A WELL FACTSHEET

Indoor air pollution, cooking stoves and health

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Up to half of the world's households use biomass fuels as a source of energy for cooking and heating. Biomass fuels are materials derived from plants and animals which are burnt. Their use is much more prevalent in rural areas.

When burnt on simple stoves, they often do not combust completely and the result is a high level of emissions (including particulates) which can cause high levels of indoor air pollution when combined with poorly ventilated conditions.

This indoor air pollution can have a severe impact on health. The respiratory and immune systems can be damaged by the particulates from smoke. This in turn makes those affected more susceptible to illness. The biggest health impact known is on children in the form of acute respiratory infections. At least 1.8 million deaths (mainly child deaths from pneumonia) per year are attributed to biomass fuel use in the home.

Potential interventions to reduce indoor air pollution focus on reducing or removing smoke and changing behaviour.

Although these interventions have been introduced relatively recently, it is clear that new stove designs and/or fuel types need to be locally acceptable and affordable to succeed.

Introduction

When biomass fuels such as wood, dung or crop residues, are burnt in inefficient stoves a mixture of particles, chemicals and gasses is released. When these fuels are used in poorly ventilated houses, the result is indoor air pollution that is widely believed to have serious health implications.

The scale of the problem

Currently around 3 billion people rely on biomass fuels for cooking, heating or lighting (Bruce et al 2000). In some African countries these fuels are used by over 80% of the population. In some areas their use is increasing (WHO 2002a). It is the poor who rely most heavily on biomass fuels. Women and young children have greatest exposure to the resulting IAP because of the amount of their time spent cooking and being in and around the home. As a result women and children face the greatest health risks.

The most conservative estimate of the annual global deaths attributable to the use of biomass fuels is 1.8 million (Smith and Mehta 2000), the majority of these being due to acute respiratory infections (mostly pneumonia) in children. Although this estimate is the most conservative, its authors suggest

that it is also the most accurate. This is because it is based on the results of studies of the health impacts of indoor air pollution in developing countries (rather than extrapolating from studies of ambient air pollution in developed countries).

How indoor air pollution affects health

There are two ways in which indoor air pollution can affect health. Substances in the smoke can themselves be responsible for a health impact (for instance, carcinogens or the toxins that cause cataracts). Alternatively, these substances can pave the way for infection by bacteria or viruses by damaging the respiratory system's mechanical and immune defences. It seems likely that the biggest health impact is due to this damage to the respiratory system.

The following list provides more detail about how indoor air pollution can affect health (Bruce et al 2000);

- The part of the respiratory system that removes particles can be damaged by nitrogen dioxide and by the mix of sulphur dioxide and particles.
- The operation of the immune system can be reduced by exposure to nitrogen dioxide and by exposure to the mix of sulphur dioxide and particles.
- Chronic inflammation of the airways or damage to the physical structure of the lungs may also increase the likelihood and severity of infection.
- Smoke from biomass fuels is known to contain a number of carcinogens
- Absorption of toxins from smoke by the lens of the eye has been found to cause cataracts in animal studies.
- Carbon monoxide can retard foetal development by reducing oxygen delivery to the foetus.

Health impact

Existing evidence for the health impacts of indoor air pollution has been reviewed by Bruce et al (2000) and Smith et al (2000) (Summaries of this work are included in von Schirnding 2002, WHO 2002a, and Budds et al 2001).

Studies have shown an association between indoor air pollution and the following health outcomes;

- Acute Respiratory Infections in children
- Chronic obstructive lung disease
- Lung cancer
- Blindness
- TB
- Adverse pregnancy outcomes

Strong evidence is reported for an association between indoor air pollution and acute respiratory infections in children. This is potentially important because acute respiratory infections are the leading cause of death in children under the age of 5 (Smith et al 2000).

Children exposed to indoor air pollution are between 2 to 5 times more likely to develop an acute respiratory infection such as pneumonia. It is estimated that 36% of all acute respiratory infections are attributable to indoor air pollution (The World Health Report 2002, WHO)

In addition to childhood acute respiratory infections, there is moderately strong evidence linking indoor air pollution with chronic lung disease and, in coal burning communities, lung cancer, in women. There is also limited evidence to suggest an association with other health problems including TB, low birth weight (itself a risk factor for acute respiratory infections) and perinatal mortality.

Difficulties in assessing health risks

There are numerous methodological problems in assessing the health risks associated with indoor air pollution.

For instance, measuring pollutant levels precisely can be expensive and ascertaining patterns of exposure can be difficult. There are also many inconsistencies in the definitions of certain health outcomes.

In addition, most of the studies undertaken are observational in design. This means they investigate the health status of those already using certain fuel- stove combinations in their homes. It is likely that those using the most polluting combinations will also be the poorest households and as such will have the worst health status.

A better design for assessing these health risks is an intervention study. Such studies allow for different stove-fuel combinations to be randomly allocated to households. This can reduce the influence of biases and likelihood of misleading results occurring due to differences in socio-economic status between households.

The numerous methodological problems mean that it is not yet clear how great the impact of different levels of indoor air pollution is on acute respiratory infections. An intervention study currently underway in Guatemala aims to provide more robust evidence (WHO 2002b).

Types of interventions

Possible interventions for reducing exposure to indoor air pollution include;

- smoke reduction (through changing characteristics of the stove and/or the fuel)
- smoke removal (through use of chimneys, flues, smoke hoods or increased ventilation)
- behaviour change (cooking outdoors, or exclusion of children from cooking area).

The reduction of indoor air pollution through changing fuel is unlikely to be a simple technical issue but will also involve considerations of policy at one level, and household practices at another.

One lesson that has emerged from interventions to date however, is that the indiscriminate use of government subsidies to encourage fuel switching tends to bring the greatest benefits to wealthier urban households that consume more fuel (Ballard-Tremeer and Mathee 2000), and are unlikely to use biomass fuels anyway. For the majority of poor households, biomass fuels seem likely to remain important for the foreseeable future.

Since the 1970s, much attention has focussed on the design of improved stoves. The emphasis has generally been on fuel savings for environmental rather than health benefits. The environmental and health benefits are not mutually exclusive, but neither do they necessarily occur together as a matter of course.

Results from a recent small-scale study in Kenya however, suggest that smoke hoods are a more effective means of reducing indoor air pollution than improved stoves (ITDG 2002). These hoods are constructed around the cooking fire and direct the smoke through a chimney vent in the roof.

Further research is taking place in Kenya, Sudan and Nepal to look for acceptable and affordable interventions that reduce indoor air pollution (ITDG 2002).

Developing successful interventions

Ultimately the success of any technical intervention will depend on its widespread and sustainable dissemination. This means, in effect, that it must be sufficiently acceptable and affordable to survive in the market place.

Findings from China (Smith et al 1993) and East Africa (Bess and Mazzoni 2001, Owala 2001), suggest that the most effective roles for external funds in this process would be;

- product development
- quality assurance
- training of artisans
- stimulation of demand,

but not subsidising of the final purchase cost as, in the absence of a long term commitment, this reduces the sustainability of an intervention and tends to be an ineffective way of reaching the poorer households.

Further information

More detailed information can be found in the references cited as well as from the websites listed below.

1. World Health Organisation http://www.who.int/inf-fs/en/fact187.jtml
2. Intermediate Technology Development Group http:/www.itdg.org/
3. Environmental Health Projec http://www.ehproject.org/live/Infoser.html

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WHO (2002a) Addressing the Links between Indoor Air Pollution, Household Energy and Human Health http://www.who.int/mediacentre/events/HSD_Plaq_10.pdf

WHO (2002b) http://www.who.int/peh/ceh/Guatemala.htm

Regional Annex for East Africa: indoor air pollution

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Globally, almost 3 billion people rely on biomass fuels (wood, charcoal, crop residues and dung) and coal as their primary source of domestic energy. Biomass fuels have been associated with Indoor Air Pollution (IAP), which is a major risk factor accounting for 4% of the global burden of disease measured by Disability Adjusted Life Years (DALYs) lost.

In developing countries 28% of deaths in children under 5 years of age are associated with Acute Respiratory Infections (ARI). The sources of fumes and particulates are either outdoor or indoor. Indoor exposures are of greater concern because concentrations are often much higher and greater time is spent indoors by vulnerable population sub-groups, including young children (USAID 1997).

In Sub Saharan Africa, around 80% of the rural communities depend on biomass fuels for their domestic energy. In all the Countries of East Africa, the majority of the populations live in the rural and peri-urban areas where poverty is rampant leading to extensive use of biomass as source of energy. Exposure to IAP from the combustion of solid fuels is a predisposing factor contributing to morbidity and mortality in developing countries and the worst levels of exposure are closely associated with the poorest households.

Indoor Air Pollution is an emerging area of focus in the health sector due to its increasing risks to Acute Respiratory Infections particularly among children under five years of age. In the East African region, there are policy guidelines for the implementation of interventions on the control of childhood diseases. However, there are no specific policies targeting IAP and the existing ARI policy focuses mainly on curative rather than both curative and preventive interventions. In Kenya for example, ARI policy does not include control measures targeting environmental factors linked to child health and by extension IAP . Consequently, ARI diseases are addressed mainly through case management and seeking prompt treatment, totally ignoring the role of IAP and other environmental factors in transmission of ARI and its appropriate interventions.

Experiences and lessons learned from past and current interventions have been documented but these are yet to be replicated or incorporated into existing policies. One of the Government of Kenya strategic objectives is to reduce underfives morbidity and mortality attributed to measles, pneumonia, diarrhoea, malaria and malnutrition from 70% to 40% in the period 1999 – 2004. This is achieved through replacement of vertical programmes such as those for Acute Respiratory Infections with Integrated Management of Childhood Illnesses (IMCI)

The importance of interventions to reduce exposure to IAP is reflected in the Millennium Development Goals (MDGs) in many ways. With less time spent on fuel collection, people will have more time available for education for children and Income Generation Activities (IGAs) for women that are likely to contribute to eradicating extreme poverty. As most of the disease burden due to IAP falls on children under five years of age, interventions will help achieve a significant reduction in child mortality and consequently contribute to the fourth MDG.

The World Bank has identified three key considerations in the successful implementation of IAP interventions. These include the policy and regulatory context; making sure that all relevant sectors / perspectives are considered and local community involvement in technology design and application.

In East Africa various interventions are ongoing with the aim of reducing the risks and mitigating the health effects of IAP. The interventions focus on improving ventilation in houses, extraction of smoke and improving combustion of fuels. In improving house ventilation, the main activities include provision of windows and eaves spaces in the existing houses. The pilot work on this aspect has focused on Manyattas (igloo like structures) and other traditional houses in the rural areas. With regard to smoke extraction, a number of appropriate technologies have been employed. These include construction of smoke hoods, chimneys and flues. Introduction of improved cooking stoves has been the main intervention in improving the combustion of fuels but the experiences need to be disseminated widely for replication.

Although IAP has been a problem mainly in rural areas, lately it has become a source of concern in the informal settlements where the slum houses are constructed back-to-back inhibiting proper ventilation. In most cases these houses are often overcrowded and low socio-economic status forces occupants to use low cost incombustible fuels. The net effect of these problems is high prevalence of acute respiratory infections among children and eye problems resulting from constant contact with a smoky environment.

The following are benefits from the current IAP interventions:

- improved health
- increased income for households
- empowerment
- prestige through increased social capital
- gender mainstreaming

As work on IAP evolves there remain several challenges to be addressed:

- how to diversify types of fuels among the communities living in abject poverty in rural and slum areas
- ensuring the sustainability of interventions given the dynamic nature of the technologies
- developing simple and affordable technologies that meet cultural diversity and contexts
- quantification of the effects of IAP with respect to emerging diseases such as tuberculosis and HIV/Aids

To effectively address issues related to IAP, there is a need for policies that recognize the linkage between environmental causes of IAP and related interventions. Similarly, sector coordination involving key stakeholders whose activities contribute to, or would influence, Indoor Air Pollution interventions should be enhanced.

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Intermediate Technology Development Group http://www.otdg.org

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