

Association between Deforestation and Pneumonia Incidence in the Bolivian Amazon from 2002-2023: An Ecological Study

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Introduction

- The Amazon is the largest tropical rainforest on the planet, but has lost up to 20% of its original area.
- Bolivia is one of the top ten countries with the most forest cover in the world, but has lost 15% of its forest since 2000.
- 2024 was the worst year for deforestation caused by fires in Bolivia's history.
- Fires release harmful chemicals into the air, which have been associated with negative health outcomes (like increased respiratory infections).

Objective

Analyze the health effects caused by deforestation in the Biogeographical Bolivian Amazon.

Methodology

Design:
Ecological study, 2002-2023

Pre/Post Vaccine:
2002-2014/2015-2023
By Sex and Age: 2007-2023

Unit of analysis/study area:
89 Municipalities (23 in Political)

Analysis: Negative binomial regression model with fixed effects for year and municipality and a population offset.

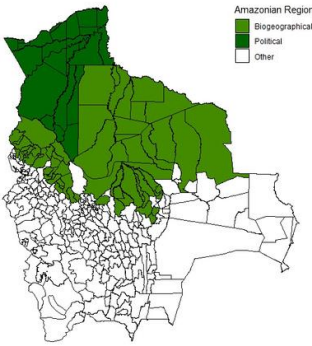
Methodology (cont.)

Outcome: Pneumonia (*National System for Health Information - Epidemiologic Surveillance*)

Exposition: Tree Cover Loss (total, primary, and by fire) (*Global Forest Watch - GLAD*)

Socioeconomic covariates (i.e. literacy rate, municipal health index, electricity coverage, etc.) (*National Statistics Institute*)

Map of Bolivia by Region Type



Results

A positive association between the rate of tree cover loss by fire and pneumonia incidence was only found in the adjusted model.

Association between Total Pneumonia Incidence and Tree Cover Loss Rate in the Biogeographical Bolivian Amazon (n=89 municipalities) from 2002-2023

| Variable | Crude RR (95%CI) | P-Value | Adjusted RR (95%CI) | P-Value |
|-----------------------------------|------------------|---------|---------------------|---------|
| Total Tree Cover Loss Rate | 0.97 (0.93-1.00) | 0.1 | 0.99 (0.96-1.03) | 0.9 |
| Primary Tree Cover Loss Rate | 0.98 (0.94-1.02) | 0.4 | 1.01 (0.97-1.05) | 0.7 |
| Tree Cover Loss due to Fires Rate | 1.28 (1.08-1.50) | 0.003 | 1.14 (0.98-1.33) | 0.08 |

After controlling for the vaccine...

Association between Total Pneumonia Incidence and Tree Cover Loss Rate in the Biogeographical Bolivian Amazon (n=89 municipalities) Pre- and Post-Pneumococcal Vaccine (introduced in 2014)

| Variable | Pre (2002-2014) | | | Post (2015-2023) | | |
|-----------------------------------|------------------|---------|---------------------|------------------|------------------|---------------------|
| | Crude RR (95%CI) | P-Value | Adjusted RR (95%CI) | Crude RR (95%CI) | P-Value | Adjusted RR (95%CI) |
| Total Tree Cover Loss Rate | 0.98 (0.94-1.03) | 0.4 | 1.00 (0.96-1.05) | 0.9 | 1.02 (0.96-1.09) | 0.4 |
| Primary Tree Cover Loss Rate | 0.99 (0.95-1.04) | 0.8 | 1.02 (0.97-1.07) | 0.5 | 1.03 (0.97-1.09) | 0.05 |
| Tree Cover Loss due to Fires Rate | 1.50 (0.81-2.79) | 0.2 | 1.15 (0.63-2.08) | 0.6 | 1.08 (0.97-1.21) | 0.1 |

Discussion

- The association was also positive with tree cover loss by fire in the elderly (60+ years) population from 2007-2023 (in the adjusted model)
- Could reflect similar associations between respiratory disease and forest fires as found in other studies.
- Results changed as data became more available and more precise – highlighting the importance of improved monitoring systems.

Conclusion

More research is needed on tree cover loss in the Bolivian Amazon in order for the impact on the health of local populations to be better understood.

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