The Effects of Particulate Matter on Lower Respiratory Tract Infections: A Population-Based Study

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Background

- Lower Respiratory Tract Infections (LRTIs) are one of the major contributors to mortality across the globe.
- Globally, about 489 million occurrences & 2.4 million deaths occurred due to LRTIs in 2019 (Safiri et al., 2023).
- In Ghana, LRTIs are a top concern, as 53.5 deaths per 100,000 people occurred in 2019 (World Health Organization, n.d.).
- A risk factor for LRTIs is poor air quality; however, very few studies have examined the effects of particulate matter (PM) on LRTIs.
- Additionally, the biosocial, sociocultural, and lifestyle factors of LRTIs are understudied especially amongst the elderly.

Objectives

1. Examine how exposure to short-lived climate pollutants (SLCPs) such as PM, has consequences for LRTIs.
2. Assess the effects of biosocial, sociocultural, & lifestyle risk factors on LRTIs in those aged 50+.

Methods

Study Setting:

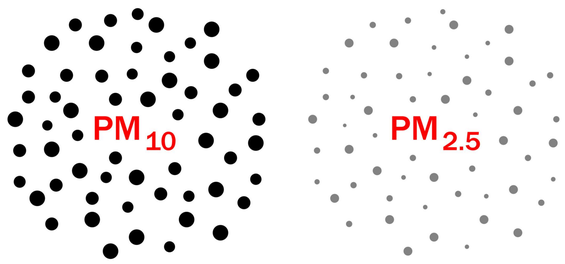
- Data: Wave 2 of 2014-2015 World Health Organization Study on Global AGEing and Adult Health (SAGE) conducted in Ghana (N = 5,707)
- Source of satellite telemetry data: Emissions Database for Global Atmospheric Research (EDGAR)

Outcome:

- LRTIs assessed using self-reported measures in the last 12 months:
  - Shortness of breath at rest while awake
  - Coughing or wheezing for ≥ 10 minutes at a time
  - Coughing up sputum or phlegm for most days of the month for at least 3 months
  - Wheezing attacks or whistling breathing
  - Tightness in the chest

Predicators:

- PM10
- PM2.5
- CO2
- NoX
- SO2



Covariates:

- Biosocial factors
  - Age, ethnicity, & living in a rural settlement
- Sociocultural factors
  - Education level & wealth status
- Lifestyle factors
  - Physical activity & smoking status

Data Analysis:

- Statistical Analyses:
  - Bivariate logistic regression analysis between LRTIs and SLCPs.
  - Multivariate logistic regression analysis between LRTIs and SLCPs while controlling for covariates.
    - Only covariates significant ($p < 0.05$) at the bivariate level were included

Results

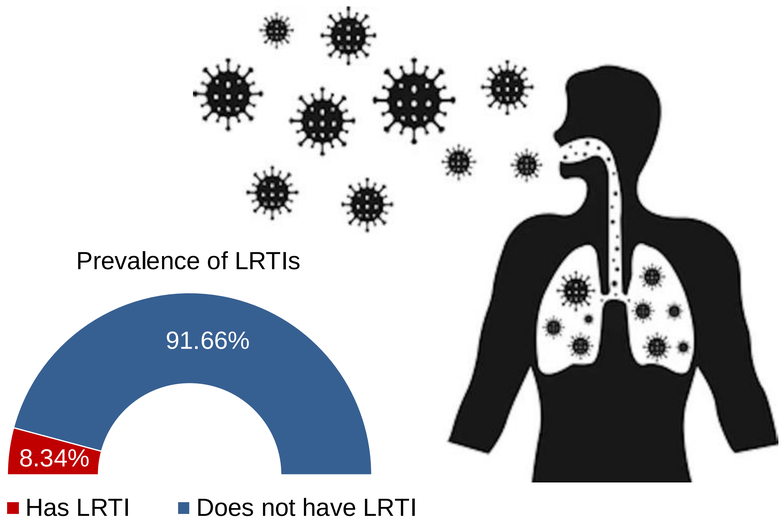


Figure 1: Semi-circle pie chart showing the percentage of the sample that has LRTIs. The red portion represents the percentage of those who have a LRTI, and the blue portion represents the percentage of those who do not have a LRTI.

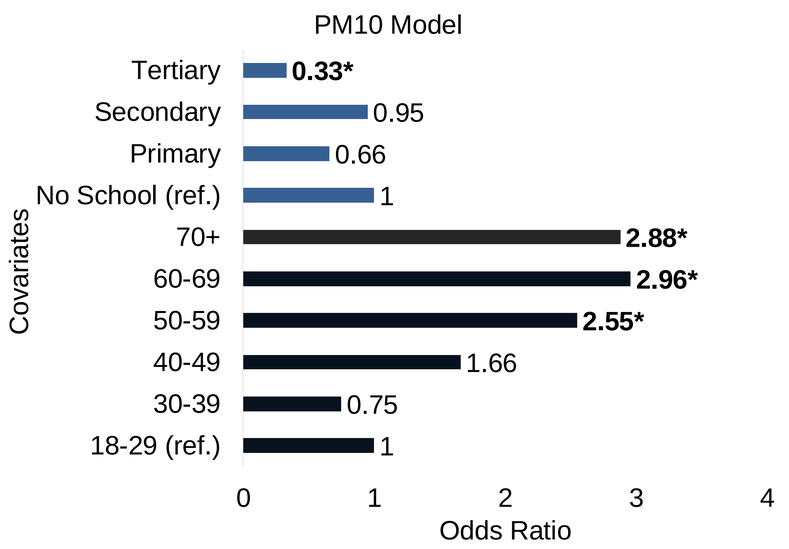


Figure 2: Clustered bar graph showing age and education as significant covariates associated with PM10 & LRTIs in the multivariate model. Black bars represent age & blue bars represent education. Ref. stands for the reference category. Bolded values with an * denotes ($p<0.05$)

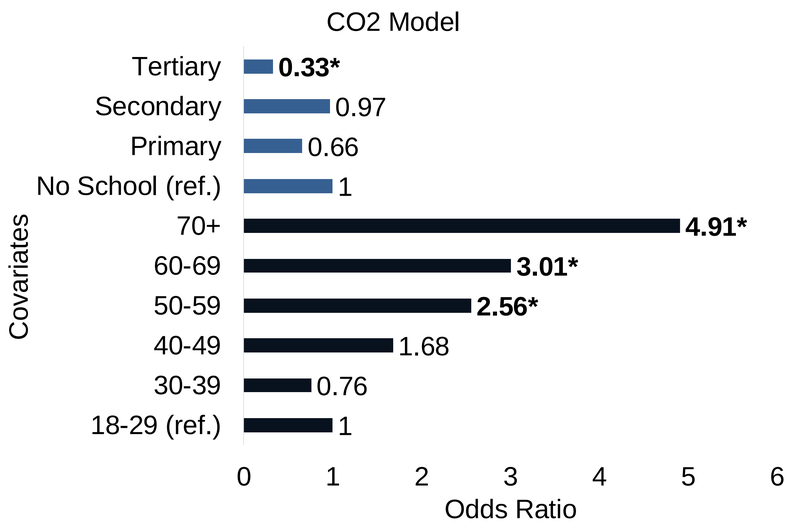


Figure 3: Clustered bar graph showing age and education as significant covariates associated with CO2 & LRTIs in the multivariate model. Black bars represent age & blue bars represent education. Ref. stands for the reference category. Bolded values with an * denotes ($p<0.05$)

Results

Table 1: Odds ratio coefficients for the PM2.5, NoX, & SO2 multivariate models. These multivariate models are not significant; however, there is an age effect for all, and an education effect for all except PM2.5. Bolded values with * denotes ($p < 0.05$)

Variables	PM2.5 Model	NoX Model	SO2 Model
18-29 (ref.)	1.00	1.00	1.00
30-39	0.65	0.77	0.78
40-49	1.97	1.68	1.69
50-59	2.18	**2.53***	**2.56***
60-69	**2.78***	**2.98***	**3.01***
70+	**4.43***	**4.84***	**4.93***
No School (ref.)	1.00	1.00	1.00
Primary	0.75	0.65	0.66
Secondary	0.73	0.96	0.96
Tertiary	0.45	**0.32***	**0.33***
PM2.5	1.07	-	-
NoX	-	1.00	-
SO2	-	-	1.00

Conclusions

- Exposure to particulate matter namely, PM10 & CO2 increased the odds of experiencing LRTIs.
- Older age significantly increased the odds of experiencing LRTIs.
- Higher education significantly reduced the odds of experiencing LRTIs.
- We need interventions aimed at improving ambient air quality, which has the potential to reduce LRTIs.
- We recommend that the government create policies that protect vulnerable older adults.
- Additionally, we propose the creation of educational programs focusing on the risks, symptoms, and treatment options of LRTIs

Funding & Contact

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