Indoor Air Quality of Low and Middle Income Urban Households in South Africa

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INTRODUCTION

- Tuberculosis (TB) is a global burden with developing countries with the most burden. [1]
- Recent original and review studies have linked to TB to indoor air pollution (IAP) exposure.[2,3]
- These studies had assessed exposure to IAP using proxy measures such as reported cooking fuel use.

OBJECTIVE

To characterise and model concentrations of three indoor pollutants (PM_{10}, NO_2 and SO_2) in the homes of children participating in the childhood TB study.

METHODS

This was a case control study with children having active PTB classified as cases and controls being children without PTB living in Durban, South Africa.

Home walkthrough

- 242 homes were investigated using a validated walkthrough checklist .

Indoor air sampling and analysis

- PM_{10} sampled for 24hrs & gravimetric analysis of mass concentration done.

- Two weeks of NO_2 and SO_2 passive sampling using radiello and samples analysed with ICP-MS.

Data Analysis

- Descriptive & bivariate analysis of data collected using walkthrough and measured pollutant concentrations.
- Stepwise linear regression model used to develop predictive models for PM_{10} and NO_2. Because of low SO_2 concentrations no predictive model was developed.
- Validation of predictive models done using leave out one cross validation (LOOCV).

RESULTS

Data was collected from 242 homes
- All 242 homes had walkthrough investigation conducted,
- 105 homes had valid PM_{10} sampled and analysed, &
- 82 homes were sampled for NO_2 and SO_2.

Table 1: Different PM_{10}, NO_2 and SO_2 concentrations ($\mu g/m^3$) in sampled households with different household characteristics tested using Mann–Whitney U and Kruskal-Wallis test with p-value considered significant at <0.05.

	Median PM_{10} ($\mu g/m^3$)	p-value	Median NO_2 ($\mu g/m^3$)	p-value	Median SO_2 ($\mu g/m^3$)	p-value
HOUSEHOLD CHARACTERISTICS						
Type of housing structure						
Formal	41.77	<0.0001	14.64	0.0070	0.22	0.0025
Informal	93.47		22.95		0.75	
Number of rooms						
1–3	78.14	0.0006	19.64	0.3412	0.62	0.0277
>3	42.29		14.69		0.22	
Sampled cooking area						
Yes	72.63	0.0001	20.31	0.214	0.48	0.191
No	39.84		14.67		0.25	
Primary cooking fuel						
Clean	42.82	<0.0001	15.24	0.0368	0.26	0.6888
Mix	87.86		22.95		0.45	
Presence of household smokers						
Yes	52.75	0.2398	18.13	0.2992	0.58	0.0401
No	46.08		14.59		0.22	
Number of smokers in the household						
1	46.08	0.0150	16.51	0.9771	0.27	0.4483
>1	89.93		17.82		0.39	
Crowding						
0.50–2.50	42.16	0.0045	14.48	0.1300	0.25	0.0942
>2.50	73.43		20.98		0.45	
Window presence						
No	92.27	0.0035	21.43	0.044	0.95	0.0035
Yes	47.50		14.97		0.25	
Environmental tobacco smoke						
No	46.05	0.0231	16.31	0.0877	0.25	0.0662
Yes	96.72		19.34		0.77	
Burning of incense						
Yes	49.97	0.8753	19.64	0.0230	0.45	0.0128
No	47.77		13.55		0.23	
Sampled room presence of windows						
Yes	47.50	0.0154	14.69	0.0353	0.25	0.0035
No	92.27		21.43		0.95	
Distance to a major roadway						
0–150	47.63	0.8727	19.32	0.0066	0.25	0.4895
>150	51.72		13.81		0.33	
Sampling season						
Warm	42.91	0.0036	14.56	0.1502	0.21	0.0052
Cold	84.51		20.98		0.72	

Significant different concentrations between different households with different characteristics are shown in bold

Models developed for indoor PM_{10} and NO_2 concentrations:

$lnPM_{10} = 0.447*$housing type $+ 0.445*$primary fuel type $- 0.174*$total number of rooms $+ 0.267*$season $+ 0.489*$number of h/h smokers $+ 3.620$

$lnNO_2 = 0.182*$housing type $+ 0.347*$primary fuel type $- 0.234*$burning of incense $+ 0.301*$secondary fuel type $- 0.311*$distance from major roadway $+ 2.79$

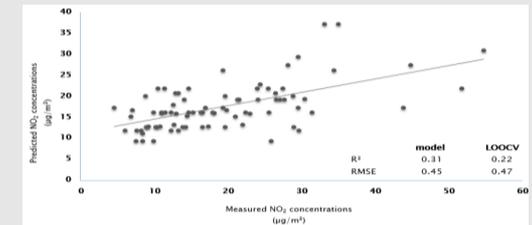## RESULTS......continued

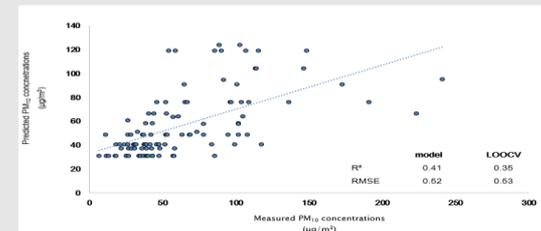Figure 1: Measured PM_{10} and predicted PM_{10} concentrations

Figure 2: Measured NO_2 and predicted NO_2 concentrations

CONCLUSION

Low concentrations of indoor air pollutants can be modeled successfully therefore eliminating direct measurement.

ACKNOWLEDGEMENTS

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