

The Impact of Timely Garbage Collection on Air Quality and Healthcare Burden

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ABSTRACT

This report synthesizes findings from a mixed-methods study investigating the interconnected challenges of waste management efficiency, air pollution, and public health across three urban centers: Mumbai, Lagos, and Singapore. The research quantifies the adverse impact of delayed waste collection on ambient PM2.5 concentrations and respiratory hospitalizations, revealing a significant correlation. Qualitative analyses uncover systemic barriers hindering effective waste management, particularly in low-resource settings. The report advocates for context-specific, integrated policy interventions aimed at optimizing waste systems, enhancing air quality monitoring, strengthening public health infrastructure, and promoting community engagement to mitigate the waste-air-health nexus.

Keywords: Waste Management, Air Pollution, Public Health, Policy Implications, Sustainable Development, Environmental Justice, Urban Health, Mitigation Strategies, Global South, Integrated Approach

I. INTRODUCTION

This report summarizes the key findings and policy implications arising from a comprehensive study that explored the intricate links between waste management practices, air quality levels, and resultant burdens on public health systems in Mumbai, Lagos, and Singapore. Recognizing that inefficient waste handling exacerbates air pollution and undermines urban livability, the study sought to identify actionable strategies for creating cleaner, healthier, and more sustainable urban environments.

Objective of the Study

The central objectives guiding this research were to:

- Assess the quantitative relationship between waste collection efficiency and levels of ambient air pollutants (PM2.5, CH4, CO) in the selected cities.
- Determine the association between air pollution exposure and respiratory health outcomes, specifically examining hospital admission rates for related illnesses.

- Uncover the key systemic challenges impeding the implementation of effective waste management systems, including barriers related to funding, governance, infrastructure, and community participation.
- Formulate practical policy recommendations tailored to the unique contexts of each city, aimed at improving waste handling practices, reducing air pollution, and safeguarding public health.

Hypotheses of the Study

H1: Improved garbage collection frequency will correlate with reduced levels of ambient air pollutants, most notably PM2.5.

H2: Increased exposure to PM2.5 will correspond with higher rates of respiratory illness and increased hospital admissions for these conditions.

II. RESEARCH METHODOLOGY

The study employed a sequential, explanatory mixed-methods approach. Quantitative data was collected on air quality metrics, waste collection schedules, and hospital admissions. This data was analyzed using descriptive and inferential statistics, including correlation and regression analyses. Qualitative data was gathered through semi-structured interviews with key stakeholders, including waste management officials, healthcare providers, and community leaders. Thematic analysis was then used to identify key themes and provide context for the quantitative findings.

Profile of Study Cities

- Mumbai, India: A densely populated megacity struggling to manage waste effectively amid rapid urbanization, social inequality, and complex governance structures.
- Lagos, Nigeria: A rapidly expanding urban center grappling with extreme resource constraints, insufficient infrastructure, and widespread open dumping and burning of waste.
- Singapore: A global exemplar of efficient waste management, characterized by robust regulations, technological innovation, and a commitment to environmental sustainability.

Comparative Analysis of Key Parameters:

- Quantitative Results: A one-day delay in waste collection corresponded with a 12.3 $\mu\text{g}/\text{m}^3$ increase in PM2.5 levels ($p < 0.01$). Each 10 $\mu\text{g}/\text{m}^3$ rise in PM2.5 was associated with 1.4 additional daily respiratory hospitalizations. These relationships were particularly pronounced in low-income neighborhoods.
- Qualitative Themes: Key themes emerging from the interviews included "Funding Shortfalls Cripple Collection," "Burning Is the Only Option," "Hospitals Are Overwhelmed," and "Policy Exists, Enforcement Doesn't."
- Contradictions: Singapore's effective policies nullified the pollution-health links seen elsewhere, supporting the Environmental Kuznets Curve. However, limited healthcare access masked the full burden of pollution in some low-income areas.

III. LIMITATION

This study faced limitations related to: the cross-sectional design preventing definitive conclusions about causality, potential biases in self-reported data, variations in data availability and quality across the studied cities, and the potential influence of unmeasured confounders.

Policy Implications & Recommendations:

For Air Quality Management:

- Implement real-time air quality monitoring with sensor networks to trigger collection alerts.
- Enforce bans on open burning, coupled with incentives for compliance and alternative waste disposal methods.
- Promote cleaner technologies for waste transport, such as electric or hybrid vehicles.

For Public Health Systems:

- Develop early warning systems to predict pollution-related health emergencies.
- Deploy mobile health units near landfills to provide targeted screening and preventative care.
- Strengthen primary healthcare services in high-pollution areas.

For Waste Management:

- Optimize collection routes using GPS-tracked trucks and dynamic routing software.
- Incentivize community participation in waste segregation and recycling through "Clean City Credits" or similar programs.
- Invest in sustainable waste disposal methods, such as waste-to-energy plants and subsidized composting initiatives.

For National/International Stakeholders:

- Create a Global Waste Management Fund to finance infrastructure development in LMICs.
- Establish knowledge-sharing platforms to facilitate the dissemination of best practices.
- Promote adherence to international standards for waste management.

IV. CONCLUSION

The research conclusively demonstrates that inefficient waste management exacerbates air pollution and

increases public health burdens, particularly in resource-constrained urban environments. Timely garbage collection emerges as a critical lever for improving air quality and protecting public health. Addressing systemic challenges and ensuring equitable access to healthcare are also vital.

V. RECOMMENDATION FOR FUTURE RESEARCH

- Conduct longitudinal studies to track the long-term health impacts of waste policy reforms.
- Evaluate behavioural interventions designed to improve public compliance with waste management guidelines.
- Explore models for integrating informal waste pickers into formal waste management systems.
- Develop comprehensive climate-waste-health models to quantify the interconnected benefits of improved waste management practices.
- Assess the environmental justice implications of waste management policies, ensuring fair distribution of benefits and burdens.