

Making a Positive Health Impact on Cleaner Cooking Using Chimneys as a Key Technology

By Dr. Katharina Dworschak, May 16, 2019

Key Health Facts

Each year, close to 4 million people in the world die prematurely from illness attributable to household air pollution from inefficient cooking practices. (World Health Organization's Fact-sheets, [1])

Household air pollution causes diseases including stroke, heart disease, chronic obstructive pulmonary disease (COPD) and lung cancer. Close to half of deaths due to pneumonia among children under 5 years of age are caused by particulate matter (soot) inhaled from household air pollution.

In Ethiopia, the percentage of population using solid fuels for cooking and heating is 98 % (Clean Cooking Alliance, 2019, Country Profiles, Ethiopia, [2]). More than 89 million people, which make up more than 18 million of all households in this country, are affected by household air pollution. About 45,000 people per year die in Ethiopia attributable to household air pollution, half of which are children. Figures show that in fact, each day more than 50 Ethiopian children die from it.

Impacts on Health

Open cooking produces high levels of household air pollution with a range of health-damaging pollutants, including small soot particles that penetrate deep into the lungs. In poorly ventilated dwellings, indoor smoke concentration can be 100 times higher than acceptable levels for fine particles. Exposure is particularly high among women and young children, who spend the most time near the domestic hearth.

Among the 3.8 million deaths a year attributable to the household air pollution -

- 27% from pneumonia
- 18% from stroke
- 27% from ischaemic heart disease
- 20% from chronic obstructive pulmonary disease (COPD)
- 8% from lung cancer.

(Source: World Health Organization fact sheets, [1])

Pneumonia

Exposure to household air pollution almost doubles the risk for childhood pneumonia. It is responsible for 45% of all pneumonia deaths in children under 5 years old and for 28% of all adult deaths.

Chronic Obstructive Pulmonary Disease

25% of premature deaths from chronic obstructive pulmonary disease (COPD) in adults in low- and middle-income countries are due to exposure to household air pollution. Women exposed to high levels of indoor smoke are more than twice as likely to suffer from COPD as women who use cleaner fuels and technologies. Among men who already have a heightened risk of COPD due to their higher rates of smoking, exposure to household air pollution nearly doubles that risk.

Stroke

12% of all premature deaths due to stroke can be attributed to the daily exposure to household air pollution arising from open cooking.

Ischemic Heart Disease

Approximately 11% of all deaths due to Ischemic heart disease, accounting for over a million premature deaths annually, can be attributed to exposure to household air pollution.

Lung Cancer

Approximately 17% of premature lung cancer deaths in adults are attributable to exposure to carcinogens from household air pollution caused by exposure to inadequate cooking methods. The risk for women is higher due to their role in food preparation.

Other Health Impacts and Risks

More generally, small particulate matter and other pollutants in indoor smoke inflame the airways and lungs, impairing immune response and reducing the oxygen-carrying capacity of the blood.

There is also evidence of links between household air pollution and low birth weight, tuberculosis, cataract, nasopharyngeal and laryngeal cancers.

It is imperative to keep in mind that a large fraction of the severe burns and injuries occurring in low- and middle-income countries are linked to open fire for cooking, heating and/or lighting.

Epidemiology

According to current World Health Organization's estimates, more than half of the world's population (52%) cook and heat with solid fuels, including biomass fuels and coal. Biomass smoke contains thousands of health-damaging substances. Small particles of less than 10 microns in diameter (PM10) are among the most dangerous. 24-hour concentrations of PM10 in poor households using biomass stoves may exceed standards for ambient air pollution levels promulgated by developed countries (e.g. United States Environmental Protection Agency/European Union) by a factor of 2 to 60. In many of the poorest areas of the developing world, one of the most insidious killers is indoor air pollution.



Figure 1: Deaths from indoor smoke from solid fuels (Source: World Health Organization, Indoor air pollution and household energy, 2019, <https://www.who.int/heli/risks/indoorair/indoorair/en/>)

In 2016, household air pollution was responsible for 3.8 million deaths, and 7.7% of the global mortality.

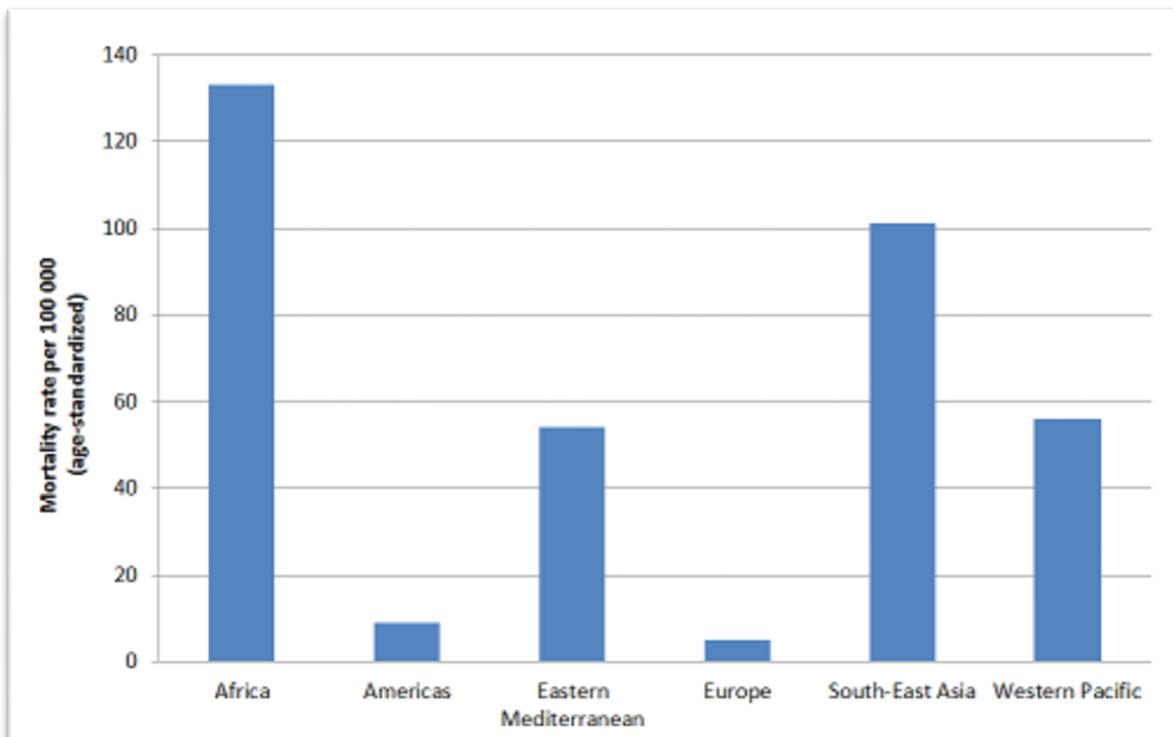


Figure 2: Mortality from household air pollution (Source: World Health Organization, Global Health Observatory (GHO) data, https://www.who.int/gho/phe/indoor_air_pollution/burden/en/)

The highest mortality due to diseases resulting from household air pollution is found in Africa whereas Europe has the lowest. This is because in Europe, everyone has access to modern and clean cooking technology. Indoor air pollution from cooking and heating is close to zero. To achieve this, Europe had to undergo a process involving centuries of experience in developing clean cooking and heating methods. Die Ofenmacher consider the implementation of chimneys as a key technology in the process of reducing indoor air pollution.

The Forecast for Access to Clean Cooking Technology in the Future

The development of chimney technology first started in Europe several hundred years ago and was one of the key technologies for clean cooking in the past.

It is well known that replacing open fires or inefficient stoves with cleaner ovens reduces emissions. Reducing personal exposure lowers the burden of disease associated with household air pollution (World Health Organization's Guidelines for indoor air quality, [3])

Randomized control trials have shown reductions in severe pneumonia in young children and reduced duration of respiratory infections in children. Additionally, emerging research indicates that switching to cleaner technologies and fuels lowers blood pressure in pregnant women, increases birth weight, and increases gestational age at delivery (United States Agency for International Development USAID, [4])

However, despite increasing awareness of the health and environmental risks, and decades of programs targeting access to modern cooking, one-third of the world's population – 2.5 billion people – still rely on the traditional use of solid biomass while another 120 million people cook with kerosene and 170 million with coal. Most of those without clean cooking are living in developing Asia (1.9 billion), followed by sub-Saharan Africa (850 million).

According to World Economic Outlook projections (WEO-2017, [5]), 2.3 billion people will remain without access to clean cooking in 2030.

In rural areas, 370 million people will gain access to clean cooking by 2030, but biomass remains a primary cooking fuel. Improved and advanced biomass cook stoves, which can be considerably more efficient and less polluting than traditional stoves, are the most common stepping-stone towards clean cooking in rural areas, but will only be used by 10% of households in 2030. In developing Asia, 1.2 billion people are set to rely primarily on the traditional use of biomass for cooking in 2030. In Sub-Saharan Africa, clean cooking efforts will fail to keep pace with population growth: as a result, the number of people without access will grow to 910 million in 2030.

Although access to modern technology is in progress, at least one more generation will suffer from highly polluted indoor air. Taking into account the health impacts of household air pollution, it is essential to provide a technology that conducts the smoke and toxic particles out of dwellings thus making it imperative to construct a chimney. In Europe, every dwelling that has a biomass, gas or oil stove for cooking or heating must have a chimney by law.

The Chimney – A Key Technology

The chimney is the key feature of all Ofenmacher stoves. This technology is a big step forward towards clean cooking which is essential for reducing indoor air pollution.



Open Cooking



Clean cooking with an Ofenmacher stove with a chimney

The first chimneys in Europe were built by Romans about 2000 years ago. Romans used tubes inside the walls to draw smoke out of bakeries. It seems that the ancient knowledge had been forgotten for a period of time but then returned in the 11th or 12th century. Chimneys appeared in large dwellings in northern Europe in the 12th century. They made their appearance in Britain around 1200 when they replaced the open fire in the middle of the one-room house. Chimneys became more common in houses in the 16th and 17th centuries. By 1719, all clay-built chimneys in England were required to be rebuilt from bricks.

Chimneys in ordinary dwellings were first built of wood and plaster or mud. Since then chimneys have traditionally been built from brick or stone, both in small and large buildings. Early chimneys were simple brick constructions. Later, chimneys were constructed by placing the bricks around tile liners. To control downdrafts, venting caps with a variety of designs are sometimes placed on the top of chimneys.

Parallel to this development of chimney construction, the profession of chimney sweeps developed as well. They became specialized in techniques of maintaining stoves and chimneys as well as fire protection. Chimney sweeps are normally paid an established fee by the homeowner.

A well-designed and maintained chimney without leaks will reduce household air pollution to zero in normal operation. To ensure that “no one is left behind”, Die Ofenmacher build cheap chimneys from clay bricks.

The Practice of Regular Maintenance

The stove builders are trained to produce high-quality chimneys. In order to maintain the function of the chimney for a long time, it is essential, to maintain the chimney properly and to make regular quality checks. Regular cleaning and repairing will be provided by chimney sweeps.

In Europe, the chimney sweep’s job evolved with the increase in the number of fireplaces built with chimneys. Originally, their primary task was to clear the ash and soot from chimneys. Their role today however, has expanded since then and they are now required to deal with the cleaning and control of exhaust systems, fireplaces, smoke evacuation systems, ventilation systems as well as measures limits on exhaust and combustion gases.

In Nepal, Die Ofenmacher are in the process of training people to become chimney sweeps in all of the districts and villages where we have already built stoves in order to guarantee regular maintenance service. We intend to do the same in Ethiopia.

Case report: Success Stories

In Nepal, Die Ofenmacher have built more than 80,000 stoves with chimneys. In close cooperation with the Nepal government, we have achieved our common goal of making entire districts smoke-free. One of these districts – Gulmi – was declared smoke-free in 2016.

We are currently receiving the first feedback from health posts and hospitals in areas which have been smoke-free for about 3 years. The improvement to people's health is reported to be significant.

Renu Lama, Manager of Madane Samudain Swastha Kendra, government health post, reports that “the patient seeking treatment for cases of respiratory disease and burn accident has been reduced” after Die Ofenmacher built the stoves with chimneys in Gulmi.

Surendra Chauhan, head of the Banjkateri health post, has informed us that “after Banjkateri VDC was declared smoke free, patients with chronic respiratory disease have also been able to perform respiratory activities and new cases of respiratory disease have been seriously reduced”. This health post is run by a foreign non-government organization.

However, indoor air pollution has a long-term effect on health, which means that some of the previously mentioned diseases such as COPD may begin perhaps 20 or 30 years after exposure. Therefore monitoring after 3 years is not definitively accurate. More detailed studies should be conducted at least 5 to 10 years after districts are declared smoke free.

Constructing an Ofenmacher Chimney from Clay

See also the video <https://www.youtube.com/watch?v=s2-B-MfFvTk>



Mixing clay with ash and sand



Making clay-bricks for the chimney with special molds



The chimney-bricks are air-dried, not fired

Building the chimney



Making the hole through the housewall to fix the outlet



The outlets, which are fixed outside of the house wall, are made from fired clay



Fixing the outlet outside of the house wall



The outlet is ready to conduct the smoke through the wall out of the dwelling







Resources and References

- [1] World Health Organization, May 2018, <https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health>
- [2] Clean Cooking Alliance, 2019, Country Profiles, Ethiopia, <https://www.cleancookingalliance.org/country-profiles/15-ethiopia.html>
- [3] World Health Organization, Guidelines for indoor air quality: household fuel combustion, 2014, <https://www.who.int/airpollution/guidelines/household-fuel-combustion/en/>
- [4] United States Agency for International Development, USAID, Clean Cooking protect Maternal and Child Health, <https://www.harpnet.org/wp-content/uploads/2017/10/f1-HAP-Briefer-DIGITAL.pdf>
- [5] WEO-2017 Special Report: Energy Access Outlook, International Energy Agency, 2017 (<https://webstore.iea.org/weo-2017-special-report-energy-access-outlook>)