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Maternal and Neonatal Factors Associated With Neonatal Morbidity: A Prospective Follow-Up Study in Selected Hospital of Nepal

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ABSTRACT

Introduction: Neonatal morbidity and mortality, a sensitive indicator which indicates the availability, utilization, and effectiveness of maternal and child health services in the community, are major global public health challenges. The objective of the study was to find out the maternal and neonatal factors associated with neonatal morbidity in selected hospital of Nepal.
Methods: This was a hospital based prospective follow up study conducted among babies nested for case control study design. Among 1104 babies, 368 babies with low birth weight and 736 babies with normal birth weight were followed up after 28 days of birth and morbidity was assessed.
Result: Neonatal morbidity was about 131/1000 neonates. Neonates who were living in *kachcha* house [AOR: 2.03, 95% CI: (1.17-3.53), p=0.012], had low birth weight [AOR: 3.46, 95% CI: (2.19-5.48), p<0.001] and had born in wet season [AOR: 3.10, 95% CI: (1.94-4.95), p<0.001] were significantly associated with neonatal morbidity.
Conclusion: The study identified 'living in *kachcha* house, low birth weight and born in wet season' as the major contributors to neonatal morbidity. Providing financial as well as technical support for the construction of house, improving maternal health and nutrition, antenatal care and practicing proper care of newborn babies especially low birth weight babies will help to improve neonatal outcome.

Keywords: Maternal factors, Neonatal Factors, Neonatal Morbidity, Nepal.

INTRODUCTION

Neonatal morbidity and mortality are major global public health challenges with approximately 2.6 million babies worldwide dying each year in the neonatal period of life in 2016. [1] Demographic, maternal and neonatal factors like premature birth and low birth weight, asphyxia and birth trauma, complications during delivery, low household income, high birth order, gender, residence and mother's education plays an important role in neonatal morbidity. [2-6] A lot of studies on causes of neonatal morbidity and mortality are available, however, there is a limited data available on demographic, maternal and newborn factors associated with neonatal morbidity in developing countries like Nepal. The objective of the study was to find out the maternal and neonatal factors associated with neonatal morbidity in selected hospitals of Nepal.

METHOD

This was a hospital based prospective follow up study conducted in

two tertiary level hospital of Nepal (Koshi Zonal Hospital, Biratnagar from state 1 and Narayani Regional Hospital, Birgunj from state 2) during 1st April 2017 to 31st March 2018.

Mothers with term single live low birth weight babies were nested as case and mothers with term single live normal birth weight babies were nested as control for case control studies. The sample size for case control study design was determined using the proportion difference approach with the assumption of 95 % confidence level ($Z_{\alpha/2}$ = 1.96), 80 % power (Z_{β} = 0.84), control to case ratio 1:2 (r = 2), the odds ratio to be detected 0.18 and the 25 % control group will be exposed. The final sample size was 1104 (368 cases and 736 controls). Cases were selected sequentially till the required number of cases completed. Mothers not willing to participate in the study, having preterm birth and having multiple births were excluded from the study. For one case two controls were selected. While selecting control, sex of the babies and place of delivery were matched. Babies with low birth weight of case group and babies with normal birth weight of control group were followed up after 28 days to find out the pattern of morbidity.

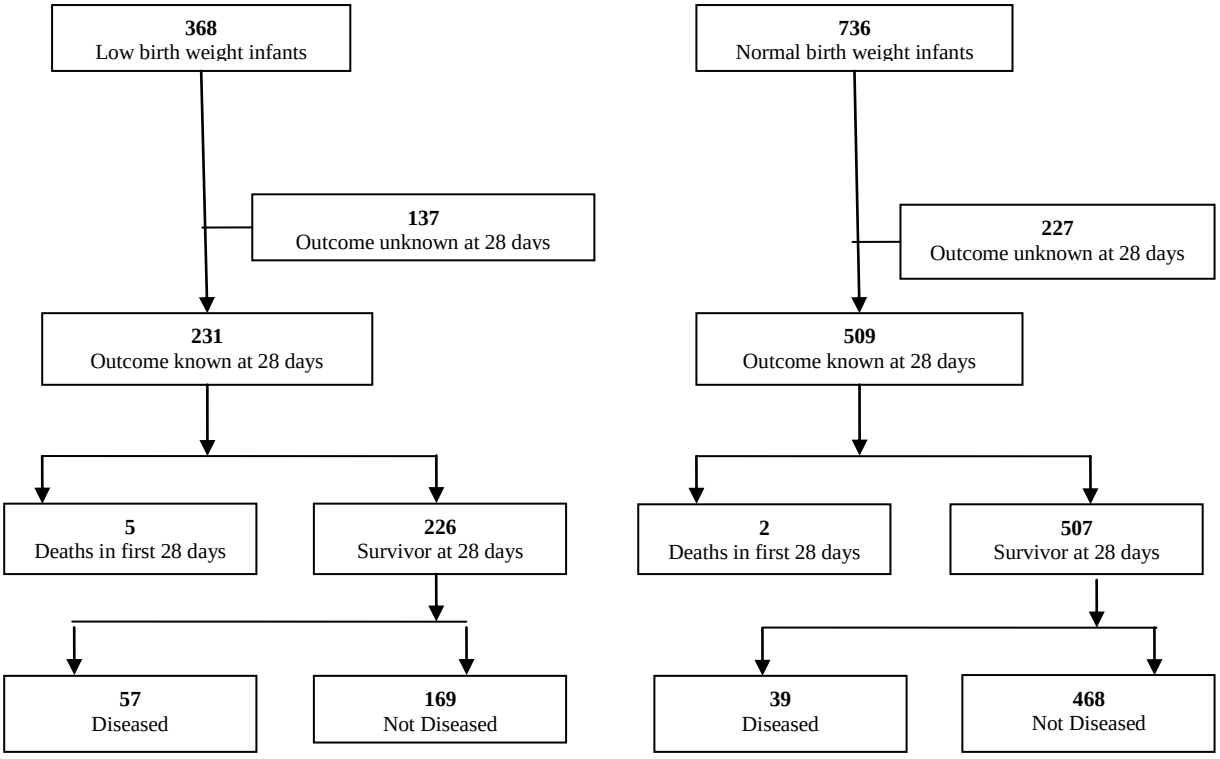

Figure 1: Progress through the study

The data were collected by researcher himself and health workers previously trained on interviewing using a pre-tested schedule. The information was collected by face-to-face interviews and by mobile phone for those unable to visit for follow up. Data regarding pattern of morbidity was collected only from mothers of survived children.

EHICAL APPROVAL

Ethical approval was obtained from Institutional Ethical Committee (SHUATS), Allahabad, India (Reg. No.: IEC/SHUATS/2017/B/53) and Nepal Health Research Council approved by '232 Ethical Review Board' (Ref. No.: 1306, Reg. No.: 541/2017. Written consent was obtained from the mothers of neonates after giving information about the nature and objective of the study before taking interview.

STATISTICAL ANALYSIS

Data was entered in Epidata version 3.1 and exported to IBM statistical package for social science (SPSS) version 16 for analysis. Bivariate analysis was done between the dependent and independent variables to determine the associations using the Pearson's chi-square test and Fisher Exact Test where expected cell was less than 5. Statistical significance was assumed at a P value of <0.05. To find out the strength of association, crude odds ratios and adjusted odds ratio was calculated using logistic regression Forward Wald model with confidence intervals at 95% level of significance.

RESULT

Among 1104 babies (736 NBW babies and 368 LBW babies), 364 babies (227 NBW babies and 137 LBW babies) lost to follow up and 740 babies (509 NBW babies and 231 LBW babies) were followed up after 28 days. Mean weight of low birth weight babies was 2161.32 grams (SD 223.74, Min 1000 gram, Max 2465 gram) and mean weight of normal birth weight babies was 2910.34 grams (SD 348.21, Min 2500 gram, Max 4250 gram). Among 740 followed up babies, 7 babies died during 28 days after birth and among 733 survived neonates, 96 neonates suffered from health problem (diseased) during 28 days after birth.

Table 1. shows the distribution of neonatal morbidity in relation to ethnic group, religion, residence place, education of mother and father, occupation of mother and father, monthly household income, family type.

Higher rate of neonatal morbidity was observed among neonates belongs to *Madhesi* ethnic group (164/1000) whereas only 98/1000 neonatal death was observed among neonates belongs to other than *Madhesi* ethnic group. 132/1000 neonatal morbidity was observed among hindu neonates whereas 120/1000 neonatal morbidity was observed among non-hindu neonates. Higher rate of neonatal morbidity was observed among neonates belongs to rural area (138/1000) whereas only 116/1000 neonatal death was observed among neonates belongs to urban area. Higher rate of neonatal morbidity was observed among neonates whose mother had no formal education (157/1000) whereas only 118/1000 neonatal morbidity was observed among neonates whose mother had formal education. Higher rate of neonatal morbidity was observed among neonates whose father had no formal education (186/1000) whereas only 126/1000 neonatal morbidity was observed among neonates whose father had formal education. Higher rate of neonatal morbidity was observed among neonates whose mother were working in house only (141/1000) whereas only 114/1000 neonatal morbidity was observed among neonates whose mother were working in house and outside. Similar rate of neonatal morbidity was observed among neonates whose father were involved in sedentary work and hard work (131/1000). Higher rate of neonatal morbidity was observed among neonates whose monthly household income was less than NRs 10,000 (304/1000) whereas only 125/1000 neonatal morbidity was observed among neonates whose monthly household income was NRs 10,000 or above. Higher rate of neonatal morbidity was observed among neonates who belong to joint family (145/1000) whereas only 81/1000 neonatal morbidity was observed among neonates who belong to nuclear family.

Table 2. shows the distribution of neonatal morbidity in relation to age of mother, parity, birth interval between last two children, history of poor pregnancy outcome, and consumption of IFA.

Table 1. Distribution of neonatal morbidity by ethnic group, religion, residence place, education of mother and father, occupation of mother and father, monthly household income, family type

Characteristics	Not Diseased (637)	Diseased (96)	Neonatal Morbidity Rate	Test of significance Chi square
Ethinic group				
Madhesi	306 (83.6%)	60 (16.4%)	164/1000	χ^2=6.980, df=1
Other than Madhesi	331 (90.2%)	36 (9.8%)	98/1000	p=0.008
Religion				
Hindu	571 (86.8%)	87 (13.2%)	132/1000	χ^2=0.088, df= 1
Non-Hindu	66 (88.0%)	9 (12.0%)	120/1000	p=0.766
Residence place				
Rural	431 (86.2%)	69 (13.8%)	138/1000	χ^2=0.683, df= 1
Urban	206 (88.4%)	27 (11.6%)	116/1000	p=0.408
Education of mother				
No Formal Education	198 (84.3%)	37 (15.7%)	157/1000	χ^2=2.131, df= 1
Formal Education	439 (88.2%)	59 (11.8%)	118/1000	p=0.144
Education of father				
No Formal Education	48 (81.4%)	11 (18.6%)	186/1000	χ^2=1.735, df= 1
Formal Education	589 (87.4%)	85 (12.6%)	126/1000	p=0.188
Type of work of mother				
House only	396 (85.9%)	65 (14.1%)	141/1000	χ^2=1.098, df= 1
House and outside	241 (88.6%)	31 (11.4%)	114/1000	p=0.295
Occupation of father				
Sedentary work	245 (86.9%)	37 (13.1%)	131/1000	χ^2<0.001, df= 1
Hard work	392 (86.9%)	59 (13.1%)	131/1000	p=0.988
Monthly household income				
Less than NRs10000	16 (69.6%)	7 (30.4%)	304/1000	χ^2=6.271, df= 1
NRs10000 and above	621 (87.5%)	89 (12.5%)	125/1000	p=0.022#
Family type				
Nuclear	147 (91.9%)	13 (8.1%)	81/1000	χ^2=4.445., df= 1
Joint	490 (85.5%)	83 (14.5%)	145/1000	p=0.035

133/1000 neonatal morbidity was observed among neonates whose mother were of 20 years or above whereas 122/1000 neonatal morbidity was observed among neonates whose mother were of less than 20 years. Higher rate of neonatal morbidity was observed among neonates whose birth order was primi parity (132/1000) whereas only 128/1000 neonatal morbidity was observed among neonates whose birth order was multi parity. Higher rate of neonatal morbidity was observed among neonates whose birth interval was more than 2 years (140/1000) whereas only 105/1000 neonatal morbidity was observed among neonates whose birth interval was between 1-2 years. Higher rate of neonatal morbidity was observed among neonates whose mother had history of poor pregnancy outcome (133/1000) whereas 131/1000 neonatal morbidity was observed among neonates whose mother had no history of poor pregnancy outcome. Higher rate of neonatal morbidity was observed among neonates whose mother had consumed IFA for 90 days or less (221/1000) whereas only 99/1000 neonatal morbidity was observed among neonates whose mother had consumed IFA for more than 90 days.

Table 2. Distribution of Neonatal Morbidity by age of mother, parity, birth interval between last two children, history of poor pregnancy outcome, consumption of IFA

Characteristics	Not Diseased (637)	Diseased (96)	Neonatal Morbidity Rate	Test of significance Chi square
Age of mother				
Less than 20 years	108 (87.8%)	15 (12.2%)	122/1000	χ^2=0.106, df= 1
20 years and above	529 (86.7%)	81 (13.3%)	133/1000	p=0.745
Parity				
Primi parity	406 (86.8%)	62 (13.2%)	132/1000	χ^2=0.026, df= 1
Multi parity	231 (87.2%)	34 (12.8%)	128/1000	p=0.872
Birth interval between last two children	N= (271)			
1-2 Years	77 (89.5%)	9 (10.5%)	105/1000	χ^2=0.637, df= 1
More than 2 years	154 (86.0%)	25 (14.0%)	140/1000	p=0.425
History of poor pregnancy outcome				
Yes	26 (86.7%)	4 (13.3%)	133/1000	χ^2=0.002, df= 1
No	611 (86.9%)	92 (13.1%)	131/1000	p=1.000#
IFA consumed during pregnancy				
90 days or below	148 (77.9%)	42 (22.1%)	221/1000	χ^2=18.287, df= 1
More than 90 days	489 (90.1%)	54 (9.9%)	99/1000	p<0.001

Table 3. shows the distribution of neonatal morbidity in relation to fuel used for cooking, type of house, status of ventilation.
163/1000 neonatal morbidity was observed among neonates whose household were using only low polluting fuel whereas 124/1000 neonatal morbidity was observed among neonates whose household were using both highly polluting fuel and low polluting fuel. Higher rate of neonatal morbidity was observed among neonates who had kachcha house (265/1000) whereas only 109/1000 neonatal morbidity was observed among neonates who had pucca/semi pucca house. 230/1000 neonatal morbidity was observed among neonates whose were living in poor ventilated house whereas 122/1000 neonatal morbidity was observed among neonates who were living in well ventilated house.

Table 3. Distribution of Neonatal Morbidity by fuel used for cooking, type of house, status of ventilation

Characteristics	Not Diseased (637)	Diseased (96)	Neonatal Morbidity Rate	Test of significance Chi square
Fuel used for cooking				
Low polluting fuel only	108 (83.7%)	21 (16.3%)	163/1000	χ^2=1.393, df= 1
Highly polluting fuel or both	529 (87.6%)	75 (12.4%)	124/1000	P=0.238
Type of house				
Kachcha	75 (73.5%)	27 (26.5%)	265/1000	χ^2=18.620, df= 1
Pucca/Semi pucca	562 (89.1%)	69 (10.9%)	109/1000	p<0.001
Status of ventilation				
Well ventilated	590 (87.8%)	82 (12.2%)	122/1000	χ^2=5.677, df= 1
Poor ventilated	47 (77.0%)	14 (23.0%)	230/1000	p=0.017

Table 4. shows the distribution of neonatal morbidity in relation to birth weight, season, gender, APGAR score at 5 minute of birth.
Higher rate of neonatal morbidity was observed among neonates whose birth weight was <2.5 kg (252/1000) whereas only 77/1000 neonatal morbidity was observed among neonates whose birth weight was ≥2.5 kg. Higher rate of neonatal morbidity was observed among neonates who were born in wet season (270/1000) whereas only 84/1000 neonatal morbidity was observed among neonates who were born in dry season. Higher rate of neonatal morbidity was observed among male neonates (151/1000) whereas only 109/1000 neonatal morbidity was observed among female neonates. Higher rate of neonatal morbidity was observed among neonates whose APGAR score at 5 minute of birth was depressed (297/1000) whereas only 122/1000 neonatal morbidity was observed among neonates whose APGAR score at 5 minute of birth was normal.

The difference in distribution of diseased and not diseased in relation to ethnic group, monthly household income, family type, IFA consumed by mother during pregnancy, type of house, status of ventilation, birth weight, season in which baby born and APGAR score at 5 minute of birth was found to be statistically significant (p<0.05).

Table 4. Distribution of Neonatal Morbidity by birth weight, season, gender, APGAR score at 5 minute of birth

Characteristics	Not Diseased (637)	Diseased (96)	Neonatal Morbidity Rate	Test of significance Chi square
Birth weight				
NBW	468 (92.3%)	39 (7.7%)	77/1000	χ^2=42.201, df= 1
LBW	169 (74.8%)	57 (25.2%)	252/1000	P<0.001
Season				
Wet Season	135 (73.0%)	50 (27.0%)	270/1000	χ^2=42.190, df= 1
Dry Season	502 (91.6%)	46 (8.4%)	84/1000	p<0.001
Sex of newborn baby				
Male	327 (84.9%)	58 (15.1%)	151/1000	χ^2=2.760, df= 1
Female	310 (89.1%)	38 (10.9%)	109/1000	p=0.097
Apgar score at 5 minute of birth				
Depressed condition <7	26 (70.3%)	11 (29.7%)	297/1000	χ^2=9.472, df= 1
Normal condition ≥7	611 (87.8%)	85 (12.2%)	122/1000	p=0.005

The difference in distribution of diseased and not diseased in relation to ethnic group, monthly household income, family type, IFA consumed by mother during pregnancy, type of house, status of ventilation, birth weight, season in which baby born and APGAR score at 5 minute of birth was found to be statistically significant ($p<0.05$).

Table 5. Factors associated with neonatal of morbidity

Factors	DISEASED AND NOT DISEASED AMONG NEONATES					
	UOR	95% CI	p-value	AOR	95% CI	p-value
Ethinic group				-	-	-
Madhesi	1.80	1.15-2.80	0.009	-	-	-
Other than Madhesi	Ref					
Monthly household income						
Less than NRs10000	3.05	1.22-7.62	0.017	-	-	-
NRs10000 and above	Ref			-	-	-
Family type						
Nuclear	Ref			-	-	-
Joint	1.91	1.03-3.53	0.038	-	-	-
IFA consumed during pregnancy						
90 days or below	2.57	1.65-4.00	<0.001	-	-	-
More than 90 days	Ref			-	-	-
Type of house						
Kachcha	2.93	1.76-4.86	<0.001	2.03	1.17-3.53	0.012
Semi pucca/Pucca	Ref			Ref		
Status of ventilation						
Well ventilated	Ref			-	-	-
Poor ventilated	2.14	1.13-4.06	0.020	-	-	-
Birth weight						
NBW	Ref			Ref		
LBW	4.04	2.59-6.30	<0.001	3.46	2.19-5.48	<0.001
Season						
Wet Season	4.04	2.59-6.29	<0.001	3.10	1.94-4.95	<0.001
Dry Season	Ref			Ref		
Sex of newborn baby						
Male	1.44	0.93-2.24	0.098	-	-	-
Female	Ref			-	-	-
Apgar score at 5 minute of birth						
Depressed condition	3.04	1.45-6.37	0.003	-	-	-
Normal condition	Ref			-	-	-

Table 5. shows the factors associated with neonatal morbidity. Bivariate logistic regression analysis found that odds of neonatal morbidity was 1.80 times higher [95% CI (1.15-2.80), p=0.009] among neonates who belongs to *Madhesi* ethnic group compared to neonates whose who belongs to other than *Madhesi* ethnic group. Odds of neonatal morbidity was 3.05 times higher [95% CI (1.22-7.62), p=0.017] among neonates whose monthly household income was <NRs 10,000 compared to neonates whose monthly household income was ≥ NRs 10,000. Odds of neonatal morbidity was 1.91 times higher [95% CI (1.03-3.53), p=0.038] among neonates who belongs to joint family compared to neonates who belongs to nuclear family. Odds of neonatal morbidity was 2.57 times higher [95% CI (1.65-4.00), p<0.001] among neonates whose mother had consumed IFA during pregnancy for 90 days or less compared to neonates whose mother had consumed IFA during pregnancy for more than 90 days. Odds of neonatal morbidity was 2.93 times higher [95% CI (1.76-4.86), p<0.001] among neonates who were living in kachcha house compared to neonates who were living in pucca/semi-pucca house. Odds of neonatal morbidity was 2.14 times higher [95% CI (1.13-4.06), p=0.020] among neonates who were living in poor ventilated house compared to neonates who were living in well ventilated house. Odds of neonatal morbidity was 4.04 times higher [95% CI (2.59-6.30), p<0.001] among neonates whose birth weight was <2.5 kg compared to neonates whose birth weight was ≥2.5 kg. Odds of neonatal morbidity was 4.04 times

higher [95% CI (2.59-6.30), p<0.001] among neonates whose birth weight was <2.5 kg compared to neonates whose birth weight was ≥2.5 kg. Odds of neonatal morbidity was 4.04 times higher [95% CI (2.59-6.30), p<0.001] among neonates who was born in wet season compared to neonates who was born in dry season. Odds of neonatal morbidity was 1.44 times higher among male neonates compared to female neonates but the association was statistically insignificant (p=0.098). Odds of neonatal morbidity was 3.04 times higher [95% CI (1.45-6.37), p=0.003] among neonates whose APGAR score at 5 minutes was depressed compared to neonates whose APGAR score at 5 minutes was normal.

Multivariable logistic regression analysis found that neonates who were living in kachcha house were 2.03 times more at risk of neonatal morbidity [95% CI: (1.17-3.53), p=0.012] compared to neonates who were living in pucca/semi-pucca house. Neonates whose birth weight was <2.5 kg were 3.46 times more at risk of neonatal morbidity [95% CI: (2.19-5.48), p<0.001] compared to neonates whose birth weight was ≥2.5 kg. Neonates who born in wet season were 3.10 times more at risk of neonatal morbidity [95% CI: (1.94-4.95), p<0.001] compared to neonates who born in dry season.

DISCUSSION

It is evident from the study that 'living in kachcha house', 'having low birth weight' and 'born in wet season' are risk factors for neonatal morbidity in Nepal even after adjustment for potential confounders. This study reveals that neonates who were living in kachcha house were two fold more prone to neonatal morbidity compared to neonates who were living in pucca/semi-pucca house. This finding is supported by the study conducted in Karnataka, India which found that acute morbidities were more in children living in kachha houses (13.6%). [7] This may be because kachha houses in rural Nepal are made from mud, thatch, or other low-quality materials as well as poor ventilation where varieties of pathogens proliferate in the environment.

Low birth weight is an important predictor of neonatal morbidity in our study. Neonates having low birth weight are three and half times more at risk of neonatal morbidity compared to neonates having normal birth weight. The study findings concur with a study conducted in Uganda which found that birth weight less than 2500 g (aRR 11.0 [95 % CI 8.1–17.2]) was associated with risk of neonatal morbidity. [8] This finding is also supported by a study conducted in Missor found that birth weight is associated to neonatal morbidity. [9]

Similarly, it has also been found that neonates who born in wet season are three fold more prone to neonatal morbidity compared to neonates who born in dry season. This finding is supported by the study conducted in Bangladesh which found that four months (June-September) in Sylhet, and six months in Mirzapur (April-September) had higher odds ratios of incidence of Very Sever Disease as compared to the remainder of the year (OR: 1.72, 95% CI: 1.32 to 2.23 in Sylhet and, OR 1.62, 95% CI: 1.33 to1.96 in Mirzapur). [10] This may be because poor ventilation which is very common in rural Nepal in summer season and an increased number of individuals indoors during the monsoon season might have resulted in overcrowding and neonates might have more contact with others whereas using less clothing might decrease protection from the environment and increase the spread of transmission of pathogens. [11-14]

There are number of limitations in this study: first, it is a hospital based study which has missed information of home based delivered neonates. Second, preterm birth and multiple births are excluded from the study which has missed information from them. Third, the study was conducted in only two hospitals; the study finding might lack its generalizability.

CONCLUSION

The study aimed to identify the maternal and neonatal factors associated with neonatal morbidity in selected hospital of Nepal. Neonates living in kachcha house, having low birth weight and born in wet season are strongly associated with neonatal morbidity. Several of these risk factors could be addressed by providing financial as well as technical support for the construction of better house, replacing highly polluting fuel with low polluting fuel like LP gas or electricity, improving maternal health and nutrition, antenatal and post natal care and practicing proper care of newborn babies especially low birth weight babies will help to improve neonatal outcome.

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Conflict Of Interest

The authors have no conflicts of interest.

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