at HIV diagnosis	--	160	11 (8-13)		--	--
Current CD4 T-cell count	--	165	496 (317-879)		--	--
Years on ART	--	160	9.5 (3.8-12)		--	--
On ART (%)	--	160	100		--	--
Perinatally acquired HIV, n (%)	--	160	150 (93.8)		--	--
Pollutant Exposure, n (%)						
Indoor fuel burning	277 (82.2)	168	134 (79.8)	169	143 (84.6)	0.65
Wood	44 (13.1)	168	26 (15.5)	169	18 (10.7)	0.19
Charcoal	229 (68.0)	168	109 (64.9)	169	120 (71.0)	0.23
Kerosene	158 (46.9)	168	67 (39.9)	169	91 (53.8)	0.01
Tobacco smoke exposure						
Primary	0 (0)	168	0 (0)	169	0 (0)	--
Secondhand	71 (21.1)	168	41 (24.4)	169	30 (17.8)	0.13
Living <100m from main road	168 (49.9)	168	83 (49.4)	169	85 (50.3)	0.87
Spirometry/oximetry data, n (%)						
zFEV1, post BD < -1.64	17 (5.1)	163	12 (7.4)	172	5 (2.9)	0.08
zFVC, post BD, < -1.64	22 (7.3)	149	15 (10.1)	153	7 (4.6)	0.08
zFEV1/FVC, post BD, < -1.64	10 (3.3)	149	6 (4.0)	153	4 (2.6)	0.54
Respiratory Symptoms, n (%)						
Cough	90 (26.7)	168	57 (33.9)	169	33 (19.5)	0.003
Phlegm	69 (20.5)	168	38 (22.6)	169	31 (18.3)	0.33
Chest tightness	88 (26.1)	168	44 (26.2)	169	44 (26.0)	0.97
Breathlessness	90 (26.7)	168	15 (8.9)	169	21 (12.4)	0.30
Activity limitation	15 (4.5)	168	7 (4.2)	169	8 (4.7)	1.0

This abstract is funded by: K23 (HL129888)