Air Pollution and Health in Ethiopia: Review of Literature

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Outline

1. Introduction
2. Methods
3. Results
3.1 Traffic/Outdoor AP
   Magnitude, Health Effects, Policy & Legal Framework & Organizational structure & Coordination (IAP/OAP)
4. Conclusion
5. Recommendation and Way Forward
6. References
7. Acknowledgement
1. Introduction

• Air pollution (AP) is a problem in both the LMIC and non-LMIC settings. The sources and magnitude differ in both cases.

• In non-LMIC setting: AP is mainly from industrial and motor vehicle sources;

• AP in LMIC, mainly from HH solid fuel use (urban + rural), with emissions from motor vehicle & industries (urban)

• The lack of capacity and data on AP makes the LMIC rely on non-LMIC models, which may not suit the LMIC settings.

• Moreover, it poses difficulty to undertake studies; i.e. Health impact linked with AP magnitude to inform policy.

• E.g. South Africa issued Air Quality Act on 1965
Air Pollution occurs when toxic aerosols are released into the environment in quantities that can adversely affect health and human wellbeing.

AP is a local as well as regional and global problem via trans-boundary movement of air.

Ethiopia, as an emerging developing country is challenged by AP

Sources can be from Indoor and/or Outdoor Environments (Natural Vs Anthropogenic; Stationary Vs Mobile)

- Indoor cooking, lighting or space heating
- Industries, agricultural or construction activities
- Motor vehicles
The latest WHO guideline on PM pollution was updated on 2005.

The US EPA identify 6 criteria pollutants:

- Ozone \((O_3)\),
- Particulate Matter \((PM)\),
- Nitrogen Oxides \((NOx)\),
- Carbon Monoxide \((CO)\),
- Sulfur Dioxide \((SO_2)\), and
- Lead \((Pb)\).

PM2.5: is the most health impacting pollutant.
Intro’ ...cont’d

- Health Impacts:
  - ALRI,
  - COPD,
  - Asthma & Allergies,
  - Lung cancer,
  - Eye disease,
  - Cardiovascular problem,

- Regular Monitoring and Concerted Action can reduce the impact of air pollution

- Thus, the aim of the SANA - systematic review is to understand the levels of air pollution in Ethiopia, and identify the gaps
2. Methods

- The literature review used a set criteria to select the Peer-reviewed articles.

- As literature from peer-reviewed articles is very limited, the review also included gray literature such as:
  - Government publications, Annual reports, Environmental Outlook Report

- A secondary source of qualitative data from SANA.

- Scope: Not included Meta-analysis; Ethiopia
Methods...cont’d

• Criteria for checking the quality of data, reports, and publications include:

1. Adherence to the principles of objectivity in the collection, processing, and dissemination;

2. Methodological soundness

3. The type of Study Design;
   • longitudinal vs cross-sectional; prospective vs retrospective

4. Accuracy and reliability

5. Ethical clearance obtained/or have no/any ethical concern;

6. Higher ranking for studies with ethical clearance and/or studies which have no/any ethical concern.
3. Results

- There is paucity of evidence on OAP as well as IAP
- Relatively more Studies conducted on IAP than OAP, though in few areas:
  - Northern - Tigray
  - Western - Jimma and West Wollega
  - Eastern - Kebribeyah
  - Central - Butajira (2) and Addis Ababa (3)
- The few outdoor air pollution studies were concentrated in Addis
## Magnitude of IAP in Ethiopia

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Study Design</th>
<th>Criteria pollutant</th>
<th>Magnitude</th>
<th>n</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kumie, A., et al. 2009</td>
<td>Longitudinal study</td>
<td>CO (ppm)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>(8-hr WHO Guidel. 10ppm)</td>
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<tr>
<td></td>
<td></td>
<td>PM (2.5)</td>
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<td></td>
<td></td>
<td>(US EPA 24-hr 35 mu g/ cu m; WHO - 15 mu/ cu m)</td>
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<tr>
<td></td>
<td></td>
<td>NOx</td>
<td></td>
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<tr>
<td></td>
<td>Wood = 71.2, cowdung = 67.5, crop res = 56.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usinger, J., 2008</td>
<td>UNKNOWN</td>
<td>X=44</td>
<td></td>
<td>3300</td>
<td>Rural</td>
</tr>
<tr>
<td>Habtamu S. et al 2012</td>
<td>Comparative Cross-Sectional study</td>
<td>X=2417, R=483-2904</td>
<td></td>
<td>60</td>
<td>Urban</td>
</tr>
<tr>
<td>Gaia Assoc. 2007</td>
<td>Exposure Assessment</td>
<td>Traditional=80.7, Cleancook =16.7</td>
<td>X=2170, R=130</td>
<td>11</td>
<td>Rural</td>
</tr>
<tr>
<td>Graham, Megan, 2011</td>
<td>Mixed method</td>
<td>X=16.08 R=0.66-69.65</td>
<td>X=1580 R=136-12,739</td>
<td>69</td>
<td>Urban</td>
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<tr>
<td>Faris, K., 2002</td>
<td>Cross sectional study</td>
<td>82.46</td>
<td>197</td>
<td>382</td>
<td>Rural</td>
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<tr>
<td>Keil, C., et al. 2010</td>
<td>Cross-sectional Study</td>
<td>Area samp=38 Personal=57</td>
<td>Area= 846 Personal= 905</td>
<td>10</td>
<td>Urban</td>
</tr>
<tr>
<td>Kumie, A, et al. 2009</td>
<td>Longitudinal study</td>
<td>NO2= 97</td>
<td></td>
<td>3300</td>
<td>Rural</td>
</tr>
<tr>
<td>Gaia Assoc. 2007</td>
<td>Pre-Post Experimental design</td>
<td>Before=28.2, After=6.8</td>
<td>Before=640, after=280</td>
<td>9</td>
<td>Urban</td>
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</table>
## HH Energy Use Pattern in Ethiopia

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<tbody>
<tr>
<td></td>
<td>Country, %</td>
<td>Urban, %</td>
<td>Rural, %</td>
<td>Rural, %</td>
<td>Rural, %</td>
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<tr>
<td>Wood</td>
<td>85</td>
<td>63.3</td>
<td>90.8</td>
<td>52.1</td>
<td>97.3</td>
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<tr>
<td>Leaves/Crop residue/ Animal dung</td>
<td>7.2</td>
<td>2.7</td>
<td>8.4</td>
<td>47.8</td>
<td>2</td>
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<tr>
<td>Charcoal</td>
<td>3.9</td>
<td>17.5</td>
<td>0.2</td>
<td>0.1</td>
<td>-</td>
</tr>
<tr>
<td>Solid fuel</td>
<td>95</td>
<td>87.4</td>
<td>99.6</td>
<td>99.9</td>
<td>100</td>
</tr>
<tr>
<td>Kerosene</td>
<td>1.2</td>
<td>4.9</td>
<td>0.2</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>LPG/Electricity</td>
<td>1.9</td>
<td>7.7</td>
<td>0.2</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
National HH Energy Use
(Source: WMS, 2011)

Country, %  Urban, %  Rural, %

Wood  85  85  90.8
LeaveCropDung  7.2  2.7  8.4
Charcoal  3.9  17.5  0.2
Solid fuel  95  87.4  99.6
Kerosene  1.2  4.9  0.2
LPG/ Electric  1.9  7.7  0.2
Household Energy Mix

Ethiopia
(Source: WMS, 2011)

- Wood: 86%
- Charcoal: 2%
- LPG/Electricity: 4%
- Kerosene: 2%
- Leave/Crop/Dung: 7%

Addis Ababa
[Habtamu S. et al. 2012]

- Charcoal: 34%
- LPG/Electricity: 22%
- Kerosene: 18%
- Wood: 21%
- Leave/Crop/Dung: 5%
Factors Determining Health Outcome

The following factors were identified:

- Type of fuel & Cooking stoves used,
- Ventilation & Number of Rooms,
- Ecology, Weather condition & season of the year
- Frequency of fire events & N0. of Foods cooked per day
- Mothers’ cigarette smoking status
- Child holding behavior while cooking

Children and Women are most affected groups
Traffic-related Ambient AP

- Only few studies published on outdoor/traffic-related AP
  
  - Addis Ababa - 3 peer-reviewed articles
    - CO (Longitudinal) – (Kumie, A. et al. 2010)
    - PM10, CO, & O3 – Cross-Sectional
    - TSP and PM10 (Longitudinal) ; PM10 speciation
  
  - Jimma - 1 peer-reviewed
    - Health Outcome Vs. Distance from Road & Traffic volume (no pollutant measurement)
    - effect of living close to traffic bearing roads (<150 m) had more risk of wheezing
    - No statistically significant difference in the overall prevalence of wheeze.
    - Increased risk of wheeze observed within 150m close to roads
Factors Affecting Asthma/Wheeze (Traffic-related & Indoor AP)

- Some identified risk factors in Jimma study:
  - Living in Proximity to Traffic-Roads
  - The volume of vehicular traffic per day
  - The use of Kerosene for cooking food
  - Indoor Smoking, Biomass fuel combustion, and

- Other environmental factors:
  - weather, season, altitude

may attribute to the onset or exacerbation of Allergies
Policy, Legal & Organ. Framework (AP)

Policy and Legal Framework

- The FDRE Constitution
- The Environment Policy
  - Pollution Control Proclamation
  - The Environmental Impact Assessment Proclamation
  - Air Quality Guideline (focusing on industrial emissions)
- The Health Policy, Energy Policy, Water Policy
Major Gaps on AP Control (KII)

• Less priority given to AP (budget allocation)

• There is paucity of evidence/research on AP:
  ➢ No strategic direction, priority research agenda, and established Key pollutants set on AP;

• No reference laboratories, research centers & facilities for AQ monitoring

• Training centers on AP not available
  ➢ Skill gaps on monitoring, data analysis
  ➢ On-the-job-training, short-term and long-term training are limited

• Organizational structure lacks focus on AP, lacks coordination mechanism among key stakeholders

• No regular Monitoring on AQ (Ambient/Indoor environs)
Priority Needs

• Need for encourage multi-sectoral/multi-disciplinary AQ research of high-quality standard

• Key pollutants to be monitored, targeted for control; and to establish well equipped AQ lab and testing center for new technologies

• Design Strategic direction, research priority agenda on AP

• Design Short & Long-term training programs & courses; On-the-job-training; and address issue of AP in curricula

• Envisage & act towards establishing regional excellence on AQ and AP training in Ethiopia
4. Discussion

- LMIC have technological and technical capacity limitations (India..)
- In Sub-Saharan Africa,
  - few countries has data on air quality and
  - very limited monitoring network for air pollutants

- In South Africa, air pollution sources are:
  - Mainly motor vehicles and coal burning for energy production elevating the PM, SO2 levels;
  - Solid fuel use is important source of IAP (source: Caradee W. & Rietta O., 2010)

- Global focus on Climate Change adaptation and mitigation benefiting LMIC countries to give the necessary attention to Air Quality

- Ethiopia adopted WHO guideline on Air Quality although monitoring suffers from lack of expertise, facilities and coordination
  - Indoor air pollution levels exceeded guidelines in key parameters, yet limited ambient parameters studied not yielding conclusive..
5. Conclusion

- Given limited available data, NOx, RPM, CO were found to be important pollutants (I/OAP),

- The policy framework on the environment is in place, yet
  - key stakeholders lacks coordination, not mainstreamed AP, and given less priority to AQ

- There is little capacity in terms of technical, financial, training facilities, and Research

- No regular monitoring or surveillance on AQ except in one NMA station (most recently established)
6. Recommendations

• There is a need for more high quality evidences focusing on key pollutants such as PM2.5, NOx, SO2, O3 and CO (both indoors & Traffic-related)

• There is a need for establishing air monitoring stations in Urban centers and Industrial areas

• The current effort to monitor Nox, O3 and CO at NMA need be strengthened by expanding the stations across country

• Actions needed to cut the pollutant emissions from motor vehicles and solid fuel burning to minimize exposure of vulnerable groups

• Health linked air pollution studies are recommended to quantify the attributed impact of air pollution on human health
Way Forward (GEOHealth EA.)

• Conduct AQ study in Addis, including PM2.5 in 5 locations of Addis (1-in-3 days for a year)
• Speciation of chemical composition
• Conduct NOx measurement and Model traffic-related pollution
• Associate the pollution with Hospital health outcomes data
• Conduct similar studies in EA
References (partly)


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- Research Assistants: Habtamu Sanbata
- Workshop Participants & Criques
- School of Public Health
Breathing Quality Air is not a luxury good, yet a constitutional right

Thank you for your attention!!