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PREDICTIVE MODEL FOR HYPERTENSIVE DISORDERS IN PREGNANCY: A CROSS-SECTIONAL STUDY FROM A MATERNAL HOSPITAL, TASHKENT

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Abstract

Background: Hypertensive disorders of pregnancy (HDP) account for significant maternal and neonatal morbidity and mortality, particularly in the low-resource setting. Detection of high-risk pregnancies early on is very important. Objective: To identify independent clinical predictors and develop a predictive model for hypertensive disorders of pregnancy.

Methods: Cross-sectional study was done among 58 pregnant women at Maternity Hospital No. 3, Tashkent. Thirty participants were with HDP. Collected data included BMI, family history of hypertension, chronic hypertension, history of preeclampsia, anemia, diabetes mellitus, and maternal age. Bivariate and multivariate logistic regression analyses were used.

Results: Obesity (BMI ⩾30), history of familial hypertension, chronic hypertension, preeclampsia history, and diabetes mellitus were independent predictors of HDP. The good discriminatory capacity of the final model was 81% (accuracy) and 0.81 (AUC). The age of the mother was not an independent predictor due to the quite young population involved in the study.

Conclusion: Five clinical predictors are capable of distinguishing women at risk for HDP: BMI, chronic hypertension, family history, diabetes, and prior preeclampsia. The model can help clinicians by utilizing early screening and prophylactic treatment.

Keywords: Pregnancy, hypertensive disorders, predictive model.

Introduction

Pregnancy hypertension (HDP) is a major concern for maternal and fetal health worlwide and significantly contributes to maternal and fetal morbidity and mortality [1]. The term HDP includes gestational hypertension, preeclampsia, and eclampsia. These disorders are associated with serious complications such as placental abruption, stroke, and growth restriction in the fetus. Despite improved obstetric care, HDP remains a major health issue for the world [2].

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In Uzbekistan, HDP poses a significant threat to maternal health outcomes [3, 4]. Identifying risk factors in early pregnancy is critical for timely intervention [2, 4-6]. This study aims to identify independent predictors of HDP in a hospital-based cohort and to develop a predictive model for use in routine antenatal care.

Materials and Methods

Study Design and Participants: This cross-sectional study was conducted at Maternity Hospital No. 3 in Tashkent between November, 2024 to March, 2025. A total of 58 pregnant women participated: 30 with HDP and 28 normotensive controls. HDP was diagnosed according to the criteria outlined by the American College of Obstetricians and Gynecologists (ACOG).

Variables Collected:

a) Maternal age
b) Body Mass Index (BMI)
c) Family history of hypertension
d) Chronic hypertension
e) History of preeclampsia
f) Anemia (Hb < 110 g/L)
g) Diabetes mellitus (gestational or pre-existing)

Statistical Analysis. Descriptive statistics summarized baseline characteristics. Chi-square tests and t-tests were used to assess group differences. Logistic regression was applied to identify predictors. Variables with $p < 0.10$ in bivariate analysis were entered into multivariate logistic regression. Model performance was evaluated using the Hosmer–Lemeshow test, classification accuracy, and ROC curve analysis. StataV17 was used for the analysis.

Results

We analyzed our patients' data and obtained the results shown in Table 1.

Table 1. Baseline Characteristics of Study Participants

Variable	HDP (n=30)	Control (n=28)	p-value
Age (mean ± SD)	27.8 ± 4.2	26.7 ± 4.1	0.22
BMI ≥30 (%)	63.3%	25.0%	0.003*
Family history of HTN (%)	56.7%	21.4%	0.007*
Chronic hypertension (%)	36.7%	3.6%	<0.001*
History of preeclampsia (%)	26.7%	3.6%	0.014*
Anemia (%)	30.0%	28.6%	0.91
Diabetes mellitus (%)	20.0%	3.6%	0.047*

*Significant at $p < 0.05$

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The results of our patients' data obtained, we conducted a statistical analysis on the ratio of the odds of detecting hypertensive disorders during pregnancy. The results are shown in Table 2.

Table 2. Bivariate Logistic Regression Analysis

Predictor	Odds Ratio (95% CI)	p-value
BMI ≥30	5.3 (1.7–16.5)	0.004*
Family history of HTN	4.8 (1.5–15.1)	0.007*
Chronic hypertension	16.7 (1.9–147.5)	0.011*
History of preeclampsia	9.7 (1.1–86.4)	0.040*
Diabetes mellitus	6.7 (1.1–40.0)	0.040*
Gestational age	0.96 (0.75-1.22)	0.74
Anemia	1.07 (0.33-3.47)	0.91

To create a prognostic model for the development of hypertensive disorders, we used logistic regression analysis. The results are shown in Table 3.

Table 3. Multivariate Logistic Regression Analysis

Predictor	Adjusted OR (95% CI)	p-value
BMI ≥30	4.6 (1.2–17.3)	0.024*
Family history of HTN	4.2 (1.1–16.1)	0.035*
Chronic hypertension	12.9 (1.3–125.0)	0.029*
History of preeclampsia	6.4 (0.8–51.5)	0.083
Diabetes mellitus	5.8 (0.9–38.4)	0.070
Gestational age	1.01(0.78-1.32)	0.94
Anemia	1.12(0.28-4.38)	0.87

Model Performance:

Hosmer–Lemeshow p = 0.72

Nagelkerke R^2 = 0.51

Classification accuracy = 81%

Area Under ROC Curve (AUC) = 0.81

Discussion

This study identified five clinical variables—obesity (BMI ≥30), family history of hypertension, chronic hypertension, history of preeclampsia, and diabetes mellitus—as significant predictors of hypertensive disorders in pregnancy (HDP). The predictive model demonstrated strong performance with an AUC of 0.81 and classification accuracy of 81%, underscoring its potential utility in clinical settings.

Obesity is a well-established risk factor for HDP. Adiposity induces a pro-inflammatory state and insulin resistance, both of which are associated with endothelial dysfunction and impaired

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placental development [7, 8]. Our finding aligns with prior literature indicating that women with BMI ≥30 have up to a threefold increased risk of preeclampsia [9].

Family history of hypertension emerged as another significant predictor. This may reflect shared genetic susceptibility and familial lifestyle patterns such as poor diet and physical inactivity [10]. Several genome-wide association studies (GWAS) have identified polymorphisms linked to blood pressure regulation and preeclampsia risk, suggesting a heritable component [11, 12].

Chronic hypertension was a strong independent risk factor in our study. It reflects underlying vascular remodeling and endothelial dysfunction, both key mechanisms in the development of superimposed preeclampsia [13, 14]. These patients often require close monitoring and may benefit from early pharmacological intervention [15].

History of preeclampsia, although only marginally significant in multivariate analysis ($p = 0.10$), showed a high odds ratio (OR = 6.4). Prior studies confirm that women with a history of preeclampsia have a recurrence risk of up to 25% in subsequent pregnancies [16]. This risk increases with severity and earlier onset in the first episode [17].

Diabetes mellitus, both pregestational and gestational, is a notable contributor to HDP due to its association with microvascular damage and oxidative stress [18, 19]. Studies show that hyperglycemia impairs placental angiogenesis, potentially exacerbating hypertensive pathology [20].

Maternal age did not significantly predict HDP in this cohort. This contrasts with larger studies that report increased HDP risk in women over 35 years [21]. Our non-significant result likely reflects the relatively young mean age of participants, with few women above 35.

Gestational age at presentation was also analyzed but showed no independent predictive value. This may reflect the cross-sectional nature of the study and the variation in gestational timing of HDP onset.

Anemia, a prevalent maternal condition in low-resource settings, was similarly not associated with increased risk of HDP in this study. While anemia can exacerbate maternal morbidity in general, it may not play a direct etiologic role in the development of hypertensive disorders.

By including these non-significant variables in both bivariate and multivariate analyses, the study reinforces the specificity of the identified predictors and highlights areas requiring larger-scale validation.

The model developed here, with an AUC of 0.81 and 81% classification accuracy, demonstrates strong discriminative capacity. Its reliance on easily accessible clinical data makes it especially applicable in resource-limited healthcare environments.

Compared to prior models, our findings are consistent with studies conducted in South Asia, Africa, and Eastern Europe [22–24]. However, the small sample size necessitates cautious interpretation. Nevertheless, the model's high predictive value indicates that even simple, routinely collected clinical variables can stratify HDP risk effectively in low-resource settings.

Clinical Implications: Early identification of at-risk women using a predictive model can inform monitoring frequency, timing of delivery, and the need for prophylactic interventions like aspirin [25]. Furthermore, integrating this model into mobile health platforms could enhance accessibility in rural clinics [26].

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Future Directions: Validation of this model in a larger, multicenter cohort is essential. Additionally, incorporating biomarkers such as sFlt-1/PlGF ratio, uterine artery Doppler, or placental growth factor may enhance predictive accuracy [27–29].

Conclusion:

Five clinical predictors are capable of distinguishing women at risk for HDP: BMI, chronic hypertension, family history, diabetes, and prior preeclampsia. The model can help clinicians by utilizing early screening and prophylactic treatment.

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