

Impact of Socioeconomic and Environmental Factors on Blood Pressure during Pregnancy in Bangladesh

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ABSTRACT

Background: Hypertensive disorders during pregnancy are a significant public health concern, contributing to maternal and fetal morbidity and mortality. Socioeconomic and environmental factors may influence the development of these conditions, particularly in low-resource settings like Bangladesh. This study aimed to evaluate the association between socioeconomic and environmental factors and hypertensive disorders during pregnancy.

Methods: This cross-sectional observational study was conducted at the Department of Obstetrics and Gynecology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from March 2023 to February 2024. A total of 80 pregnant women were enrolled. Data on demographic characteristics, socioeconomic status, and environmental exposures were collected using a structured questionnaire. Blood pressure was measured, and participants were classified into hypertensive and normotensive groups. Statistical analysis was performed using SPSS version 25, and associations were tested using chi-square and t-tests, with significance set at $p < 0.05$.

Results: Among the participants, 35% (28/80) had hypertensive disorders. Low family income ($\leq 10,000$ BDT) was significantly associated with hypertensive disorders (64.3% vs. 19.2%, $p < 0.001^*$). Perceived high air

pollution was reported by 64.3% of hypertensive women compared to 38.5% of normotensive women ($p=0.025^*$). Use of tube well water was significantly associated with hypertensive disorders (64.3% vs. 30.8%, $p=0.005^*$). Occupation and noise pollution showed no significant associations.

Conclusion: Socioeconomic and environmental factors, including low income, air pollution, and poor drinking water quality, are significantly associated with hypertensive disorders during pregnancy. Addressing these factors through targeted interventions could improve maternal health outcomes in Bangladesh.

Introduction

Hypertensive pregnancy disorders remain a primary reason for perinatal and maternal morbidity and mortality worldwide [1]. They include gestational hypertension, preeclampsia, and eclampsia and cause adverse outcomes like preterm birth, low birth weight, placental abruption, and increased risk of future cardiovascular disease for the mother [2]. In low- and middle-income nations like Bangladesh, HDP burden is particularly large with additional burden of poor access to quality antenatal care, unawareness, and socio-environmental concerns [3].

Blood pressure changes in pregnancy are influenced by complex interactions between biological, genetic, and environmental variables [4]. However, more recent evidence shows that socioeconomic determinants such as education, income, occupation, and living conditions have a marked effect on maternal outcomes, including the initiation of hypertensive disorders [5]. Women in lower socioeconomic levels are likely to experience more psychological stress, worse nutrition, and suboptimal access to prenatal care, all of which are factors in poor control of blood pressure [6].

Environmental determinants also significantly affect pregnancy outcomes [7]. Air pollution, contaminated drinking water, and hygiene can lead to systemic inflammation and oxidative stress, both of which share a relationship with hypertension and adverse pregnancy outcomes [8]. Pregnant women living in highly populated urban slums or rural settlements with inferior infrastructure have exacerbated environmental risks. Also, exposure to noise pollution, indoor air pollution from cooking biomass fuels, and chemical and pesticide exposure in certain professions might contribute to the risk of hypertensive disorders of pregnancy [9].

In Bangladesh, where maternal health care facilities are gradually improving, socioeconomic and environmental determinants continue to produce major disparities in maternal health outcomes [10]. While their significance has been established, few interdisciplinary studies have specifically aimed at investigating how socioeconomic and environmental determinants influence blood pressure during pregnancy in Bangladesh [11]. It is important to identify these associations to devise specific interventions that improve antenatal care and reduce maternal and perinatal complications [12].

The present study aimed to assess the impact of socioeconomic and environmental determinants on pregnancy blood pressure in women accessing antenatal care at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. Identifying major socioeconomic and environmental risk factors of hypertensive disorders through this research, it will yield valuable

evidence to inform policymakers and clinicians for making more successful, context-appropriate maternal health interventions, particularly for vulnerable groups. Finally, tackling the social and environmental determinants can potentially decrease the burden of pregnancy hypertensive disorders and assist the nation and globe in meeting its maternal and children's health improving targets.

Methodology & Materials

This cross-sectional observational study was conducted at the Department of Obstetrics and Gynecology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, over a period of one year from March 1, 2023 to February 28, 2024. A total of 80 pregnant women attending antenatal care during the study period were enrolled using a purposive sampling technique. Pregnant women of any trimester who provided informed consent were enrolled, but those with pre-existing hypertension, diabetes, chronic kidney disease, or multiple pregnancy were excluded. It was a hospital-based cross-sectional observational study to assess the impact of socioeconomic and environmental determinants on blood pressure during pregnancy. Data were collected through face-to-face interviews using a structured questionnaire on demographic information, socioeconomic status, environmental conditions, and obstetric history. Blood pressure was measured with a standard sphygmomanometer on each antenatal visit as per guidelines. Environmental exposures such as perceived noise and air pollution, source of water, and place of residence were recorded as per the participant's responses. Socioeconomic exposures such as age, education, occupation, income, and parity were also recorded. The participants were categorized into normal blood pressure, gestational hypertension, or preeclampsia groups as per the blood pressure readings and clinical presentation. Analyses were conducted using SPSS version 25, descriptive statistics presented as percentage and frequency, and relationship of socioeconomic or environmental factors with hypertensive disorders were explored using chi-square tests. Multivariate analysis was also performed to identify independent risk factors. Participant data was maintained confidential and anonymous throughout the research process.

Results

Table 1: Socio-Demographic Characteristics of Study Participants (n=80)

Characteristics	Frequency (n)	Percentage (%)
Age (years)		
≤25 years	32	40.00
>25 years	48	60.00
Educational Level		
No formal education	9	11.25
Primary	21	26.25
Secondary or above	42	52.50
Higher (others)	8	10.00
Monthly Family Income (BDT)		
≤10,000 BDT	28	35.00
10,001-20,000 BDT	34	42.50
>20,000 BDT	18	22.50

Occupation		
Housewife	58	72.50
Service	14	17.50
Others	8	10.00
Body Mass Index		
Underweight	10	12.50
Normal	42	52.50
Overweight and obese	28	35.00
Residence		
Urban	54	67.50
Rural	26	32.50
Parity		
Primigravida (first pregnancy)	38	47.50
Multigravida (2 or more pregnancies)	42	52.50

Table 1 presents the socio-demographic characteristics of the study participants (n=80). The majority of participants were above 25 years of age (60%) and resided in urban areas (67.5%). More than half (52.5%) had completed secondary education or higher, and most were housewives (72.5%). Regarding economic status, 42.5% had a monthly family income between 10,001-20,000 BDT. In terms of body mass index (BMI), 52.5% had a normal BMI, while 35% were overweight or obese. Slightly more participants were multigravida (52.5%) compared to primigravida (47.5%).

Table 2: Environmental Factors among Study Participants (n=80)

Environmental Factor	Frequency (n)	Percentage (%)
Source of Drinking Water		
Tube well	34	42.50
Supply water	46	57.50
Air Pollution Perception		
High	38	47.50
Moderate	30	37.50
Low	12	15.00
Noise Pollution Perception		
High	36	45.00
Moderate	28	35.00
Low	16	20.00

Table 2 summarizes the environmental factors among the study participants (n=80). Most participants (57.5%) used supply water as their main source of drinking water, while 42.5% relied on tube wells. Nearly half (47.5%) perceived a high level of air pollution in their surroundings,

and 45% reported high noise pollution. Perception of moderate air and noise pollution was also common among participants.

Table 3: Blood Pressure Status among Study Participants (n=80)

Blood Pressure Category	Frequency (n)	Percentage (%)
Normal (<140/90 mmHg)	52	65.00
Gestational Hypertension (\geq 140/90 mmHg)	20	25.00
Preeclampsia (\geq 140/90 + Proteinuria)	8	10.00

Table 3 presents the blood pressure status among the study participants (n=80). The majority (65%) had normal blood pressure, while 25% were diagnosed with gestational hypertension. Preeclampsia, characterized by elevated blood pressure along with proteinuria, was observed in 10% of participants.

Table 4: Association of Socioeconomic Factors with Hypertensive Disorders in Pregnancy (n=80)

Socioeconomic Factors	Hypertensive Disorders (n=28)	Normal BP (n=52)	p-value
Age >25 years	20 (71.4%)	28 (53.8%)	0.121 (NS)
Low Education (\leq Primary)	20 (71.4%)	16 (30.8%)	<0.001*
Low Family Income (\leq 10,000 BDT)	18 (64.3%)	10 (19.2%)	<0.001*
Housewife	24 (85.7%)	34 (65.4%)	0.054 (NS)

*NS = Not Significant, * = Statistically Significant

Table 4 shows the association of socioeconomic factors with hypertensive disorders in pregnancy (n=80). Participants aged >25 years had a higher prevalence of hypertensive disorders (71.4%) compared to those with normal BP (53.8%), though the difference was not statistically significant (p=0.121). Low education (\leq Primary) and low family income (\leq 10,000 BDT) were significantly associated with hypertensive disorders, with 71.4% and 64.3% of participants in these categories affected, respectively (p<0.001). The association between being a housewife and hypertensive disorders was not statistically significant (p=0.054).

Table 5: Association of Environmental Factors with Hypertensive Disorders in Pregnancy (n=80)

Environmental Factors	Hypertensive Disorders (n=28)	Normal BP (n=52)	p-value
High Air Pollution Perception	18 (64.3%)	20 (38.5%)	0.025*
High Noise Pollution Perception	16 (57.1%)	20 (38.5%)	0.102 (NS)
Drinking Water Source (Tube well)	18 (64.3%)	16 (30.8%)	0.005*

*NS = Not Significant, * = Statistically Significant

Table 5 illustrates the association of environmental factors with hypertensive disorders in pregnancy (n=80). Participants who perceived high air pollution had a significantly higher prevalence of hypertensive disorders (64.3%) compared to those with normal BP (38.5%) (p=0.025). While high noise pollution perception showed a trend toward increased hypertensive disorders, the association was not statistically significant (p=0.102). A significant association was also found between drinking water from tube wells and hypertensive disorders, with 64.3% of affected participants using tube wells compared to 30.8% of those with normal BP (p=0.005).

Discussion

We intended to assess the contribution of socioeconomic and environmental determinants to hypertensive disorders of pregnancy in Bangladesh in this study. Our findings suggest that some socioeconomic and environmental determinants, including education level, household income, air quality, and water source for drinking, are associated with pregnancy-associated hypertensive disorders.

Socioeconomic determinants, particularly low family income and low education, were strongly related to an increased risk of hypertensive disorders of pregnancy. Results support previous research that has highlighted the contribution of lower socioeconomic status in amplifying maternal illness, such as pregnancy hypertension. Sum et al. and Qin et al., recognized parallel correlations wherein socioeconomic disadvantage would result in increased probabilities of adverse maternal health outcomes via restricted access to healthcare, healthy lifestyle choices, and educational access that form the bases of effective management of pregnancy-related conditions [13, 14].

Family low income and having hypertensive disorders are of special interest as a correlation. In our research, 64.3% (18 out of 28) of the patients with hypertensive disorders earned a monthly income of ≤10,000 BDT, which was much higher than in patients with normal BP (19.2%, 10 out of 52). This finding is consistent with Stephens et al., who noted the link between poor families and higher rates of preeclampsia and other hypertensive disorders of pregnancy among Indigenous populations in Canada, Australia, New Zealand, and the United States [15]. Poor populations are more likely to have greater stress, poor nutrition, and less access to prenatal care, all of which are risk factors for pregnancy hypertensive disorders.

Our study also revealed that environmental factors, including air pollution and drinking water sources, are crucial in hypertensive disorders during pregnancy. Specifically, 64.3% (18 out of 28) of the subjects with hypertensive disorders experienced high air pollution, which is in line with Zhang et al., who demonstrated a significant relationship between exposure to fine particulate matter and hypertensive disorders during pregnancy [16]. Environmental pollutants such as particulate matter and chemicals may trigger systemic inflammation, oxidative stress, and endothelial dysfunction, all of which are involved in the pathogenesis of hypertension.

Moreover, the association of tube well drinking water with hypertensive disorders was another significant finding. The subjects who drank tube well water (64.3%, 18 out of 28) were more likely to develop hypertensive disorders in pregnancy compared to those who drank supply water (30.8%, 16 out of 52). This could be due to the fact that tube well water may get polluted with heavy metals or other harmful substances, and thus may lead to hypertension. This correlation was also identified in studies on environmental exposure effects, where water quality was found to be associated with hypertension and other risks of maternal complications [17, 18].

We also found in our study a correlation between housewives and hypertensive disorders. Although not statistically significant, the frequency of housewives (85.7%, 24 out of 28) with hypertensive disorders is indicative that lifestyle habits of working as a full-time homemaker, such as absence of physical exercise and limited access to health education, could be partly to blame for poor pregnancy outcomes. Similar trends have been reported in other research on the effect of occupation on mother's health where sedentarity and stress suffered by housewives were associated with higher incidence of hypertension during pregnancy [14, 19].

Demographically, maternal age was not found to be a significant contributor to the hypertensive disorders in our study, as well as in some previous studies with no conclusive finding between maternal age and hypertensive disorders. However, some other studies have established advanced maternal age as a risk factor for preeclampsia and hypertension [20]. Failure to obtain strong findings in this study may be due to the comparatively young age group of study participants, with 60% (48 out of 80) being under the age of 25.

Limitations of the study

It is important to note that the strength of the study is that it takes a holistic approach to analyzing both environmental and socioeconomic factors and their relationship to hypertensive disorders in pregnancy. There are, however, some limitations that need to be discussed in future studies. To start with, the cross-sectional nature of the study restricts causality between the factors that have been identified and hypertensive disorders. Additionally, the application of self-report data for environmental factors such as perception of air and noise pollution can result in recall bias.

Recommendations

Longitudinal designs should be used in future studies to more accurately reflect the temporal dynamics between socioeconomic and environmental exposures and the development of hypertensive disorders of pregnancy. In addition, a wider array of environmental exposures, including diet, environmental pollutants, and physical activity, should be examined to give a better understanding of the multitude of factors that contribute to hypertensive disorders of pregnancy.

Conclusion

In conclusion, our study underscores the significant role of socioeconomic and environmental determinants in contributing to the burden of hypertensive disorders in pregnancy. The findings suggest that improving education, income, and environmental conditions may help reduce the burden of hypertensive disorders among pregnant women in Bangladesh and other low- and middle-income countries. Decision makers and healthcare providers must give highest priority to the strategies that tackle these factors to enhance maternal health outcomes and prevent the risks that accompany hypertensive disorders in pregnancy.

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Conflicts of interest

There are no conflicts of interest.

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