DISCUSSION

Present manuscript is to evaluate women's awareness towards health, related to indoor air pollution and the harmful effect of smoke exposure to cooking. In the present work the toxic effect of smoke on the health of rural women around Meerut is highlighted. This investigation has shown that certain haematological, biochemical and immunological parameters presented high exposure to biomass fuel smoke particularly during the 2010-2015 period and 180 women, who were in extensive use.

During this period, the mal effects of smoke levels in the affected women were probably observed accompanied by extensive lung disease and by respiratory tract disorder. According to Fullerton & Gordon et al. (2008) the respirable dust levels were high in Malawian homes which use biomass fuels. Findings are also suggestive of that indoor air pollution from biomass fuel smoke in Africa is a significant cause of mortality and morbidity both in children and adults.

In the villages, smoking is reparable for 80% women who suffered from chronic bronchitis i.e. inflammation of the lining of bronchial tube and for most women of emphysema (over inflammation of the air sac in the lung) and chronic pulmonary disease, due to the progressive and incompletely reversible air flow obstruction. These diseases occur in the regions where biomass smoke use is very frequent.
The spectrums of this disease have been reported in those women, which were extensively depended on biomass fuel for cooking. Adult women over 40 year age had a high occurrence of respiratory symptoms. A major problem of asthma was found in the women of 36-51 years of age. The complex effect of indoor pollution was the developing of asthma.

Biomass smoke may be a factor sensitizing susceptible individual to allergies in early life. According to Bjarksten (1999) asthma and throat allergy also occurs in children due to indoor pollution. These studies revealed mixed findings and found asthma in children and adult women in relation to biomass smoke.

In our survey of women aged 15 to 65 in Datawali, Geshupur, Keenapur and Murlipur etc. which included spirometry found that biomass fuel users had more day/night cough and respiratory problems in comparison to LPG using women. Several studies however have reported in favour of above observations. In our study, women were selected so as to include those working in kitchen.

The health effects of indoor pollution in developing countries confirms the finding of Smith, K.R. (1987) and Chen, B.H. et al. (1990) and provides further evidence of association with a range of serious and common health problems. Few studies measuring indoor air pollution or biomass exposure present the possibility of serious manifestation of exposure and imply that very little information is available to quantify, the co-relation between exposure level and risk.
This has important implication for assessing the health impact of exposure levels in various populations as well as in estimating the potential health. RTI research on biomass cook stoves revealed, more than the half of the world's population cook their food and heat their homes by burning biomass fuel like coal, would, animal dung and others in open and most often indoors. This practice releases toxic gases and particles in to confined spaces. Use of domestic chullah stoves with the biomass residues burning is one of the main cause of child and maternal death in the developing world's (RTI updates, 2010). The cooking with chullah stoves with the biomass residues in rural areas (representing about 80% of the country’s population) generally found in non-ventilated indoor areas with poor living conditions. There is also problem of clean water or sewage, and separate space for cooking, living and sleeping in the premise.

However, some families of good income living in comfortable houses with facilities of clean water, good cooking conditions and ability to use better fuels in well ventilated, designed areas. Women, across the socioeconomic group acknowledge on the whole, that biomass fuel smoke has negative effects on the health causing breathing difficulties.

The awareness about health is very low in this group of population. Paradoxically in this rural population the level of reported respiratory disease is two to three times higher than in urban traditional or middle class group. A lack of
knowledge about health and lack of concern are associated with reduced willingness to change.

A large survey on this problem would strengthen our observations and provide good basis for devising a population awareness campaign. Our study focused with the view of health of rural women as they primarily have responsibility for cooking within the household.

**HAEMATOLOGICAL STUDY**

The findings of significant associations between haematological parameters variable was unexpected.

In this study, the haematological parameters decline along with increase in lymphocytes, monocytes, eosinophils, and RBC and haematocrits. Both monocytes and eosinophils were only marginally elevated in this study. On the statistical association of serum biomass fuel smoke levels and monocyte counts were strong. Smoke, from the other sources has been proposed to be a major environmental risk factor and a cause for a variety of human respiratory diseases.

Recently smoke was found a main cause of cataract and eye lens opacification, which is a major cause of blindness. Hassan et al. (2009) stress upon that domestic air pollution from biomass fuel burning is associated with increased prevalence of cataracts. Studies revealed the smoke from biomass combustion release toxin which could get absorbed systematically and get accumulated in the
lens, resulting in development of cataract. Our studies show some women suffering from the eye problem likely eye irritation, tears, cataract and redness etc.

The variations in haematological parameters caused due to the inhalation of toxic gas of biomass fuel burning that leads hypotac polycythaemia in women. Present findings gain support with the finding of De Gabriele and Perrington (1967) and Penney and Bishop (1978) have observed decrease in platelets count due to polycythaemia in rat, exposed to carbon monoxide. On the basis of present studies one of five women suffered from respiratory problems in the villages.

The leading cause of these problems is acute respiratory infection from breathing of the smoke from cooking fires. While respiratory infections are not as visual as burn victims the results are equally devastating and are a silent killer. Alternations were observed in haematological parameters of women, undergoing biomass fuel smoke exposure.

The present observations clearly show significant decrease in haemoglobin, RBC, PCV in majority of results, obtained in all the three age groups. This showed anemic condition, a common finding in women. Anemic condition was evident in all the age groups but in 36 to 50 was more pronounced. The anemic condition was evident and progressed with time (as evidenced by decrease in RBC count, haemoglobin concentration, packed cell volume and MCHC).

Our data indicated the haematotoxic effect of biomass fuel smoke
throughout the studies. Air pollution from coal burning in thermal power plant and smoking was found important factors for the level of cadmium in blood, which had an inhibitory effect in the synthesis of bilirubin. This finding confirmed with the observation of Prenaj et al. (2009) and Agha and Gokmen (2002).

Few women acknowledged that biomass fuel smoke has a negative effect on their health, causing breathing difficulties only half of women acknowledge it is dangerous for their children. This dropped to less than 20% in the rural population, found the most susceptible group. The awareness to health is low in this group, although the women interviewed did consider some fuels as cleaner than others.

Blood vessel are common pipe lines through which enzymes, blood component (RBC, WBC, Platelets and eosionophilic cells etc) and entire immune components are circulated to the cells and tissue. Interesting correlation in the present work have been observed for the first time. The affinity of blood and immune component to become more relevant, as both have common origin from haemopoeitic stem cells and both are closely linked together.

Present investigation provide an interesting evidences for anemia (pernicious and macrocytic) hypoxia, polycythemia and hypoderonic anaemia. This marked by the significant depletion in RBC, Haemoglobin and haematocrit value (PCV) in women using biomass, of all groups. The PCV value decreased, in all groups of women showed anemia and bone marrow depression.
The depression in MCV value following pathological condition like microcytic anaemia, mormocyticytic anaemia and macrocytic anaemia. MCH value increased in women, showed normochromic anaemia. The low value of MCHC showed hypochromic anaemia. The extended depletion in these groups is related to intensity of biomass smoke exposure, this showed anemic condition in women of all age groups.

Anaemia is a very common effect in women and men also, after oral exposure to biomass smoke, smoking and industrial smoke exposure which effects to the blood, lungs, liver and kidney. Present study clearly showed significant reduction in RBC, Hb% and PCV% in majority of results obtained from all age groups. Decrease in the number of RBC may be due to decreased rate of erythropoeisis.

Decreased in haemoglobin content and PCV value under stressful condition would be an expected consequence of loss of erythrocytes. The present work revealed that the decrease in RBC value due to biomass fuel smoke exposure. The present observations on the effects of smoke on RBC count confirms erythropenia as a result of disturbances in the metabolism caused by toxic substances, which are produced by the exposure of biomass smoke in the body of women.

Hypo-haemoglobinemia followed by a fall in RBC and Haemoglobin content at all age groups during the present investigation has been observed.
During the present study the TLC value reduce in all groups of women. Sharp decrease in TLC well marked this variation and show leucocytosis and leucopenia condition in women.

Present study clearly showed variation in differential leucocytes count. The neutrophils decrease all the groups of women. This condition showed pathological variation i.e. neutrophils and neutropenia. Lymphocytes increased throughout the study showed lymphocytosis. The haematological studies, suggested a slight decline in PMNs and some increase in lymphocytes, monocytes and eosinophils.

**BIOCHEMICAL STUDY**

The biochemical study showed significant decrease in serum total protein of all age group women due to indoor air pollution exposure of biomass fuel smoke. The decrease in total serum protein is due to respiratory inflammation which accompanies epithelial cell injury by biomass smoke exposure resulting in increase in epithelial and capillary membrane permeability which cause leakage of protein from serum to site of pulmonary injury leads to decrease in serum total protein value in women.

The glucose is formed from digestion of carbohydrates. The release of glucose into blood takes place in two ways. Conversion of liver glycogen to blood glucose (Glycogenolysis) and formation of blood glucose by liver from non carbohydrate sources viz. amino acids, pyruvate, lactate (gluconeogenesis).
Glucose-6-phosphate dehydrogenase (G-6-PD) is a key enzyme in glycolysis and catalyze glucose-6-phosphate to 6-phospholactose through HMP pathway and provides NADPH to stimulate glucose metabolism. In the present study blood glucose decrease in biomass exposed women. A decrease in blood glucose level is due to inhibition by biomass smoke that causes pulmonary injury seem to inhabitate glycogenolsis and glyconeogenesis resulting in hypoglycaemia in women. It is well known fact that any type of tissue injury and stress condition stimulate sympathetic branch of nervous system to release and inhibit epinephrine. In the liver epinephrine affects glycogenolysis and gluconeogenesis in muscle from lactate and decrease glucose from liver and muscle into the blood. Decrease blood glucose level is correlated with increase and decrease in serum cholesterol in women due to increase and decrease lipolysis. In adipose tissue epinephrine stimulate lipolysis i.e. break down of triglycerides to fatty acid and glycerol. Glycerol is taken by the liver and converted to glucose (Chatterjee and Shinde, 2000).

In the present investigation serum glutamate oxaloacetate transaminase and serum glutamate pyruvate transaminase increase in women. Increase in SGOT and SGPT activities is the indication of biomass smoke induced damage to the hepatocytes membrane causing leakage of enzymes from site of injury to the serum in women.
IMMUNOLOGICAL STUDY

Present study, revealed significant increase of serum IgM, IgG and IgA antibodies in the women exposed to biomass fuel. Biomass fuel exposure elevates humoral immune response leading to the production of IgM, IgG and IgA antibodies, in the biofuel using women (Willian and Stuart, 1996., Charpin et al. 1990, and Baelden et al. 1990). In another study of humoral and cell mediated immune response in the women with tuberculosis meningitis. The disease inducing humoral immune response, showed higher level of IgM, IgG and IgA antibodies as compared to healthy controls (Kamat et al. 1999, Murthy et al., 1991) also observed higher level of serum IgM and IgA antibodies in the patients of tubercular meningitis. Shanumuga sundaram et al. (1988) studied the serum immunoglobulin profile in pyogenic and tubercular meningitis. In this study the levels of IgM and IgG antibodies were observed to be high verses normal healthy subjects. Bhatnagar et al. (1977) and Faulkner et al. (1967) reported higher level of serum IgM antibodies in the tubercular patients. Jain et al. 1984) studied the higher level of serum IgM, IgG and IgA antibodies in the pulmonary tuberculosis. The high level of mean serum IgA antibodies in these women is not surprising, owing the fact, that this is the most abundant, naturally occurring antibody, which is responsible for immune surveillance of the secretary surfaces.
The above results are also consistent with the present findings, in which a statistically significant elevation of serum IgM, IgG and IgA antibodies was observed in these women. Grange (1984) studied the humoral immune response in the patients of tuberculosis. During this study the IgM surge was noticed within the first few days.

The IgM concentration rapidly after class switching of antibodies to give place to a longer lasting IgG production. Our findings appear to support this phenomenon because with the increase in duration of illness, IgM titer decreased and showed the lower IgM level. Mean serum IgG level showed a significant rise as compared to control subjects.

The above results also consistent with the present findings in which a statistically significant elevation of serum IgM, IgG and IgA antibodies observed in this case of pulmonary tuberculosis. Contradictory to the above Ahmed et al. 2002 reported low titer of IgG antibodies in the tubercular patients and suggested the reason of false seronegativity as poor antigenic stimulation, formation of immune complex and suppressor T lymphocytes were main causes of low levels of IgG antibodies.

Low titer of IgG in this study may be due to the above mentioned reason. Present study revealed that low titer of IgG antibodies might be due to shorter duration of illness. High IgG titers in our study and as well in numerous other
study are supposed to be due to active pulmonary tuberculosis disease.

Elevated IgG antibodies are found in tuberculosis which can be clearly distinguished from controls (Jackett et al. 1998). This phenomenon supports the findings and interpretation of present study. The elevation in the mean serum IgG observed in patients with pulmonary tuberculosis suggests that an immunological response is involved, although the antigens responsible for this response are still not well defined.

Experimental work of Deniel and Baum (1968) suggested that probably this exposure is due to the purified protein derivative, nevertheless, antibodies against polysaccharides, phosphatide fraction and other protein fractions are well known (Bhave et al. 1989). Women of above subgroup did not revealed alterations in the amount of IgE antibodies as compared to healthy controls.

Present study suggests that increased synthesis of IgM, IgG and IgA antibodies is responsible for the normal level of IgE antibodies in the pulmonary tuberculosis. In view of above explanations and suggestions, present study revealed that biomass fuel smoke exposure is very injurious to health of human kind and cause severe chronic illness due to poor ventilation and improper room for various domestic activities. This condition is directly related to socioeconomic condition of rural population. The availability of better fuel for cooking is far from
the rural population. In this connection study strongly recommends, LPG users of all age groups were found safer than the biomass fuel users.