



Residential traffic exposure and pregnancy related birth outcomes- a prospective birth cohort study

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Abstract : A survey was conducted in the different areas of Patna in the year 2010, to study the possible effects of exposure to residential traffic on pregnancy related birth outcomes. 400 mothers were interviewed with standard predesigned questionnaires, which included data on residential address of mothers along with their age, weight, education, economic status and epidemiological diseases. Out of the 400 women, 10.5% had preterm delivery, 24.4% babies were born small for gestational age (low birth weight), 1.75% women had gestational diabetes and 2.75% women had the complications of pregnancy-induced hypertension. In addition, 5.2% had intrauterine growth restriction (IUGR). A significant association was found between the residential traffic exposure and pregnancy related complications.

Key words : Residential traffic exposure, Pre-term birth, Low birth weight.

Introduction :

Indicators of residential proximity to traffic, such as distance to major road and traffic intensity around a location, are increasingly used as the proxies for long term exposure to traffic pollutants. NO₂, hydrocarbons and suspended particulate matters (SPM) are possible markers of traffic related pollution (Janssen et.al,2001). According to Central Pollution Control Board (CPCB,2009), India, 71% CO, 50% hydrocarbons and 30% of SPM are released from vehicles. Due to this, Indian cities are reeling under heavy particulate pollution with 52% of cities hitting critical levels (exceeding 1.5

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times of the standard level). According to CPCB, Patna has been identified as one of the major cities, where the air quality is found to be critical as there has been a sharp increase in the concentration of SPM: ($113\mu\text{g}/\text{m}^3$ in 2006-2007 to $225\mu\text{g}/\text{m}^3$ in 2007-2008) and nitrogenous gases ($67\mu\text{g}/\text{m}^3$) (CPCB,2007) due to rapid increase in the number of vehicles (from 1.75 lakhs in 2007 to 2.93 lakhs in 2009) on the congested roads. Levels of these pollutants get elevated near roads and are correlated with the traffic intensity on these roads. Epidemiological studies have linked these pollutants to various outcomes, such as respiratory symptoms (English et.al,1999), cardiovascular diseases (Tonne et.al, 2007) and mortality rate (Beelen et.al, 2000). Some studies have also explored the effect of these indicators on birth and pregnancy related outcomes (Sram et.al, 2005). Over the last two decades, the rate of preterm births have increased from 9.4% to nearly 12% (Ritz & Wilhelm, 2008) due to hitherto unknown reasons. But association of proximity to traffic with birth weight (Zeka et.al,2008; Ponce et.al, 2005; Wilhelm et.al, 2005), Small size for gestational age at birth (SGA refers to a fetus which is smaller in size or weight than usual normal babies of same age), Intra uterine growth restriction (IUGR) refers to a condition in which a fetus is unable to achieve genetically potential size due to lack of nutrients and oxygen at any stage of pregnancy (Zeka et.al, 2008; Genereux et.al, 2008; Brauer et.al, 2008). Several potential biological mechanisms have been described through which air pollution could influence pregnancy outcomes, such as induction of inflammation (placental, pulmonary or systemic) and oxidative stress along with increased maternal

susceptibility to infections (Slama et.al,2007). The objective of this study is to explore, whether and to what extent these adverse conditions in the social and physical environments might increase the risk of preterm delivery in women and also investigate the association between residential traffic exposure and adverse pregnancy outcomes in a given locality.

Materials and Methods :

The survey was conducted in the year 2010, between August and November in different hospitals of Patna namely Danapur Railway hospital, Danapur Government hospital , Shrishti nursing home, Kankarbagh, Kurji hospital, Sidharth nursing home, Jakkanpur, Patna.

We investigated the association between residential proximity to traffic and various birth and pregnancy outcomes in 400 pregnant women and new borns in different hospitals of Patna. All of the pregnant women surveyed were resident of different localities of Patna and went to hospital for their delivery.

The study area was divided on the basis of its distance to major road around the residence of the women. In our study various localities were classified on the basis of their distance from the major highway (NH-30) as 1-4 km (Kankarbagh, Rajendra nagar, Hanuman nagar, Gandhi maidan, Bakarganj, Patna City, Sabji bagh, Bailey road), 4-7 km(Anisabad, Mahendru ,Kurji, Raja bazar), 7-10 km (Shahpur, Digha, Phulwarisarif), 10-13 km (Khagaul, Danapur, Daniyawan), all in and around Patna.

We collected information about ambient air quality of Patna and pollutants such as SO_2 , NO_2 – and SPM from Bihar Pollution Control Board.

Residential traffic exposure was measured by its proximity to major roads from the maternal address during pregnancy. Medical records from hospitals were reviewed to collect information about mothers and infants. We used standardized self-administered questionnaires which included data on reproductive factors. We estimated its relation with infant birth weight, risks of preterm birth and gestational age at birth. Statistical analysis was done with ANOVA.

Results and Discussion :

In this study, we surveyed about 500 hundred mothers and their infants out excluded 100 of them due to inadequate information.

Table-1 : Demographic characteristics mothers (N=400)

CHARACTERISTICS	MEAN ± S.D.
MATERNAL CHARACTERISTICS	
Maternal age intake(Yr)	27 ± 3.41
Maternal pregnancy weight(Kg)	65 ± 8.01
Parity	
Uniparous (%)	45
Multiparous(%)	55
Maternal education	
Upto high school(%)	56.65
Upto college graduate(%)	33.68
No education(%)	9.66
CHILD CHARACTERISTICS	
Sex of children surveyed	
Male(%)	61.5
Female(%)	38.5
Birth and pregnancy outcomes	
(i) New- borns :	
Birth weight (kg)	2.85 ± 1.7
Preterm Birth(%)	10.50 ± 3.7
(ii) Problems in mothers :	
Gestational Age (Weeks)	37.5 ± 3.181
Gestational Diabetes(%)	1.75
Oedema(%)	2.0
Pregnancy induced Hypertension(%)	2.75
Intrauterine growth restriction(%)	5.2
(iii) Foetal abnormalities	
Structural abnormalities(%)	0.75
Respiratory and heart Problems(%)	1.00

The median age of women was 27 years (S.D. =3.41). The average maternal weight during pregnancy was 65 Kg (S.D.= 8.06). Approximately, 56.65% had completed high school education and 33.68% graduated. Nearly 45% of mothers had uniparity and 55% had multiparity of all children, 10.5% were born preterm and 24.4% were born small for gestational age (SGA, S.D. = 3.181). Among the pregnant women, 1.75% were diagnosed with gestational diabetes, 2% oedema, 2.75% were suffering from pregnancy induced hypertension and 5% had Intrauterine growth restriction. (Table 1).

Table-2 : Association between residential traffic exposure and pregnancy outcomes

DISTANCE TO MAJOR ROAD (km)	BIRTH WEIGHT (kg)	SMALL FOR GESTATIONAL AGE(%)	PRETERM BIRTH(%)
1-4(n=122)	2.58	27.04(n=33)	17.21(n=21)
4-7 (n=102)	2.32	19.6 (n=20)	7.84(n=8)
7-10 (n=86)	2.41	27.90(n=24)	9.30(n=8)
10-13 (n=90)	2.70	23.33(n=21)	5.55(n=5)

Out of the 122 mothers about 17.21% (n= 21) had preterm delivery. These were living in the areas which were about (1-4)km of distance from the major roads. The cases of SGA were mostly in the areas which were close to traffic (27.04%, n=33) (Table 2). At p-value=0.5, Distance significantly affected Preterm birth. (p= 0.1455). Birth weight has no effect on Preterm birth (p-value=0.9319). Gestational age (p-value=0.4501) significantly affected Preterm birth. Thus we found a significant association between preterm birth and SGA in the areas which were close to traffic.

Table–3 : Association between residential traffic exposure and pregnancy complications

DISTANCE TO MAJOR ROAD (km)	PREGNANCY INDUCED HYPERTENSION (%)	GESTATIONAL DIABETES (%)	INTRA UTERINE GROWTH RESTRICTION (%)
1-4 (n=122)	5.73(n'=7)	3.27(n'=4)	6.55(n'=8)
4-7 (n=102)	7.84(n'=7)	1.96(n'=2)	0.98(n'=1)
7-10 (n=86)	4.65(n'=4)	1.16(n'=1)	2.32(n'=2)
10-13(n=90)	2.22(n'=2)	0	0

We observed that 3.27% mothers had gestational diabetes. Intrauterine growth restriction was common in high traffic area (about 6.55%). However, there was about 5.73% cases of pregnancy induced hypertension in the areas within the range of (1-4) km (Table 3). Pregnancy induced hypertension had no effect on preterm birth. (P-value=0.6682). Gestational Diabetes (P-value=0.1046) and Intra uterine growth restriction significantly affected preterm birth. (P-value =0.0027). In our study we found highest percentage of preterm birth and SGA in the areas which were about 1-4 km away from major highway but we did not find any significant association between traffic exposures and pregnancy related outcomes. Balmes et.al (2009), reported that exposure to the traffic generated pollutant may be more relevant to human health than exposure to any single ambient air pollution. Brauer et.al, (2008) observed an increased risk of SGA at birth in mothers living within 50m from expressway or highway (with a mean of >21,000 vehicles per day). Zeka et.al, 2008, observed a positive correlation to a primary highway and birth weight but not with the risk of preterm and SGA birth. It was reported that proximity

to highway (with a minimum speed of 70km/hr.) was associated with preterm birth, but not with SGA at birth (Genereux et.al, 2008). Our study has revealed that most of the pregnancy complications such as pregnancy induced hypertension, intrauterine growth restrictions and gestational diabetes were prevalent within area which were in the range (1-4)km from the major highway (Mean=14.6, S.D = 10.89). We observed that nearly 55% (n=220) of women had children before the collection of data. Moreover, our study observed an association between the risk of preterm birth in mothers living in lower socioeconomic status areas. (n=128). Our study has some potential limitations. The sample size of our study population was small and based on birth records. Further more, distance to major road are derived from digital maps that cover the most important roads but do not include the smaller local roads. Finally, we were also unable to collect information about area wise traffic density and number of vehicles passing on roads. Overall traffic pollutants were taken into consideration rather than of specific areas.

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