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Indoor Biomass fuel as a Higher Risk Factor for TB in HIV Positive Female Patients of Western India

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ABSTRACT
Backgroud:-It is well known that one third poor population of world use biomass fuel for cooking and heating. It is universally accepted fact that bio-mass fuel plays a significant role as predisposing factor of tuberculosis, acute respiratory tract infections and COPD even in non-immune-suppressed (HIV sero-negative) individuals. As we all know house hold cooking is the primarily performed by women. So close association with bio mass fuel and even longer duration to it make women more vulnerable to this RTI secondary RTI infections. **Aim:-** To study effects of biomass fuel on prevalence of RTI/tuberculosis on HIV-infected patients of Gujarat. **Material & Methods:-**In the present study 961 HIV infected patients with RTI and 300 HIV infected patients without RTI and 300 HIV-uninfected patients with RTI were surveyed for use of bio-mass fuel or clean fuel. Result:- **Conclusion:-**It had been surveyed, statistically analysed and had been found even higher risk predisposing factor mainly for tuberculosis and other acute respiratory tract infections in immune-suppressed HIV-sero positive patients. Here biomass fuel had been evaluated as a risk factor in developing TB in HIV patients and incidences of RTI in HIV sero-positive patients had been found in our study that those who were found to have 2.3 times higher risk of contracting respiratory tract infections as compared to those who were not suffering from HIV. Even among all these RTI patients who might acquire secondary RTI infections due to bio mass fuel, 61.87 % were found to be women. When only TB is considered in this study it was found 67.44 % women were observed suffered from TB when compared with same group males.This increased infected woman to TB and COPD in turn results in preterm delivery which leads to birth of low birthweight babies if women are pregnant.
Key words :- Biomass fuel, Clean fuel, HIV, TB

I. INTRODUCTION

BMF refers to burned plant or animal material; wood, charcoal, dung and crop residues account for more than one-half of domestic energy in most developing countries and for as much as 95% in lower income countries (Smith et al., 2004). Around 2.4 billion people rely on BMF as their main source of domestic energy for cooking, heating and lighting (Reddy et al., 1996, Smith et al., 2004) and a further 0.6 billion people use coal. The adverse health effects of indoor air pollution are often exacerbated by lack of ventilation in homes using BMF and by the poor design of stoves that do not have flues or hoods to take smoke out of the living area. The combustion efficiency of BMF is also very low, thus it yields relatively high levels of products of incomplete combustion, which are more damaging to health.

The polluting effect, efficiency and cost of domestic fuel use are often construed as an 'energy ladder' (WHO, 2006a). Dried animal dung, scavenged twigs and grass, which are cheap, inefficient and pollute the most, are at the bottom of the ladder. Crop residues, wood and charcoal are a higher level BMF, whilst kerosene, coal and bottled or piped gas are the most efficient (non-BMF) combustible energy sources. Electricity is at the top of the energy ladder. The correlation of socioeconomic factors with the main fuel used is relatively close, however most households use several fuels in different settings. Four factors that appear to be most relevant in a household's choice of fuel type are: (a) cost of fuel, stove type and accessibility to fuels; (b) technical characteristics of stoves and cooking practices; (c) cultural preferences; and lastly, if at all, (d) the potential health impacts (Masera et al., 2000).

Inefficient burning of BMF on an open fire or traditional stove generates large amounts of particulate matter as well as carbon monoxide, hydrocarbons, oxygenated organics, free radicals and chlorinated organics (Naeher et al., 2007). The particulate matter component of this smoke is classified according to its size, with inhalable

material <10 μm in aerodynamic diameter referred to as PM_{10}. The 24-h mean particulate matter levels set in the WHO guidelines for air quality are 50 $\mu g/m^3$ for PM_{10} and 25 $\mu g/m^3$ for $PM_{2.5}$ (WHO, 2006b), but in many parts of the developing world the peak indoor concentration of PM_{10} often exceeds 2000 $\mu g/m^3$ (Ezzati and Kammen, 2001, Regalado et al., 2006). Critically, there are age, gender and socioeconomic differences in levels of exposure and the consequent health effects (Bruce et al., 2000). Exposure to BMF has been estimated to have caused 0.5% of all deaths and 0.4% of all disability-adjusted life-years in South Africa in 2000 (Norman et al., 2007). The adverse or bad effect of biomass fuel on human health are:-1. Respiratory illness in children 2. Nutritional deficiency in young children 3. Respiratory illness in adults 4. Interstitial lung diseases 5. Chronic obstructive lung diseases (COPD) 6. Tuberculosis 7. Lung cancer 8. Cardiovascular diseases 9. Cataract

II. METHODS & MATERIALS-

This study has been conducted at the ICTC& ART Centres of many cities of Gujarat, like Surat, Ahmedabad and Himmatnagar's Civil Hospitals and/or Government Medical Colleges. All the cases and both control groups patients (961 cases and 300 group of control patients) included in the study were those who were either OPD or indoor patients of Civil Hospitals, of all the civil Government hospitals of any of the above cities either with complaint of respiratory tract infections (Cough persistent for more than a week). All TB patients were diagnosed mainly by ZN staining with few exceptions (diagnosed by chest X-ray or culture on LJ medium), whereas other RTI were diagnosed by culture of sputum and gram staining or wet mount with numerous pus cells and co-relating them clinically. (Rajeev Shah, 2015). All the patients including all control group patients were inquired about their cooking facilities for their food at home and ventilation in the kitchen.

A predesigned and pretested questionnaire was used to collect data on socio-demographic profile. Blood samples of these subjects were tested for HIV. The HIV-infected patients were all diagnosed as HIV reactive as per the NACO guidelines [6]. In the patients found HIV seropositive even, CD4 count was calculated on FACS count, by flow cytometry method (Becton Dickinson) method from their blood samples.

Three consecutive early morning sputum samples were collected and even samples were concentrated before reporting negative for AFB from 961 HIV infected patients and 300 HIV sero-negative subjects who had complaint of cough and fever for more than one week. Sputa samples were collected in a sterile wide mouthed container. The quality of the expectorated sputum was assessed both by macroscopic and microscopic examination. Any sample that was thin, watery and with no purulent matter was considered unsuitable for further processing. Bartlett's scoring method was used for microscopic evaluation of the expectorated sputum [7]. A sputum was considered unsuitable if it had a final score of 0 or less. All unsuitable specimens were discarded and a repeat specimen was collected.

Case definition for T Cases were defined as patients with both HIV sero-positive as well as having complaints of cough and fever for more than one week or in other words suffering from respiratory tract infections (RTI) at the time of sputum and data collection. One patient was included only once. If HIV infected patient with sign and symptoms of RTI but having history of allergic common cold, were excluded from the study.

Definition for C1 (Control group) C1 Control group was defined as patients with respiratory tract infection (RTI) but seronegative for HIV at the time of sample and data collection

Definition for C2 (Control Group) C2

Control group was defined as patients without any fungal and routine bacterial respiratory tract infection (RTI) but sero- positive for HIV at the time of data collection.

Exclusion criteria Patients having history of allergic common cold or allergic respiratory tract infections.

Sputum smear microscopy and culture

The most frequent method of TB detection involved microscopic examination of sputum for acid-fast bacilli (AFB) [8]. Microscopy had the advantage of being inexpensive, relatively rapid to perform, and specific in most settings. However, to be considered smear positive a specimen needs to contain approximately 105 Mycobacteria per milliliter. The sensitivity of sputum microscopy in HIV infection ranges from 43 to 51 per cent [9] and in many resourcelimited settings with high rates of co-infection, the sensitivity may be much lower [10]. Methods that improved speed or sensitivity include fluorescence microscopy [11] and alternative specimen processing methods, such as concentration, bleach sedimentation and sameday sputum collection (so called front loading) strategies [11, 12]. Any procedure for digestion or

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liquefaction followed by centrifugation, prolonged gravity sedimentation, or filtration increased sensitivity by 13 to 33 per cent over direct microscopy, when culture was used as the reference standard [11].

Culture of Mycobacterium tuberculosis is much more sensitive than smear microscopy and has been recommended to assist in the diagnosis of TB in HIV-infected individuals. But in the present study it had been used in the limited number of the patients, which were clinically strongly suggestive of pulmonary TB but negative by ZN staining even after concentration of sputum samples

Expectorated sputum was used to detect the bacterial and fungal pathogens and induced sputum was used for detection of trophozoites and cysts of P. carinii. Quality of the expectorated sputum was assessed both by macroscopic and microscopic examinations. Specimens which were clear, thin, and watery with no purulent material were rejected. Microscopically, Bartlett's scoring method was used to assess the quality of the sputum.

Smears were prepared and subjected to Gram's staining, Ziehl-Neelsen staining (20% H2SO4 and 1% H2SO4), and Toluidine O stain. KOH mount was done for fungi. The specimens were cultured on 5% Sheep Blood agar, MacConkey agar, heated Blood agar, Lowenstein Jensen Media (only in limited number of cases).

III. RESULTS:-

The RTI are among the first opportunistic infections, observed in HIV patients and unlike HIV sero-negative persons some of the RTI even causes permanent damage to respiratory tract, thus affecting both quality and quantity of rest of their life. So, it is very important to prevent RTI in HIV patients by understanding risk factor for RTI in them. In this study we tried to understand the effect of biomass fuel (BMF) on opportunistic RTI in HIV patients.

Table 1: Occurrence of RTI among those reporting to ART centre

	HIV+	HIV-	Total
RTI+	961	300	1261
RTI-	300	217	517
Total	1261	517	1778

OR=2.317 and 95% CI = 1.86 to2.88

It can be seen that those who were detected as HIV+ had 2.3 times higher chance of contracting respiratory tract infection as compared to those detected negative for HIV. The 95% confidence interval not including the null value (OR=1) indicates the significant association of the HIV status and the occurrence of RTI.

In our present study biomass fuel was found statistically significant predisposing factor of TB with p value found to be 0.5 in female and 0.10 in male it was found less significant, when compared between TB Patients of group C1 and non-TB patients of group C2 (Table 2).

Table 2: Comparison of Risk of acquiring TB between TB patients from HIV sero-positive patients from T group and HIV/TB negative patients from C2.

	FTB+/HIV+/RTI+ (T)		FTB-/HIV+/RTI- (C2)		P
	(n)	**%**	**(n)**	**%**	
Female Patients using Biomass fuel	52	69.33	47	35.33	0.05
Total Female Patients	75		133		
Male Patients Using Biomass fuel	71	52.98	61	36.52	0.10

IV. DISCUSSION:-

Globally, total number people living with HIV in 2012 are 35.3 million. In parts of the world where HIV infection is most common, BMF is the main energy source. In Malawi, for example, the incidence of HIV in pregnant women is 33%, and 70% of hospital admissions and >80% of households use BMF. However, the influence of BMF smoke on HIV-infected individuals has not been clarified.

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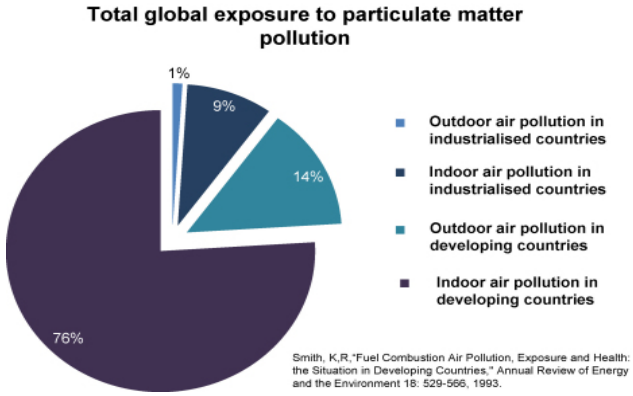
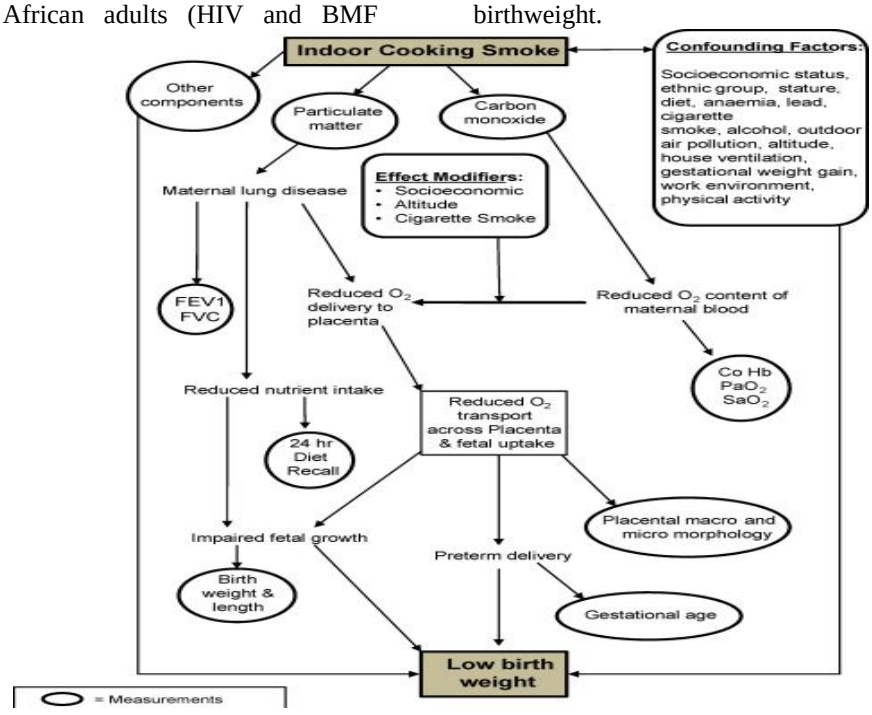


The most important effect of HIV infection in Africa is to cause increased bacterial infections, pneumonia and TB. HIV infection is associated with mild airway obstruction and loss of gas transfer, with severe impairment occurring in the presence of Pneumocystis jiroveci infection (Mitchell and Clarke, 1995). HIV is also associated with the accelerated development of COPD (Diaz et al., 2003) and it is likely, although not proven, that HIV infection is a significant contributor to airway disease in much of the adult population of Africa. Since both BMF use and HIV are associated with an increase in the incidence of pneumonia (Gordon et al., 2002; Smith et al., 2000) and as particulate matter exposure and HIV result in increased pulmonary inflammation (Ghio et al., 2000; Rowland-Jones, 2003; van Eeden et al., 2001), it is possible that by causing pulmonary inflammation the two major risk factors for pneumonia in African adults (HIV and BMF smoke) may actually demonstrate previously unrecognised synergy.

Evidence exists that implicates exposure to BMF smoke in adverse effects on different birth outcomes (Sram et al., 2005). There is a published association of low birthweight, intrauterine growth retardation and perinatal mortality with air pollution (Dejmek et al., 1999, Mavalankar et al., 1991, Wang et al., 1997). A study from Guatemala identified an association between birthweight and type of fuel used. The use of an open fire produced average levels of PM_{10} of 1000 $\mu g/m^3$. The babies of mothers using open wood fires were on average 63 g lighter compared with babies born to mothers using cleaner fuels (Boy et al., 2002). A similar (slightly larger) effect has also been reported in Zimbabwe (Mishra et al., 2004). The model in figure below attempts to explain how BMF may fit into a multifactorial explanation of low birthweight.



Tuberculosis is the second most common cause of death globally in adults attributable to a single infectious agent (WHO, 1998). Tuberculosis remains the leading cause of death due to infection in India, which bears nearly 30% of the global tuberculosis burden (Dye C, Scheele, 1999; 282: 677–686).Each year, 2 million people in India develop tuberculosis and nearly 500 000 die from it, averaging more than 1000 TB deaths a day (WHO, 2000). India has the largest pool of people infected with tuberculosis (mycobacterium tuberculosis) with an annual incidence 1.98 million, the largest number in any one country and catering to a fifth of the global burden of TB. It is estimated that more than half of India's adult population is infected with tuberculosis bacterium, mycobacterium tuberculosis. Once a person is infected, any condition that weakens the immune system can trigger the development of active tuberculosis. Typically 5 to 10% of these infected eventually become ill with active tuberculosis (**ATS 1990**). However this percentage may be higher in the case of India, because of the ubiquity of thetuberculosis bacillus, high population density and poor socioeconomic and health conditions. Approximately 500,000 persons die from tuberculosis each year in India. In recent years, the growth of drug resistant tuberculosis and the rapid spread of human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) has contributed to the resurgence of tuberculosis in India and in other parts of the world (Raviglione MC, 1995;Piot P, 1997; Kochi A, 1994; WHO, 1992;Sawert H, 1996). NFHS recorded an overall active tuberculosis prevalence rate of 467 per 100,000 persons (IIPS, 1992) slightly higher than other estimates of the active (sputum positive) disease rate in India, which mostly range between 400-450 per 100,000 persons (WHO, 1992). Tuberculosis is a social disease with medical aspects and it has been described as a barometer of social welfare. As the women spend much more time in proximity to biomass fuel for cooking they were found at higher risk of acquiring secondary RTI and TB than male staying in the same home.

The reason seems to be very simple and well understood that in our society mostly female are supposed to cook food, so spending much more time in close proximity to sources of biomass fuel during cooking foodfor the family even though she might be even HIV-sero-positive. While males of same family with sero-positivity of HIV spend most of their time either out of home or away from the sources of biomass fuel. So naturally acquire less badeffects of biomass fuel and that is why the chances of acquiring TB due to the bad effect of biomass fuel was found very less when compared with same group of male.

Indoor air pollution from BMF disproportionately affects women and children and is the cause of significant global mortality and morbidity in even normal HIV negative women. Here our study proved that the HIV positive person have 2.3 times higher risk of contracting respiratory tract infections as compared to those who were not suffering from HIV.Even among all these RTI patients who might acquire secondary RTI infections due to bio mass fuel, 61.87 % were found to be women. When only TB is considered in this study it was found 67.44 % women were observed suffered from TB when compared with same group males. This is a neglected area of global disease that affects a large proportion of the world's population, and required further detail research on this matter to confirm exact risk of biomass fuel to HIV sero positive female. In my one research paper I had compared our findings with other workers findings and found that HIV sero-positive patients had 2.6 time more risk of acquiring TB and other complications of biomass more than normal healthy individuals with normal immune system (Rajeev Shah et al, 2023)

V. CONCLUSION:-

Weather cooking had been done outside of in home or even in well ventilated home, the chances of bad effect of biomass fuel always remains more to females due to close proximity and longer duration of time for women to the biomass fuel sources than men, who very rarely contribute in cooking the food. So, my present study proved that HIV positive women are at higher risk of acquiring secondary RTI, COPD and TB than HIV positive male patients due to indoor biomass fuel, when it had been sued for cooking. Here we had excluded biomass fuel used for heating room purposes which may affect both gender equally. The same scenario is even applied to HIV negative, i.e. normal healthy women with intact immunity who are also same way are at higher risk of all disadvantages/diseases of indoor biomass fuel than healthy men. If such HIV positive women are pregnant it may leads to preterm delivery and low birth weight babies.

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