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Coal Based Power Plant Emitting Pollution to Cause Environmental Health Problems

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Abstract

Coal based power plant emitted pollution is responsible for environmental burden of disease (EBD) from solid fuel use (SFU) like combustion of coal or biomass. Environmental pollution due to operation of thermal power plants is also one of the factors for acute lower respiratory infection (ALRI), chronic obstructive pulmonary disease (COPD), lung cancer (from exposure to coal smoke), asthma, tuberculosis and cataracts etc among community members. Determining the impact of solid fuel/ coal based use at thermal power units at national or local levels is important for identifying and prioritizing environmental and public health interventions. Carbon emission from coal based energy source is a serious problem and world community must switch over towards green energy. There is need to explore uses of bio-energy & bio-fuels and imposition of ban on coal-based industries with immediate effect. Use of clean energies like solar and wind power for running industries and household lights must be encouraged through subsidies by Government.

Keywords: power plant; air quality; health; ALRI; COPD; intervention.

1. Introduction

The disease burden from solid fuel use is most significant in populations with inadequate access to clean fuels, particularly poor households in rural areas of developing countries. Women and their youngest children are most exposed because of their household roles. Solid fuel use is most firmly associated with acute lower respiratory infections (including pneumonia) in young children, and chronic obstructive pulmonary disease and lung cancer in women (and to a lesser degree in men). Each of these three health outcomes is a major disease category in most societies and thus household solid fuel use is likely to be a major cause of disease burden in communities where it is prevalent. Globally, 2.6% of all ill-health is attributable to indoor smoke from solid fuels, nearly all in poor regions [1]. The combination of exposure levels and relative risks enables the calculation of disease burdens. In many populations, exposures to major pollutants from indoor sources can be higher than exposures to pollutants from outdoor sources [2]. Over the past two decades, the hazards of indoor air pollution, particularly those associated with solid fuel use (SFU) in developing countries, have been documented by a growing body of literature [3-7]. Biomass fuels emit substantial amounts of health-damaging pollutants, including respirable particulates, carbon monoxide, nitrogen oxides, benzene, formaldehyde, 1,3 butadiene, and polyaromatic compounds such as benzo(α)pyrene [8-9].

Depending on their quality, coal fuels may also emit sulphur oxides and other toxic elements, including arsenic, lead and fluorine. When these fuels are used in poorly ventilated conditions and burned in open fires or inefficient stoves, conditions common in households throughout the developing world, SFU may result in indoor air pollutant levels well above those in even the dirtiest of cities [8-9]. Although there are relatively few data on the levels of indoor air pollutants from SFU, compared to the data on outdoor air pollutants, what evidence there is illustrates the magnitude of the problem. Indoor exposures to the combustion products of solid fuels are responsible for the majority of non-smoking human exposures to particulates and other major pollutants [10-11]. As a result, large numbers of people are at increased risk of contracting acute lower respiratory infections (ALRIs), chronic obstructive pulmonary disease (COPD), lung cancer, and other afflictions associated with SFU. The recent global comparative risk assessment organized by WHO calculated that SFU accounted for approximately 2.6% of global ill-health in 2000 [12-14]. Estimating the nature, size and distribution of this impact at more specific local levels is clearly vital for informing regional and national decision-making on environmental health. The method utilizes relative risks2 for exposure-response relationships, and a binary classification scheme for exposure levels, which separates the study population into those exposed to SFU and those not exposed. The disease burden of the study population can be measured using various metrics, such as disability-adjusted life years (DALYs) lost or deaths [15]. Indoor air pollution from SFU is a significant risk factor for acute respiratory infections (ARI), which account for a remarkable 7% of the global burden of disease [16-18]. ARI belongs to a class of infections that result from a wide range of viruses and bacteria, but exhibit similar symptoms and risk factors [10-12].

Uttar Pradesh (India) has large number of thermal power plants. Lack of clean and reliable energy sources such as electricity is, in part, causing about 80 crore (800 million) people in India to continue using traditional biomass energy sources – namely fuelwood, agricultural waste and livestock dung – for cooking and other domestic needs [19]. Traditional fuel combustion is the primary source of indoor air pollution in India, causes between 300,000 to 400,000 deaths per year and other chronic health issues. India's coal-fired, oil-fired and natural gas-fired thermal power plants are inefficient and offer significant potential for greenhouse gas (CO_2) emission reduction through better technology. Compared to the average emissions from coal-fired, oil-fired and natural gas-fired thermal power plants in European Union (EU-27) countries, India's thermal power plants emit 50% to 120% more CO_2 per kWh produced [20].

2. Evidence Based Health Problem

Operation of power plants have changed climatic conditions and speeding up the rate of global warming. This is a direct result of the increase in production of greenhouse gases, such as CO2 (carbon dioxide), CH4 (methane) and oxides of nitrogen due to the burning of fossil fuels. Moreover, incomplete combustion from vehicles and release of anthropogenic chemicals called chlorofluorocarbons (CFCs) into the atmosphere has degraded the stratospheric ozone layer around the Earth, which shields the planet from harmful ultraviolet radiation. Global warming may increase the frequency of climatic disturbances such as fires, disease, insects, storms, etc. Coal based pollution is continuously increasing and control of carbon emission (Fig. 1) is one of the priority of world community to safeguard environmental health of human. Based on the strength of evidence, it is recommended that the quantification of health impacts from SFU should only be reported for the three endpoints with strong and moderate-I evidence (i.e. ALRI, COPD and lung cancer (from exposure to coal smoke)). The evidence for the moderate-II category is not sufficiently robust to warrant inclusion of these endpoints in a local assessment, particularly given the need to maintain a conservative approach within the entire environmental burden of disease (EBD) exercise [10, 13]. The relative risks which are shown in Table 1 are widely applicable, since they are based on the entire evidence base.

The relative risks include the results of formal meta-analyses for ALRI, COPD, and lung cancer (from exposure to coal smoke), the strong endpoints. Details of the meta-analyses, including discussions on the identification of studies, aggregation of studies, estimation of risk factor-disease relationships, and sources of bias [10, 13] are well established. For moderate health endpoints, the lower end of the range of relative risks was set at 1.0 (no effect), and the upper end at the geometric mean of the available relative risks from household studies in developing countries. Lung cancer (from exposure to coal smoke) is indicated in many studies in many countries [21-26]. Coal smoke exposure to men is classified as moderate-I, owing to the paucity of studies that address men's exposures. In regions where coal use is common, lung cancer (from exposure to coal smoke) is likely to be an important component of the EBD from SFU. The results of the meta-analysis indicate that the relative risk for lung cancer (from exposure to coal smoke) in women over 30 years of age, a strong health outcome, is 1.94 (95% CI: 1.09-3.47) [1]. Biomass smoke contains a range of chemicals that are known, or suspected, human carcinogens, and contains particulates in the small sizes known to penetrate deep into the lungs [8, 10, 12].

Some studies have identified an association between biomass fuel use and lung cancer in women [15, 21, 22, 25]. Asthma attacks have been associated with urban outdoor pollution and this may be due to coal based fuel used in thermal power plants [27-29]. The extent to which air pollution leads healthy people to become asthmatic is still not clear, although there is some evidence to support this idea, both epidemiological [30-31] and toxicological [32]. The effects of environmental tobacco smoke (ETS) on asthma is still controversial, but a number of studies have shown that exposure to ETS during childhood is an important risk factor for the later development of asthma and coal based pollution can be additional factor. Cataracts are the leading cause of blindness worldwide. There are no direct evidences for cataract due to coal based pollution but there is possibility that it can be additional factor for initiation of the disease. Tuberculosis is responsible for almost 2 million deaths worldwide each year [17]. There are many studies indicating coal based pollution can be a potential factor for tuberculosis. Other health problems/ outcomes can be due to indirect impact of pollution caused by coal based fuel generation units [33, 3].

3. Exposure Level and Variables

Effects and impacts are directly proportional to exposure level and the pollutant coupled with other factors/ pollutant. An exposure variable for SFU must capture the air pollutant concentrations in various environments, the person-time spent in the environments, and the number of people exposed. Ideally, the indoor air pollutant levels would be measured when people are present, using a probability sample that is representative of the entire at-risk population. Prior studies have shown that indoor levels of air pollutants can be quite high from SFU in developing country households, much higher than health-based standards and guidelines. Sometimes data do not allow exposure distributions to be estimated for wide areas. In any case, it will be prohibitively expensive and time-consuming for most local assessments to conduct sufficient indoor air pollution measurements to obtain reliable exposure distributions. It is also valuable to know the age and sex distributions that correspond to the health outcomes of interest for the study population exposed to SFU. The most simple and efficient approach is to assume that the age and sex distributions within the overall population of a country are no different from those in the SFU-exposed population. In reality, exposures to indoor air pollution from SFU result in a wide range of exposures. Since the distribution of exposures is continuous, exposures would best be categorized into multiple exposure categories. A range of variables affecting the degree of exposure have already been discussed in previous sections. Examples include differences in fuel types, stove types, cooking/heating practices, demographics, and climate or season. In addition, indoor air pollutant levels will be heavily influenced by differences in household characteristics, as well as by household location with regard to other sources of air pollution, including other households with solid fuels. Actual human exposures will be further influenced by differences in time-activity patterns, particularly the time spent within the household and in close proximity to the pollution source.

4. Relative Risk

Pollutants from coal based fuel generation unit include poisonous pollutants, agrochemicals, metals, acids and phenol etc and these pollutants are responsible for relative risk with other factors and pollutants. Ninety-five percent confidence intervals exist for all relative risks associated with health outcomes in the strong evidence category (Table 1). For health outcomes in the moderate-I category, the use of a lower estimate of 1.0 (no risk) is quite conservative (i.e. likely biased toward understating risks), and the central and upper estimates are also conservative. As mentioned previously, the evidence for moderate-II outcomes is too limited to recommend any quantitative estimate of disease burden. Since the method addresses only certain health outcomes in certain populations, owing to a lack of available epidemiological studies, it tends to underestimate the total burden. Perhaps the most important source of this error stems from the fact that the method does not address the effects of exposures on pregnancy outcomes. The two population groups primarily assessed, young children and adult women, experience the greatest exposures, so the method does not seem to greatly underestimate the total burden. Epidemiological studies at best derive risk estimates related to the exposure measure utilized.

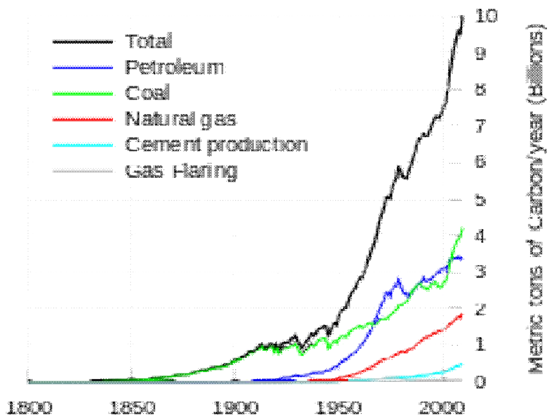

Fig. 1: Carbon emission from different source of fuel combustion.

Table 1: Relative risks for strong and moderate health outcomes from coal based fuel burning.

Evidence	Health outcome	Group (sex, age in years)	Relative risk	confidence interval (CI)
Strong	acute lower respiratory infection **(**ALRI**)**	Children <5	2.3	1.9–2.7
	chronic obstructive pulmonary disease **(**COPD**)**	Women ≥30	3.2	2.3–4.8

	Lung cancer (from exposure to coal smoke)	Women ≥30	1.9	1.1–3.5
Moderate-I	COPD	Men ≥30	1.8	1.0–3.2
	Lung cancer (from exposure to coal smoke)	Men ≥30	1.5	1.0–2.5
Moderate-II	Lung cancer (from exposure to biomass smoke)	Women ≥30	1.5	1.0–2.1
	Asthma	Children 5-14	1.6	1.0–2.5
	Asthma	All ≥15	1.2	1.0–1.5
	Cataracts	All ≥15	1.3	1.0–1.7
	Tuberculosis	All ≥15	1.5	1.0–2.4

Source: World Health Organization, 2004 (WHO Environmental Burden of Disease Series, No. 4), Geneva.

5. Conclusion

There are evidenced based studies which indicate that coal based fossil fuel have impact on environmental health. For policy-makers, disease burden estimates provide an indication of the health gains that could be achieved by targeted action against specific risk factors. The measures also allow policy-makers to prioritize actions and direct them to the population groups at highest risk. There is need for further research to explore new and renewable energy resources to meet increasing demand of energy.

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