population in eastern India. J Clin Microbiol. 2013;51:1439-44.
6. Chourasia MK, Raghavendra K, Bhatt RM, Swain DK, Meshram HM, Meshram JK, *et al*. Additional burden of asymptomatic and sub-patent malaria infections during low transmission season in forested tribal villages in Chhattisgarh, India. Malar J. 2017;16:320.
7. Alves FP, Durlacher RR, Menezes MJ, Krieger H, Silva LH, Camargo EP. High prevalence of asymptomatic Plasmodium vivax and Plasmodium falciparum infections in native Amazonian populations. Am J Trop Med Hyg. 2002;66:641-8.
8. Chaturvedi N, Krishna S, Bharti PK, Gaur D, Chauhan VS, Singh N. Prevalence of afebrile parasitaemia due to Plasmodium falciparum and P. vivax in district Balaghat (Madhya Pradesh): Implication for malaria control. Indian J Med Res. 2017;146:260-6.
9. Chourasia MK, Raghavendra K, Bhatt RM, Swain DK, Valecha N, Kleinschmidt I. Burden of asymptomatic malaria among a tribal population in a forested village of central India: A hidden challenge for malaria control in India. Public Health. 2017;147:92-7.
10. Aju-Ameh C. Prevalence of asymptomatic malaria in selected communities in Benue state, North Central Nigeria: A silent threat to the national elimination goal 2017. Edorium J Epidemiol. 2017;3:1-7.

Exposure to Household Air Pollution During Pregnancy and Birthweight

This case-control, hospital-based study aimed to study the role of household air pollution in adverse birth outcomes like low birth weight. 200 newborn babies weighing <2500 g were included in the study along with 200 matched controls. After adjusting for confounders, it was found that exposure to second hand smoke (adjusted OR 1.72, 95% CI 0.85, 3.50, *P*=0.13) or indoor air pollution due to cooking fuel (adjusted OR 1.63, 95% CI 0.71, 3.72, P=0.25) were not significantly associated with birth weight.

Keywords: *Epidemiology, Low birth weight, Smoking.*

Household air pollution is an important risk factor for morbidity and mortality, and has been estimated to contribute to 4.5 million deaths globally in 2012, almost all in low- and middle-income countries [1]. The studies have shown its association with multitude of adverse health and birth outcomes among women [2-4].

The current case-control study attempted to evaluate the role of household air pollution in adverse birth outcomes like low birth weight (LBW). It was conducted from January to December 2014 in one rural and one urban hospital of Delhi. Two hundred cases, constituted by all newborn babies weighing less than 2500 g were included in the study along with 200 matched controls. A control was a newborn baby weighing 2500 g or more, born on the same day as the case in the same hospital but unrelated to the same. Ethical clearance was obtained from Institutional ethics committee before the start of the study.

A semi-structured questionnaire was designed using various determinants and factors known to be associated with low birth weight. It was pretested on 10 mothers of newborn babies born in the hospital over a period of 5 days. The questionnaire was devised in both English and Hindi versions, and the Hindi version was translated back into English for validation. In order to be consistent with the epidemiological literature, binary classifications of household use of solid fuels (biomass and coal) were used as a practical surrogate for actual exposure to indoor air pollution. Thus, mothers giving a history of consistent usage of solid fuel were categorized into the group exposed to household air pollution. The outcome (birth weight of baby) was measured by the investigator using a digital non-hanging type Salter scale and rounded to the nearest 10 grams. Birth weight was assessed within 24 hours of birth.

The data collected was entered in MS-Excel sheet and was analyzed and statistically evaluated using SPSS version 16. Odds ratio and 95% confidence interval were used to quantify the risk factors. P<0.05 was considered significant. Univariate analysis was followed by multivariable logistic regression to calculate adjusted odds ratios. Variables with a *P* value of 0.2 or less were used for adjustment in calculation of adjusted odds ratio.

The frequency of females was more (*P*=0.003) in cases compared to controls and the difference was statistically significant. Household air pollution as a result of cooking using biomass fuel (cow dung cakes, wood, coal) and kerosene during pregnancy was identified in 86 (43.0%) cases which was more than the controls (41, 20.5%). The use of LPG as fuel for cooking was more (P<0.001) among controls than cases.

Exposure to second hand tobacco smoke (SHTS) or passive smoking was associated with higher odds (OR 3.78; 95% CI=2.39, 5.98; P<0.001) for risk of LBW compared to mothers with no such exposure during pregnancy. Household air pollution resulting from use of

cooking fuel in the form of biomass fuel (cow dung cakes, coal, wood) and kerosene had higher odds (OR 2.93; 95% CI 1.88, 4.55; *P*<0.001) of LBW when compared to mothers who used LPG fuel for cooking during pregnancy.

On multivariable analysis (***Table* I**), the determinants of low birth weight identified in this study were preterm birth (*P*<0.001), anemia (*P*=0.03), mother's height less than 145 cm (*P*<0.001), mother's weight less than 45 kg (*P*<0.001), tobacco chewing during pregnancy (*P*=0.04) and inadequate antenatal care (*P*=0.001). Exposure to second hand smoke (adjusted OR 1.72, 95% CI 0.85, 3.50, *P*=0.13) or indoor air pollution due to cooking fuel (adjusted OR 1.63, 95% CI 0.71, 3.72, *P*= 0.25) was not significantly associated with birth weight after adjusting for confounders.

Though majority of studies in literature have demonstrated an association between exposure to household air pollution and low birth weight, a few studies have shown congruity with the findings of our study [5-7]. The reason of scarcity of studies that did not find an association between household air pollution and LBW could be related to publication bias [8].

Major limitations of the study were the retrospective (case-control) study design and small sample size. A prospective study design would have been more suited for this study with objective measurement of pollution levels. We also acknowledge that the study overlooks the large variability of exposure within households using solid fuels. Also, though use of solid fuel has been considered as being exposed to household air pollution, pollution emissions from the use of solid fuel may not always indicate high exposures.

The interplay of determinants of birth weight is complicated, and more studies are needed to find the robustness of relationship between household air pollution and birth weight.

TABLE I MULTIVARIABLE ANALYSIS FOR DETERMINANTS OF LOW BIRTH WEIGHT IN THE STUDY POPULATION

Characteristic	*Adjusted Odds Ratio(95% CI)*	*P Value*
Prematurity	21.31 (6.41, 70.86)	<0.001
Anemic mother (Hb <11g/dL)	2.15 (1.05, 4.40)	0.03
Mother's height <145 cm	15.51 (4.94, 48.75)	<0.001
Mother's weight <45 kg	8.60 (3.73, 19.81)	<0.001
Inadequate antenatal care	15.15 (2.90, 76.90)	0.001
<4 antenatal visits	8.72 (1.76, 43.29)	0.008
No IFA supplementation during pregnancy	2.83 (1.19, 6.76)	0.02

IFA: *Iron and folic acid.*

Contributors: NPJ, AR, DKT: conceptualized the study and its design; NPJ,AR: contributed to data collection and analysis. All the authors provided critical inputs into manuscript writing, and approved its final version.
*Funding***:** None; *Competing interest*: None stated.

NAVEEN PRABHU JAYARAJ, AKANKSHA RATHI* AND DAVENDRA KUMAR TANEJA
Department of Community Medicine,
Maulana Azad Medical College,
New Delhi, India.
**akanksharathi.dr@gmail.com*

REFERENCES

1. World Health Organization (WHO) (2014) Burden of disease from Household Air Pollution for 2012. Geneva: WHO. Available from: *http://www.who.int/phe/health_topics/outdoorair/databases/FINAL_HAP_AAP_BoD_24March2014.pdf*. Accessed April 20, 2018.
2. Hettfleisch K, Bernardes LS, Carvalho MA, Pastro LD, Vieira SE, Saldiva SR, *et al*. Short-term exposure to urban air pollution and influences on placental vascularization indexes. Environ Health Perspect. 2017;125:753-9.
3. Lee P-C, Roberts JM, Catov JM, Talbott EO, Ritz B. First trimester exposure to ambient air pollution, pregnancy complications and adverse birth outcomes in Allegheny County, PA. Matern Child Health J. 2013;17:545-55.
4. Wylie BJ, Coull BA, Hamer DH, Singh MP, Jack D, Yeboah-Antwi K, *et al*. Impact of biomass fuels on pregnancy outcomes in central East India. Environ Health. 2014;13:1.
5. Devkota N, Kodkany BS , Angolkar M, Pokhrel S. Indoor air pollution and low birth weight- A cross-sectional study. IOSR Journal of Nursing and Health Science (IOSR-JNHS). 2014;3:16-22.
6. Thompson L, Bruce N, Diaz A, Arana B, Klein R, Jenny A, *et al*. Low birth weight in rural Guatemala: Indoor air pollution as a contributing factor. Epidemiology. 2005;16:S100-1.
7. Oskouie F, Bagherzadeh A, Feizi Z, Mohmoodi M, Peyrovi H. The effect of air pollution on low birth weight: A cohort study. Internet J Epidemiol. 2005;3:1.
8. Mimouni M, Krauthammer M, Gershoni A, Mimouni F, Nesher R. Positive results bias and impact factor in Ophthalmology. Curr Eye Res. 2015;40:858-61.