Bioethanol and Health

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4.3 Million Deaths a year from ambient air pollution

3 Million Deaths a year from household air pollution
Household Air Pollution (HAP):
Pollution from of biomass (firewood or charcoal) for cooking and heating

Burden is primarily on low and middle income countries

Primarily impacts women and children

3 billion people cook and heat their homes using polluting fuels and inefficient technologies.
FIGURE 8 Global map of the proportion of each country’s population cooking with solid fuels in 2019.

State of Global Air 2020

Proportion of population
- 0 to <0.069
- 0.069 to <0.22
- 0.22 to <0.47
- 0.47 to <0.76
- 0.76 to <1
- No data

Visit stateofglobalair.org to explore data for your country or region.

3.8 million people a year die from the exposure to household air pollution.

Is the 10th leading risk factor for disease
(2019 Global Burden of Disease)
Components of HAP

- **Gases**
  - Carbon monoxide

- **Particulate Matter**
  - Coarse PM (10µm)
  - Fine PM (2.5µm)

- **Benzenes**

- **Polycyclic aromatic hydrocarbons (PAHs)**

- **Volatile organic compounds (VOCs)**
PM$_{2.5}$

https://www.epa.gov/pm-pollution/particulate-matter-pm-basics

https://blog.gotopac.com/2019/03/25/particulate-matter-what-is-it-how-does-it-affect-our-health/
Children bear burden primarily from:
- Pneumonia
- Lower respiratory track infections (LRIs)

Emerging evidence for pregnancy complications and pre-term and low-weight births
Ambient (outdoor) and household air pollution combine to increase risk
Deaths are not evenly distributed; there is variation across different age groups.
Neonatal deaths attributable to air pollution are highest in Sub-Saharan Africa. 64% of these deaths are attributable to household air pollution.
Among children 0-9, household air pollution is the 4th leading risk factor for DALYs (disability-adjusted life years).

It is 1st in environmental risk factors; above unsafe water and sanitation.

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<tbody>
<tr>
<td>1 Child wasting</td>
<td>24.7 (20.7 to 28.9)</td>
<td>24.7 (20.7 to 28.9)</td>
<td>28.9 (27.3 to 30.4)</td>
<td>-43.3 (-51.8 to -33.0)</td>
<td>-42.6 (-51.2 to -32.2)</td>
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<td>2 Low birthweight</td>
<td>23.1 (22.1 to 24.1)</td>
<td>24.7 (23.3 to 26.1)</td>
<td>-41.2 (-49.6 to -30.2)</td>
<td>-40.4 (-49.0 to -29.3)</td>
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<td>3 Short gestation</td>
<td>19.0 (18.1 to 19.9)</td>
<td>14.8 (12.3 to 17.3)</td>
<td>-72.9 (-78.4 to -66.3)</td>
<td>-73.6 (-79.1 to -67.3)</td>
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<td>4 Household air pollution</td>
<td>11.2 (8.7 to 14.2)</td>
<td>7.7 (6.0 to 9.5)</td>
<td>-68.8 (-75.2 to -60.6)</td>
<td>-68.9 (-75.4 to -60.9)</td>
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<td>5 Unsafe water</td>
<td>11.0 (8.5 to 13.3)</td>
<td>7.7 (5.9 to 9.4)</td>
<td>-68.3 (-75.8 to -57.4)</td>
<td>-68.9 (-76.4 to -58.6)</td>
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<td>6 Child underweight</td>
<td>10.4 (8.2 to 13.3)</td>
<td>5.1 (4.3 to 6.0)</td>
<td>-72.0 (-78.7 to -62.0)</td>
<td>-72.5 (-79.3 to -63.0)</td>
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<td>7 Unsafe sanitation</td>
<td>8.2 (6.8 to 9.7)</td>
<td>4.5 (3.2 to 5.8)</td>
<td>-66.0 (-72.9 to -57.0)</td>
<td>-66.7 (-73.6 to -58.0)</td>
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<td>8 Child stunting</td>
<td>6.2 (3.2 to 10.5)</td>
<td>4.4 (3.6 to 5.4)</td>
<td>-80.8 (-85.2 to -75.3)</td>
<td>-81.4 (-85.7 to -76.1)</td>
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<td>9 Handwashing</td>
<td>6.0 (4.3 to 7.6)</td>
<td>4.0 (2.8 to 5.2)</td>
<td>-23.3 (-45.9 to 11.5)</td>
<td>-20.5 (-46.3 to 10.8)</td>
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<td>10 Non-exclusive breastfeeding</td>
<td>3.8 (2.8 to 4.9)</td>
<td>2.7 (1.3 to 4.8)</td>
<td>-80.3 (-85.8 to -74.5)</td>
<td>-81.1 (-86.4 to -75.5)</td>
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11 Ambient particulate matter | 2.3 (1.3 to 3.9) | 2.4 (1.8 to 3.0) | -72.1 (-77.8 to -65.3) | -72.1 (-77.8 to -65.3) |

GBD 2019 website see http://ghdx.healthdata.org/gbd–2019
How do we reduce burden of disease from household air pollution and improve health?

Ideally, households would have access to electricity for cooking and heating.

Given the challenges to electrification, we can reduce the risk of disease from household air pollution with “cleaner burning” fuel and stove technologies.
Goal: Reduce health burden by utilizing electricity or “cleaner” fuel and stove combinations.
Access deficit

FIGURE 2.8 - Access deficits by region (population without access to clean fuels and technologies), 2000–18

Source: WHO.
Bioethanol:

An opportunity to reduce household air pollution and improve health
Fuel and stove combinations

ISO Tiers
CleanCook Aluminum One-Burner (A1)

Manufacturer
Dometic (Pty) Ltd.

Website

All stainless steel burner parts, body of aluminum, galvanized steel, aluminum. Single burner.

IWA tiers of performance

4 🌴 Emissions
4 🌿 Efficiency
4 🌿 Indoor emissions
4 🌿 Safety

http://catalog.cleancookstoves.org
In research studies, ethanol stove interventions have reduced kitchen PM$_{2.5}$ by 82% (compared to biomass) (Pope et al. 2017)
Full length article

Effect of a clean stove intervention on inflammatory biomarkers in pregnant women in Ibadan, Nigeria: A randomized controlled study

Christopher O. Olopade, MD, Elizabeth Frank, Emily Bartlett, Donee Alexander, PhD, Anindita Dutta, PhD, Tope Ibigbami, MSc, Damilola Adu, MSc, John Olamijulo, MPH, Ganiyu Arinola, PhD, Theodore Karrison, PhD, Oladosu Ojengbede, MD

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Original Article

Randomized Controlled Ethanol Cookstove Intervention and Blood Pressure in Pregnant Nigerian Women

Donee Alexander¹, Amanda Northcross², Nathaniel Wilson³, Anindita Dutta¹,⁴, Rishi Pandya⁵, Tope Ibigbami⁶, Damilola Adu⁶, John Olamijulo⁶, Oludare Morhason-Bello⁷, Theodore Karrison⁶, Oladosu Ojengbede⁷, and Christopher O. Olopade¹,⁴

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ORCID ID: 0000-0002-4243-1488 (C.O.O.).
Impact of prenatal and postnatal household air pollution exposure on lung function of 2-year old Nigerian children by oscillometry

Anindita Dutta a, Mariam Alaka b, Tope Ibigbami c, Dayo Adepoju c, Samuel Adekunle c, John Olamijulo c, Babatunde Adedokun a, Oluwafunmilade Deji-Abiodun a, Ryan Chartier d, Oladosu Ojengbede e, Christopher O. Olopade a,b,e

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Key take-away messages:

1. Household air pollution contributes to the burden of disease

2. Bioethanol is a cleaner burning fuel compared to traditional biomass

3. Reduction in household air pollution from bioethanol stoves results in better health outcomes