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Situation Analysis of Household Energy Use and Indoor Air Pollution in Pakistan



Department of Child and Adolescent Health and Development World Health Organization

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Preface

More than two billion of the world's poorest people in developing countries rely on solid fuels including biomass for household energy needs, particularly for cooking and heating. These fuels lead to indoor air pollution (IAP) levels many times higher than developed countries. IAP exposure increases the risk of diseases, including pneumonia, chronic respiratory diseases and lung cancer, and accounts for a substantial burden of diseases in developing countries. Women and children in developing countries are the worst sufferers due primarily to their indoor involvement.

Pakistan is a predominantly rural society where biomass fuel is the major source for cooking and heating. Women are primarily involved in biomass collection and combustion, therefore also inhale most of the poisonous chemicals present in the smoke.

Biomass meets about 86% of total domestic energy requirements. Ninety per cent of the rural and 50% of the urban population depend on biomass fuels. Information regarding IAP and its health effects is lacking in Pakistan. However, information regarding the amount of wood consumed by an average household is available. Small-scale endeavours to control IAP are being carried out by various agencies in Pakistan.

In conclusion, more information regarding use of biomass and other fuels, behavioural studies and housing details regarding conditions of indoor air in Pakistan is required. Further, numbers of interventions are available and have been tried on a smaller scale at low cost by government, NGOs and academic institutions to address the impact of indoor air pollution. Intervention studies need to be conducted on a larger scale to know the impact clearly. These may relate to the intervention at source such as improved stoves, use of cleaner fuels; improving living environment such as better ventilation and working to improve user behaviours, such as keeping children away from smoke during cooking times. Furthermore, a meeting of government, NGOs and academic institutions working on environmental health is needed to develop a plan of action on IAP for the future.

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Summary

Indoor air is defined as "air within a building occupied for a period of at least one hour, by people of varying states of health". According to *The World Health Report 2002* indoor air pollution (IAP) is responsible for 2.7% of the global burden of disease and nearly 2.5 million people die due to air pollution, mainly (65%) because of indoor air pollution. Biomass fuel is the major source of IAP and it is burned for cooking, heating and lighting homes. *Biomass fuel* refers to any plant- or animal-based material deliberately burned by humans. Biomass is the energy source of the poor in developing countries. Use of biomass leading to a high level of indoor air pollution, particulate matters and chemicals, is a serious potential health hazard.

The Department of Community Health Sciences, Aga Khan University has undertaken the task to review the situation of household energy use and indoor air pollution in Pakistan with the support of the Department of Child and Adolescent Health and Development of the World Health Organization, Geneva. A review of sources of published and non-published literature was conducted to assess the situation of IAP. In addition, data from governmental and non-governmental agencies working on IAP in Pakistan were collated.

The Pakistan Household Energy Strategy Study (HESS) undertaken in 1992 showed that biomass fuels account for about 86% of total household energy consumption in Pakistan, while wood fuel alone accounts for 54% of total. Therefore, biomass is the major cooking and heating energy in Pakistan. Wood, crop residues and animal dung are the major sources among the biomass. Biomass is mostly burned in inefficient three-stone stoves leading to incomplete combustion and high levels of indoor air concentration of smoke. IAP due to burning of biomass fuel is posing a serious threat, particularly to women and children in Pakistan. During peak hours of cooking the concentration of indoor air pollution may be many times higher than safe levels.

Less published evidence is available regarding the indoor air concentrations of particles and chemicals due to biomass fuel burning in Pakistan. Most studies have been conducted to estimate the amount of emissions due to biomass combustion. Only a few studies have been conducted in Pakistan to relate IAP to health effects. Furthermore, few studies have been conducted to learn the behaviour of the population regarding the use of stoves. Besides urban-rural differences in use of type of fuel, there are expected cultural differences in household cooking practices. Therefore, in turn the exposure levels and adverse health effects may also vary in different ethnic and cultural regions of Pakistan. Also given the climatic variations in different regions in Pakistan, in comparing the colder northern part, where houses are relatively closed, with the southern part of the country which is warm and houses are open to the outside environment would give different exposure levels among the population. Therefore, it is expected that there would be more adverse health effects due to IAP in northern areas of Pakistan.

IAP is not a recognized environmental hazard at policy level, therefore, generally less efforts have been made in this regard so far in Pakistan. No legislation governs the indoor air concentrations of hazardous substances at household level in Pakistan A few governmental, non-governmental and academic institutions are working to improve IAP, however on a small scale. Intervention studies such as on improved stoves were introduced on a small scale which indicates positive results. Also there is a network of institutions working on renewable energy technology, again on a small scale. The situation in Pakistan regarding IAP warrants urgent attention. This requires a meeting of the stakeholders to define a policy and agenda of action to develop future strategies. Studies gathering evidence of effect of intervention through improved cooking stoves or other technologies on IAP are required. The studies conducted so far are on a small scale, therefore, there is a need to conduct studies on a larger scale. This will have a favourable impact on the population in general and especially on the health of women and children in Pakistan.

Introduction

INDOOR AIR POLLUTION

Air pollution is an atmospheric condition in which certain substances like gases, particulate matter, radioactive materials etc. are present in such a condition that they can produce undesirable effects on mankind and his environment. The National Health and Medical Research Council (NHMRC) defines *indoor air* as *"air within a building occupied for a period of at least one hour by people of varying states of health"*. Covered by the definition are buildings such as homes, schools, restaurants, public buildings, residential institutions, hospitals and offices. Workplaces covered by occupational health standards such as industry, etc. are not included in this definition. *Indoor air quality* can be defined as the totality of attributes of indoor air that affect a person's health and well-being (1).

In developing countries biomass fuel is the major source of indoor air pollution (IAP). *Biomass fuel* refers to any plant or animal-based material deliberately burned by humans. Biomass fuels are burned for cooking, heating and lighting homes and are the energy source for the poor. Frequently, these biomass fuels are burned on an open fire or in poorly functioning stoves (three-stone stoves) for cooking or in open hearth for heating and drying food. In addition to the smoke produced within one household, smoke which is produced outside could be a major contributor for an individual household, especially for developing countries in temperate climates where houses are open to the outside environment. These include smoke from nearby houses, burning of forests, agricultural land and household waste, use of kerosene lamps, industrial and vehicle pollution. Therefore, to decrease IAP, intervention at the community level is also required alongside the household level.

Indoor smoke contains a range of health-damaging pollutants, such as small particles and carbon monoxide and particulate matters, etc.. Concentration of IAP levels vary greatly depending on the time of day, season and place of measurement, especially for inhalable particles (Particulate matters <10 microns) and carbon monoxide (CO) levels. Pollution levels may be 20 times higher than accepted standards (2).

According to the *World Health Report 2002* indoor air pollution is responsible for 2.7% of the global burden of disease. The health burden from IAP is greater in high altitude rural areas because the houses are small and closed due to the cold climate. Women and young children of developing countries are at greatest risk because of their gender roles and household responsibilities and behaviours – cooking and spending a lot of time indoors – result in high exposure to IAP. As an estimate on the impact of IAP on women and children, 85% of all global particulate exposure occurs indoors (2).

More than two billion people in the world and 75% of households in India, China and nearby countries, and 50-75% of people in parts of South America and Africa still use solid fuels which include dung, wood, agricultural residues or coal. Nearly 2.5 million people die each year from air pollution. The burden is greater due to indoor air (65%) than ambient air pollution. More than 90% of this exposure occurs in developing countries, often in rural or peri-urban areas, because of the use of biomass as the main source of energy. The total amount of pollution released from domestic fuels is not high relative to fossil fuels used in industry, therefore, there may be less harmful effects on environment; however human exposure to IAP is much higher, leading to increased adverse

health effects. This is because (i) people tend to spend more time indoors than outdoors, and (ii) the concentration of air pollutants indoors is much higher due to limited ventilation, compared to outdoors where pollutants quickly become diluted. Therefore, developing countries account for 77% of all global particulate exposure. Numerous studies have found that IAP levels are typically many times higher in developing countries than developed world standards for ambient air quality (3).

Poor environmental conditions are associated with high infant and child mortality (4). More than two million children die annually in developing countries from respiratory infections (2). Agents and factors responsible for respiratory diseases are mainly transmitted through the air. Domestic smoke and inadequate ventilation are significant risk factors for acute respiratory infections. Distribution of global attributable deaths according to age group by risk of indoor smoke from biomass fuels are as follows: 0-4 years is 56%, 5-14 years is 0%, 15-59 years is 55%, 60+ years is 38%. The distribution among females is 59%, more compared to males which is 41%. Distribution of attributable disability adjusted life years (DALYs) due to indoor smoke from solid fuels according to age group is as follows: 0-4 years is 83%, 5-14 years is 0%, 15-59 years is 8% and 60+ years is 9% in the year 2000. These figures point to the fact that children and women suffer the worst from IAP (2).

Adverse health effects due to IAP

The incomplete combustion of biomass fuels in simple stoves releases a host of complex chemicals. Pollutants include suspended particulate matters, carbon monoxide, formaldehyde, nitrogen dioxide, ozone and polycyclic aromatic hydrocarbons (see table below).

Indoor air pollutants and their potential health effects			
Pollutant	Mechanism	Potential health effects	
Particulate matters (PM-10/2.5)	 Bronchial irritation Reduced mucocilliary clearance 	 Respiratory infections COPD and exacerbation Wheezing, asthma Excess mortality including CVD 	
Carbon monoxide (CO)	 Binding with Hb (reduced Oxygen delivery) 	Low birth weightIncreased perinatal deaths	
Benzopyrene	 Carcinogenic 	Lung cancerCancer of mouth, pharynx, larynx	
Formaldehyde	Nasopharyngeal and airway	 Increased infections (?) 	

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