

# Lung function in HIV infected adolescents on antiretroviral therapy in Cape Town, South Africa

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Cape Town Antiretroviral Cohort (CTAAC) study



# Background

- > 90% HIV infected adolescents live in Sub-Saharan Africa
- Lung disease is common complication of HIV
- Limited information on determinants and spectrum of HIV chronic lung disease in adolescents on ART



# Aim



- To describe the spectrum and determinants of lung function in HIV infected adolescents on ART in Cape Town, South Africa
- Setting: Research Centre for Child and Adolescent Health, Red Cross War Memorial Children's Hospital



# Methods

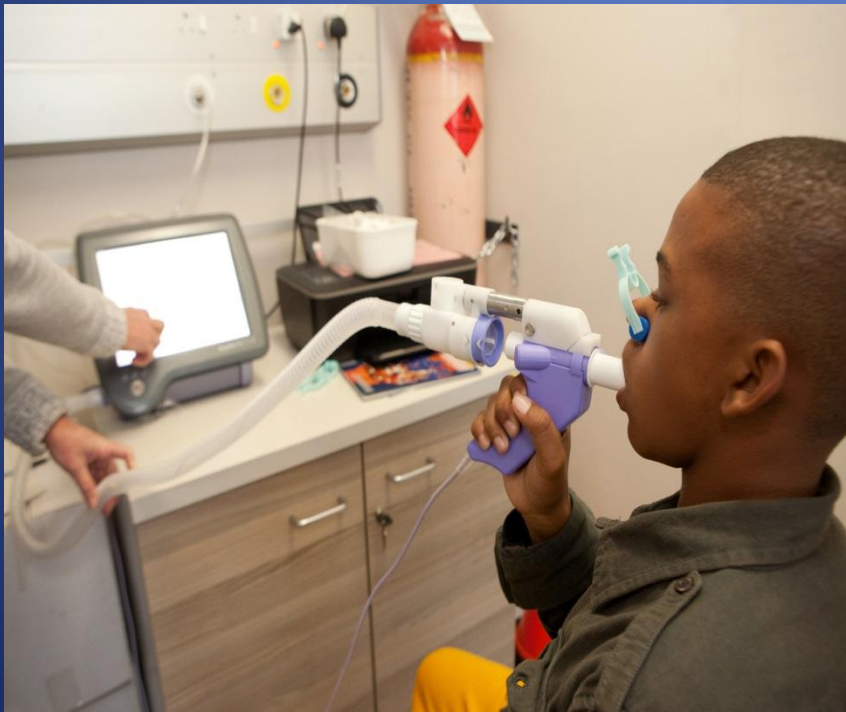
- Cross-sectional analysis from a prospective cohort, recruited 2013-2015
- 515 HIV infected adolescents, aged 9-14 years on ART for  $\geq 6$  months
- Children recruited from primary care clinics and hospital-based ART services across Cape Town
- 110 uninfected age, sex, ethnicity matched controls
- Informed consent and assent provided
- Ethical approval obtained from University of Cape Town



# Lung function in HIV infected adolescents – CTAAC cohort

- ◆ Spirometry
- ◆ N<sub>2</sub> multiple breath washout
- ◆ DLCO

- ◆ FOT
- ◆ Bronchodilator response



# Methods: measures

- Lung function
  - Spirometry (pre- and post bronchodilator)  
(Measure of lung volume and airflow)
    - Obstructive pattern:  $FEV_1/FVC < LLN$
    - Bronchodilator response:  $FEV_1 > 12\%$
  - Single breath diffusion test for CO  
(measures how well our lungs exchange gases)
    - Transfer factor for CO (TLCO)

forced expiratory volume in 1s (FEV1);  
forced vital capacity (FVC)

# Methods: measures

## -N<sub>2</sub> Multiple breath wash-out test (MBW)

(Measures volume that remains in lung after normal breath & non-uniformity of gas distribution in the lungs)

-Functional residual capacity (FRC)

-Lung clearance index (LCI)

## -Forced Oscillation Technique (FOT)

(non-invasive measure of respiratory mechanics i.e. resistance, compliance & reactance)

## -Six minute walk test

# Methods

- Demographic and clinical factors included as covariates to predict lung function
- Data analysis: STATA 12.0
  - Summary statistics
  - Linear regression to predict lung function parameters



# Results: Participant characteristics

	HIV+ (n=510)	HIV- (n=110)	P value
Age (y) (mean/SD)	12.0 (1.6)	11.8 (1.8)	0.355
Height Z-score (mean/SD)	-1.3 (1.0)	-0.5(1.1)	<0.001
Male, n (%)	266 (52.1)	48 (45.3)	0.127
CD4 nadir n=442 (median/IQR)	510.5 (274-903)		
ART duration, years n=497	7.6 (4.6-9.2)		
Age ART initiated (y) (mean/SD)	5.0 (3.5)		
CD4 current (n=510) (median/IQR)	713 (561-958)		
Had Pneumonia, (n%)	147 (28.8)	1 (0.9)	<0.001
Had PTB (n%)	301 (37.1)	0 (0)	<0.001
Passive smoking (n%)	127 (24.9)	20 (18.9)	0.185

# Comparison of lung function by HIV status

Lung function outcome				Multivariable analysis *		
	HIV+	HIV-	N	Co-efficient	95%CI	P value^
FEV <sub>1</sub> (L)	1.60 (0.45)	1.86 (0.51)	601	-0.13	-0.20 to -0.05	0.001
TLCO (ml/min/mmHg)	16.59 (3.37)	18.09 (4.22)	550	-0.60	-1.20 to -0.01	0.048
FRC (L)	1.01 (0.81-1.17)	1.16 (0.94-1.51)	231	-0.12	-0.20 to -0.04	0.04
LCI (T.O)	7.35 (6.79-8.14)	6.89 (6.27-7.64)	231	0.47	0.06 to 0.87	0.024

\* adjusted for age, sex, height

# Comparison of lung function by HIV status

Lung function outcome				Multivariable analysis **		
	HIV +	HIV -	N	Co-efficient	95%CI	P value
Resistance at 8Hz	5.0 (4.2-5.7)	4.4 (3.5-5.4)	498	0.41	0.15 to 0.68	0.002
Reactance at 8Hz	-1.98 (-2.67 to -1.49)	-1.66 (-2.24 to -1.19)	498	-0.31	-0.53 to 0.08	0.008
*Compliance	11.1 (8.7-14.0)	13.5 (10.0-21.0)	498	-7.63	-10.48 to -4.79	<0.001

Resistance (cmH<sub>2</sub>O.L.s<sup>-1</sup>), \*Compliance (ml/cmH<sub>2</sub>O) multiplied by 1000 \*\* adjusted for age, sex, height

# Results: Spirometry

	HIV+ n=499	HIV- n =106	P value
FEV1 (L)	1.60 (0.45)	1.86 (0.51)	<0.001
FEV1 % predicted	87 (17)	94 (13)	<0.001
FVC (L)	1.80 (0.48)	2.00 (0.56)	<0.001
FVC % predicted	87 (16)	90 (13)	0.071
FEV1/FVC	89 (8.7)	93 (6.3)	<0.001

# Multivariate analysis: Covariates

FEV1 (n=461)			DLCO (n=419)		LCI (n=181)	
	coeff	95%CI	coeff	95%CI	coeff	95%CI
Age	0.15	<b>0.13-0.16</b>	1.09	<b>0.94 to 1.24</b>	0.02	-0.09 to 0.12
Sex	0.05	-0.01 to 0.11	0.87	<b>0.37 to 1.36</b>	-0.10	-0.43 to 0.23
Height Z-score	0.21	<b>0.18-0.24</b>	1.48	<b>1.24 to 1.72</b>	-0.20	<b>-0.35 to -0.04</b>
ART duration (years)	-0.01	-0.02 to -0.00	0.00	-0.08 to 0.08	0.08	0.03 to 0.13
History of pneumonia	-0.11	<b>-0.18 to -0.04</b>	-0.65	<b>-1.19 to -0.10</b>	0.30	-0.07 to 0.67
History of TB	-0.07	<b>-0.13 to -0.004</b>	-0.44	-0.94 to 0.07	0.30	-0.04 to 0.63

# Six minute walk test

	<b>HIV infected n=339</b>	<b>HIV uninfected n=99</b>	<b>P value</b>
Distance walked (m)	433.7 (57.0)	443.5 (60.5)	0.138
Pulse before test (bpm)	78.1 (12.2)	83.0 (13.5)	<0.001
Pulse after test (bpm)	82.3 (13.9)	87.2 (14.4)	0.002
Oxygen saturation after test (%)	98.7 (0.8)	98.8 (0.6)	0.473
MAP before test (mmHg)	77.6 (7.9)	81.4 (7.9)	<0.001

Ref values (Swiss Cohort BMC 2013)  
mean arterial pressure (MAP)

# Strengths & Limitations

- Novel data on lung function in this population
  - Good local access to ART
- No normative data for several parameters
  - Local HIV-negative controls
- Focus on lung function
  - Data on lung structure (CT, CXR) being analysed

# Conclusion

- African HIV infected adolescents on ART have decreased lung volumes, airflow, diffusion capacity and compliance and increased resistance and ventilation homogeneity compared to HIV uninfected adolescents
  - Generally within normal limits
- Age, gender, height, past pneumonia and TB were predictors of lung function





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