

NATIONAL FAMILY HEALTH SURVEY BULLETIN

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The NFHS BULLETIN summarizes findings from the 1992–93 National Family Health Survey. The NFHS collected information from nearly 90,000 Indian women on a range of demographic and health topics. The survey was conducted under the auspices of the Indian Ministry of Health and Family Welfare to provide national and state-level estimates of fertility, infant and child mortality, family planning practice, maternal and child health, and the utilization of services available to mothers and children.

The International Institute for Population Sciences (IIPS), Mumbai, conducted the NFHS in cooperation with various consulting organizations and 18 population research centres throughout India and with the East-West Center in Honolulu, Hawaii, and Macro International in Calverton, Maryland. The U.S. Agency for International Development provided funding for the NFHS and for this publication.

Cooking with Biomass Fuels Increases the Risk of Blindness

Blindness is a major health problem in India. According to the 1992–93 National Family Health Survey (NFHS), 3% of India's population suffers from blindness, comprising 2.6% who are partially blind and 0.4% who are completely blind. Altogether, almost 30 million people in India are partially or completely blind, including more than 8% of women age 30 and above.

In India, about three-quarters of all households cook primarily with biomass fuels, such as wood, animal dung, and crop residues. Cooking stoves that use these fuels are generally nothing more than a pit, a *chulha* (a U-shaped construction made from mud), or three pieces of brick. Such stoves burn fuel inefficiently and produce large amounts of smoke throughout the cooking process, often in poorly ventilated cooking areas where Indian women spend much of their time.

Biomass smoke contains several noxious components, including respirable particulates, carbon monoxide, nitrogen oxides, formaldehyde, and polyaromatic hydrocarbons such as benzo(a)pyrene. Extended exposure to high levels of these air pollutants is a known risk factor for acute respiratory infections, chronic obstructive lung disease, pulmonary heart disease, tuberculosis, and lung cancer. At the anecdotal level, cooking smoke is commonly associated with eye problems, but little epidemiological evidence is available linking cooking smoke to blindness.

This issue of the *NFHS Bulletin* analyzes the relationship between type of cooking fuel used in a household and prevalence of partial or complete blindness. The analysis is based on information on 83,319 women age 30 and older covered by the NFHS. It is limited to women age 30 and older because women are more likely than men to be exposed to cooking smoke and because the effects of cooking smoke on blindness—being long-term and cumulative—are more likely to be observed in people age 30 and older than in younger age groups.

Results indicate that women living in households that use biomass cooking fuels—defined in the survey as wood and dung—have a much higher prevalence of both partial and complete blindness than women living in households that use cleaner fuels. The effect remains strong even after controlling for several potentially confounding demographic and socioeconomic variables. Among women age 30 and older, 17% of partial blindness and 20% of complete blindness can be attributed to cooking smoke from biomass fuels.

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How cooking smoke might cause blindness

The main proximate cause of complete blindness worldwide is cataract, a progressive condition in which the lens of the eye becomes increasingly opaque. Cataract accounts for more than 80% of complete blindness in India.

Cataract is known to be linked to oxidative damage to the eye that can be produced by heavy airborne pollution, among other factors. A number of studies in humans indicate that tobacco smoke can cause cataract, suggesting that cooking smoke might have a similar effect. A connection between cataract and both wood and tobacco smoke has also been observed in experimental studies in rats.

Other causes of blindness that could be aggravated by exposure to smoke are trachoma and conjunctivitis. In the case of trachoma, irritation from cooking smoke may cause people to rub their eyes, which can spread the infection. Conjunctivitis may be associated with long-term exposure to cooking smoke, which has many irritating chemical components.

About the analysis

The NFHS asked several questions on current health status, including the prevalence of partial or complete blindness. Partial blindness was defined as blindness in one eye, partial cataract, night blindness, or any other eye problem resulting in seriously impaired vision. The household head or another knowledgeable adult in the household reported on the status of each household member. No effort was made to test for blindness clinically.

This analysis measures exposure to cooking smoke indirectly by the primary type of cooking fuel used in a household. The NFHS identified nine types of cooking fuel, grouped here into two categories—biomass fuels (wood or dung) and cleaner fuels (charcoal, coal/coke/lignite,

kerosene, electricity, petroleum gas, or biogas). The small category of ‘other fuels’ is excluded.

The effect of cooking smoke on the prevalence of blindness can be calculated by a simple bivariate analysis, producing an ‘unadjusted’ effect. Several other demographic and socioeconomic factors may also affect the prevalence of blindness, however, potentially confounding the effect of cooking smoke.

For this reason, the independent (‘adjusted’) effect of cooking smoke is estimated by logistic regression and multiple classification analysis, controlling for the effects of nine other, potentially confounding, variables. These are: woman’s age and education; household head’s religion and membership in a scheduled caste or tribe¹; and urban/rural residence, geographic region, house type (*kachcha*, *pucca* or semi-*pucca*²), crowding (number of persons per room), and availability of a separate kitchen. In the calculation of adjusted prevalence rates, the control variables are held constant by setting them to their mean values in the underlying logistic regression.

Effects of cooking smoke and other variables

Figure 1 shows the effects of cooking fuel type on the prevalence of partial blindness both before and after adjusting for nine potentially confounding variables. The unadjusted prevalence of partial blindness is 50% higher among women

1. Scheduled castes (SC) and scheduled tribes (ST) are those castes and tribes identified by the Government of India as socially and economically disadvantaged and in need of protection from social injustice and exploitation.

2. *Kachcha* houses are made from mud, thatch, or other low-quality materials. *Pucca* houses are made from high-quality materials such as bricks, tiles, or cement. Semi-*pucca* houses are made from partly low-quality and partly high-quality materials.

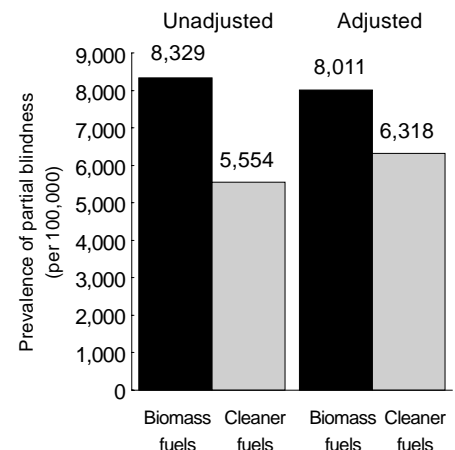


Figure 1. Unadjusted and adjusted prevalence of partial blindness in women age 30 and older, by primary type of cooking fuel

living in households that use biomass cooking fuels than among other women. Adjusting for the nine control variables reduces the difference in prevalence rates to 27%, but the effect remains highly statistically significant ($p=.001$).

The effect of cooking fuel on the prevalence of complete blindness is even larger (Figure 2). The unadjusted prevalence of complete blindness is 103% higher among women living in households that use bio-

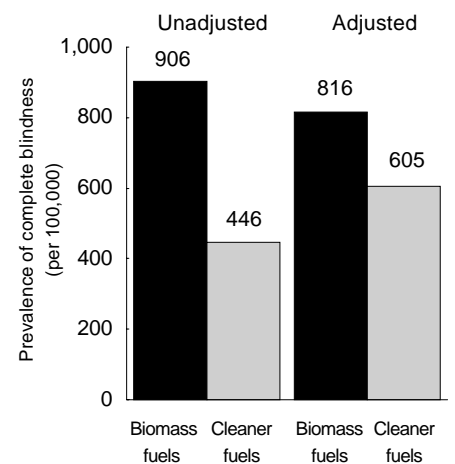


Figure 2. Unadjusted and adjusted prevalence of complete blindness in women age 30 and older, by primary type of cooking fuel

Table 1. Adjusted prevalence of partial or complete blindness in women age 30 and older, by primary type of cooking fuel and other selected variables

Variable	Blindness prevalence per 100,000
Primary type of cooking fuel	
Biomass fuels	8,701*
Cleaner fuels ^a	6,844
Separate kitchen	
Yes	7,792*
No ^a	8,888
House type	
<i>Kachcha</i> ^a	8,569
<i>Pucca</i> or semi- <i>pucca</i>	7,954
Crowding	
<3 persons per room ^a	8,412
≥3 persons per room	7,982
Age	
30–39 ^a	2,999
40–49	7,555*
50–59	13,438*
60–69	23,691*
70+	33,341*
Residence	
Urban	8,624
Rural ^a	8,078
Education	
Illiterate ^a	9,032
Below high school	7,060*
High school or more	5,123*
Religion	
Hindu	8,334
Muslim ^a	8,371
Other	6,808*
Caste/tribe	
Scheduled cast/tribe	8,675
Other ^a	8,119
Geographic region	
North and northeast	2,879*
Central and eastern	7,316*
West	11,049
South ^a	9,839
Number of women	81,144

^aReference category

* Statistically significant at the 5% level.

mass fuels than among other women. Adjusting for the control variables reduces this difference to 35%, but the effect remains statistically significant ($p=.08$). The lower level of statistical significance (larger p value) for complete blindness reflects the comparatively small number of cases in the sample.

Table 1 gives the adjusted effects of cooking fuel type and the other nine predictor variables on partial or complete blindness. For any given predictor variable, the set of control variables consists of all the remaining predictor variables listed in the table.

Blindness prevalence increases as women age and tends to be higher for women who are economically and culturally disadvantaged, most likely because they have poorer access to medical care than do other women. Thus, women who are less educated and who belong to scheduled castes or tribes have a relatively high prevalence of blindness. Similarly, the prevalence of blindness is higher for women who live in poor-quality (*kachcha*) houses or in houses that lack a separate kitchen than for other women. Surprisingly, crowding in the household tends to reduce the prevalence of blindness, although the effect is not statistically significant. This may be because women who live in crowded households are likely to spend a good deal of time outdoors.

Hindu and Muslim women have higher blindness prevalence than do women belonging to other religions, probably because households of other religions tend to have relatively high socioeconomic status. Regional differences are large, with blindness lowest in the north and northeast and highest in the west.

Without controlling for other variables, urban women have a lower prevalence of blindness than do rural women (not shown). When the other variables are controlled, however, blindness prevalence is higher in urban areas, although the effect

is not statistically significant. This reversal in the effect of residence indicates that the lower unadjusted prevalence of blindness in urban areas is mainly due to better socioeconomic conditions.

Figure 3 gives the adjusted effects of cooking fuel type on partial or complete blindness, broken down by urban and rural residence. The analysis shows that cooking fuel type has a much larger effect on the prevalence of blindness in rural areas than in urban areas. This may be because women's exposure to cooking smoke is greater in rural areas, or because medical services to prevent or treat eye problems are better and more widely available in urban areas, or both.

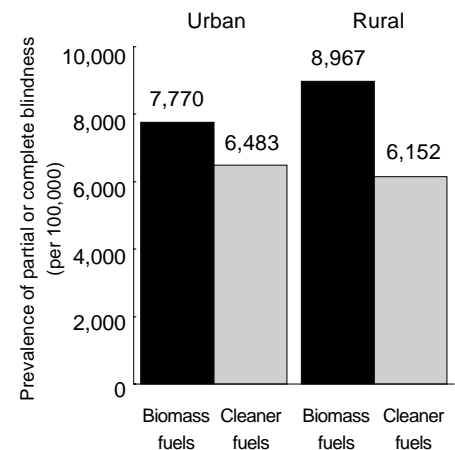


Figure 3. Adjusted prevalence of partial or complete blindness in women age 30 and older, by primary type of cooking fuel and by residence

How much blindness prevalence can we attribute to cooking smoke?

It is useful to consider how much of the blindness prevalence indicated in the NFHS may be due to smoke from biomass fuels. A 'population attributable prevalence proportion' can be defined as:

$$\frac{\text{Prevalence in total population} - \text{Prevalence in unexposed group}}{\text{Prevalence in total population}}$$

This measure can be interpreted as the proportionate reduction in blindness prevalence that would occur, hypothetically, if everyone were to use cleaner fuels. Among Indian women age 30 and older, we find that 17% of partial blindness and 20% of complete blindness can be attributed to cooking smoke from biomass fuels.

Discussion

The true effect of biomass fuels is probably greater than this analysis suggests. For one thing, the NFHS only provides information on the primary cooking fuel used. To the extent that households in India actually use a combination of cooking fuels, the difference in blindness prevalence due to fuel type will be greater than estimated here.

In addition, the NFHS does not provide information on the history of household fuel use. To the extent that households shifted at some time in the past from biomass fuels to cleaner fuels, the difference in blindness prevalence due to fuel type will be underestimated. Finally, the estimated effect of fuel type would be larger if the comparison were between biomass fuels and a very clean fuel such as electricity.

On the other hand, the prevalence of blindness may well be higher in households that use biomass fuels not because of fuel use, but because such households tend to be poor and thus probably have

less access to medical care than households that use cleaner cooking fuels.

Further research, in India and in other developing countries, could elucidate the relationship between cooking smoke and blindness more precisely. For one thing, fuel type is not an ideal measure of exposure to smoke, and reports of blindness (especially partial blindness) by household heads or other informants are not as accurate as clinical measurements.

The NFHS also does not provide information on several, possibly confounding, risk factors for blindness such as vitamin deficiencies, severe diarrhoeal episodes, and exposure to sunlight. To validate the results presented here, studies should be based on better measures of smoke exposure, clinical measures of partial blindness, and more complete information on potentially confounding variables.

Policy implications

These findings, although subject to validation, suggest that blindness prevalence could be reduced substantially in India—and probably in many other developing countries—by lowering exposure to cooking smoke from biomass fuels. Perhaps the most obvious long-run policy implication is that the government should promote a shift from biomass fuels to cleaner fuels. Such a policy would undoubtedly bring several other health benefits.

In the short run, however, such a shift may not be feasible. Many households in India cannot afford cleaner cooking fuels. Moreover, given current infrastructure and fuel supplies, neither the government nor the private sector can make cleaner fuels available to all households.

A more feasible policy in the short run would be for the government and nongovernmental organizations (NGOs) to increase their efforts to educate the public about the adverse health effects of cooking smoke. The government should also place greater emphasis on blindness prevention in its health programmes because blindness can often be prevented if detected and treated at an early stage.

In addition, the government and NGOs need to strengthen programmes to promote inexpensive biomass-burning stoves—equipped with flues or hoods—that are more fuel-efficient and less smoky than traditional stoves. For such programmes to be effective, local needs and community participation must be given high priority.

Further reading

Mishra, Vinod K., Robert D. Retherford, and Kirk R. Smith. 1999. Biomass cooking fuels and prevalence of blindness in India. *Health Transition Review*. Forthcoming.

The **International Institute for Population Sciences** was established at Mumbai in 1956 as the regional institute for training and research in population studies for the Asia and Pacific region of the United Nations. Now also a deemed university, it is an autonomous institution sponsored jointly by the Government of India, the United Nations Population Fund, and the Sir Dorabji Tata Trust.

The U.S. Congress established the **East-West Center** in 1960 to foster mutual understanding and cooperation among the governments and peoples of the Asia-Pacific region, includ-

ing the United States. Principal funding for the Center comes from the U.S. Government, with additional support provided by private agencies, individuals, and corporations and more than 20 Asian and Pacific governments.

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