



Household Smoke Pollution and Chronic Cor Pulmonale

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An investigator from India has reported a very high incidence of cor pulmonale (16.6%) of the admitted cardiac cases in an urban hospital. Men and women were almost equally affected in the study (1.2:1.0) unlike previous studies that recorded a high preponderance of men over women [1,2]. The investigator suggested very squalid living conditions and the smoke-filled atmosphere in which these patients lived were contributory factors, but the investigator unable to followup with field studies [3].

It was the winter of 1976-1977, as chief of the Medical and Cardiology Department, I was working at Bir Hospital, which was the premiere hospital of Nepal, and was serving both the urban and rural populations. A large number of patients admitted to the medical ward were suffering from chronic bronchitis and chronic obstructive pulmonary disease (COPD), often complicated by cor pulmonale. After spending a few days, they used to be discharged from the hospital but most of them would return to the hospital after a few days or weeks with the same problem. This was the situation mainly during the winter months. The patients and their families suffered. It cost them time and money. This illness not only caused a lot of agony but also brought deleterious socioeconomic consequences to the family, society, and the nation. This touched my heart very much as it became clear to me personally that the problem was an important neglected problem especially of the poor and disadvantaged people. We decided to plan a study to find out the cause of this problem and how to control it. We approached Nepal Academy of Science and Technology and explained to the leaders and experts of the academy about the great socioeconomic impact of the subject. After some effort, we were able to convince them to support the study, and

they granted us 300,000 Nepalese Rupees (equivalent to US\$6,000).

First, we analyzed admitted cardiac cases of Bir Hospital, Kathmandu, from the years 1970 to 1975 and the incidence of chronic cor pulmonale was found to be 46%. This high incidence motivated us to do a community-based survey of chronic bronchitis, COPD, and chronic cor pulmonale in 4 different sites: urban Kathmandu (1,350 m); rural Kathmandu (1,500 m); plains of Terai (150 m); and high mountain region of Jumla (2,500 m) to discover the risk factors. As most of our cases of chronic cor pulmonale were secondary to chronic bronchitis and COPD, our field survey included these conditions along with chronic cor pulmonale.

Chronic bronchitis was diagnosed using the British Medical Research Council criteria, COPD by lung function test by spirometry as recommended by American Thoracic Society at the Snow Bird meeting [4], and chronic cor pulmonale was diagnosed using the then-current World Health Organization criteria [5].

The prevalence of chronic bronchitis and cor pulmonale were, respectively: in urban Kathmandu 11.3% and 1.5%; in rural Kathmandu Valley, 18.3% and 1.5%; in plains of the Terai, 13.1% and 0.5%; and in mountain region, 13.9% and 5.6%. It is interesting to note the increasing prevalence of cor pulmonale with an increase in altitude and the higher rates of chronic bronchitis in rural versus urban Kathmandu. The data also showed that there were higher rates of chronic bronchitis in women than in men, which contrasts with the findings of most other studies, which showed the reverse [6–10]. On the other hand, higher percentages of women as compared to men in all 4 sites were either nonsmokers or smoked lesser quantities. This disparity can be explained because

a significantly higher proportion of women as compared to men in all 4 areas were exposed to household smoke pollution for longer hours from cooking and heating stoves using wood fuel. The statistically significant increasing trend of the prevalence of chronic bronchitis as the hours of exposure to household smoke pollution increased (even after elimination of the age effect and also among the nonsmokers) further established the definite role of household smoke pollution in causing this disease. In the urban Kathmandu and Terai sites also, significant association between disease prevalence and hours of exposure to household smoke pollution was found [11].

Right from the beginning, after seeing the poor female patients, I had the impression that household smoke could be an important factor for these women suffering from cor pulmonale. It made sense then to conduct a survey in a high-dose situation to see if we could understand the impact better. We chose Jumla in the mountain region, which was known to have very high exposures to household smoke, so much so that patients use to cough black sputum. The Jumla people are known as the “Black people” in other parts of the country because their faces and clothing are black from the wood smoke. Traveling to Jumla was difficult in those days. At 2,500 meters, it was accessible only by air or after many days of arduous walking. One had to wait for weeks to obtain air tickets or walk 8 to 9 days from the nearest road. Equally difficult was the task of transporting equipment such as X-ray machines, electrocardiographs, and pulmonary function test machines, not to mention the needed electrical generators. Often the plane would take off from Kathmandu but would not be able to land at Jumla airport due to unpredictable weather en route. There was only 1 flight a day, and the team was only able to land at Jumla after 4 attempts on 4 successive days. Flying through the mountains in bad weather is quite scary to most people, including us. Life in Jumla was also hard for us, spoiled as we had been by the comforts of Kathmandu. I praise my dedicated colleagues and staff who successfully completed the research under these circumstances, which was a difficult feat in itself.

In those days, even the Jumla district hospital did not have X-ray, electrocardiograph, or pulmonary function test equipment. When the people saw us using them in our check-ups, it was a matter of great curiosity to many. People from far-off villages flocked around just to have a glimpse of the machines.

A large number of people exposed to household smoke pollution for more than 8 h in Jumla provided an opportunity to see the effect of longer hours of exposure versus shorter hours of exposure. Positive correlation was seen even beyond 8 h of exposure in both sexes: the longer the exposure, the higher the disease prevalence. This is evidence of a dose-response relationship between household smoke pollution and chronic bronchitis [11]. This further potentiates the causal relationship between household smoke pollution and chronic bronchitis. These studies show that in rural Nepal, nearly 15% of nonsmoking women (20 years and older) had chronic bronchitis, a very high rate for nonsmokers [12].

In another study on household smoke pollution and respiratory function among women in a rural community, there was a fall of mean forced vital capacity, forced expiratory volume in 1 s, and forced mid expiratory flow (25% to 75%) as duration of exposure increased. This decline was found to be statistically significant (forced vital capacity: $p < 0.025$, forced expiratory volume in 1 s: $p < 0.025$, forced mid expiratory flow: $p < 0.01$) among the smokers but not among the nonsmokers though the declining trend was there. Similar results were found even after adjusting for age and height [13]. This suggests a synergistic relation between tobacco smoking and household air pollution.

Prevalence of chronic cor pulmonale was also found to be increasing with increased level of exposures in all the study areas. However, no significance test could be done on chronic cor pulmonale because of the relatively small number of cases [11].

The figures for cor pulmonale were from the very strict old World Health Organization criteria for diagnosis of cor pulmonale. With modern technology such as Doppler echocardiography, we can detect pulmonary hypertension and right ventricular hypertrophy at an early stage. New studies are needed to apply the more sensitive modern instrumentation in consistent protocols. It will surely reveal much more cor pulmonale than shown by the old criteria in these populations. Moreover, early detection of cor pulmonale is very important from both the prevention and treatment points of view, as we have seen that the prognosis is very poor in advanced cases.

So, these studies showing the increasing prevalence with the increasing level of exposure to household smoke pollution in nonsmoking women has established that household smoke is an important factor for chronic bronchitis, COPD, and cor pulmonale.

Unfortunately, relatively little attention has so far been paid to this important subject by national governments as well as international agencies. Even we cardiologists have generally ignored this problem as shown by the relatively little importance given to it in most of the important international cardiology conferences. Recently, because of the effort of many socially minded experts, the importance of household smoke is being realized more and more. In the 2004 World Health Organization Comparative Risk Assessment of the Global Burden of Disease project, it took the 10th place in the global burden disease and 4th place in the South Asia region, even without consideration of heart disease. In the update due this year, however,

cardiovascular outcomes dominate the total impact in terms of premature mortality. I would like to congratulate the researchers who have contributed to this issue of *Global Heart* and the colleagues who have worked hard to bring out this relatively neglected issue of household smoke pollution and heart disease.

By the mid-1980s, after our investigations starting in the 1970s, I and close colleagues in Nepal became convinced that household smoke pollution is an important health risk, so we started building different types of chimney cook stoves in villages around Kathmandu. We spent much time on this, indeed, to the extent that sometimes my wife used to ask, “Have I married a cardiologist or a stove maker?”

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