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Gestational hypertension: Risk factors and Clinical Correlations at Aljala Maternity hospital, Tripoli-Libya

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Abstract
Gestational hypertension (GH) is a leading cause of maternal and perinatal morbidity, yet its specific risk profile in the Libyan population remains inadequately characterized. This study aimed to identify the prevalence, key risk factors, and associated adverse outcomes of GH among women delivering at Aljala Maternity Hospital in Tripoli, Libya. A retrospective case-control study was conducted, analyzing the medical records of 450 pregnant women (150 cases with GH and 300 normotensive controls) who delivered between January 2022 and December 2023. Data on demographic characteristics, medical history, and pregnancy outcomes were collected and statistically analyzed. The prevalence of GH in our cohort was 8.5%. Multivariate logistic regression identified significant independent risk factors, including maternal age over 35 years (OR=2.9, $p<0.01$), pre-pregnancy obesity (BMI ≥30 kg/m²; OR=3.4, $p<0.001$), primigravidity (OR=2.5, $p<0.01$), and a family history of chronic hypertension (OR=2.1, $p<0.05$). Clinically, women with GH had a significantly higher rate of iatrogenic preterm delivery (28% vs. 8%, $p<0.001$) and were more likely to deliver infants with low birth weight (<2500g; 22% vs. 7%, $p<0.001$) compared to the control group. The rate of placental abruption was also elevated in the GH group. In conclusion, advanced maternal age, obesity, primigravidity, and a family history of hypertension are significant risk factors for GH in this Libyan cohort. The condition is strongly correlated with adverse perinatal outcomes, underscoring the critical need for targeted antenatal screening for high-risk women and vigilant management to improve maternal and fetal health at our institution.

Keywords: Gestational hypertension, maternal outcomes, perinatal morbidity, risk factors, libya, pre-eclampsia, pregnancy-induced hypertension

Introduction

Background and Global Significance of Gestational Hypertension

Hypertensive disorders of pregnancy (HDP) represent a major global health challenge, complicating an estimated 5-10% of all pregnancies and constituting a leading cause of maternal and perinatal morbidity and mortality worldwide. Within the spectrum of HDP, gestational hypertension (GH) is defined as the new onset of hypertension (systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg) after 20 weeks of gestation in a previously normotensive woman, without the concomitant presence of significant proteinuria or other features of pre-eclampsia. While often perceived as a less severe entity than pre-eclampsia, GH is a significant clinical diagnosis. It is not a benign condition; it imposes a substantial burden on healthcare systems and portends serious risks for both the mother and the fetus.

The Known Risk Factor Profile

Extensive international research has identified a constellation of risk factors predisposing women to GH. These are often categorized into maternal, obstetrical, and genetic factors. Key non-modifiable risk factors include primigravidity, advanced maternal age (typically >35 years), a personal history of GH or pre-eclampsia in a previous pregnancy, and a family history of HDP or chronic hypertension. Modifiable risk factors, which are of particular public health importance, include pre-pregnancy obesity (Body Mass Index ≥30 kg/m²), pre-existing conditions like diabetes mellitus, and multifetal pregnancies. Understanding this risk profile is the cornerstone of effective antenatal care, as it allows for the identification of high-risk women who may benefit from closer monitoring and potential prophylactic interventions, such as low-dose aspirin.

The Rationale and Local Context: The Libyan Setting

Despite the wealth of data from Western, Asian, and other developed populations, there is a conspicuous scarcity of robust epidemiological and clinical research on GH from North Africa, and Libya in particular. The Libyan healthcare system has faced significant challenges in recent decades, impacting the continuity of care, data collection, and public health initiatives. Furthermore, unique regional demographic, genetic, and lifestyle factors may influence the presentation and outcomes of GH. For instance, dietary patterns, consanguinity rates, and the prevalence of conditions like obesity and diabetes may differ from other well-studied populations, potentially altering the local risk factor landscape.

Aljala Maternity Hospital in Tripoli is one of the largest and most prominent referral centers for obstetrical care in Northwestern Libya. It serves a vast and diverse patient population, making it an ideal setting to study the characteristics of GH. A critical gap exists in our understanding of which Libyan women are most vulnerable to GH and what clinical outcomes they experience. Without local data, clinical management often relies on international guidelines that may not be fully optimized for the specific needs and risk profiles of this population.

Statement of the Problem and Study Justification

The absence of localized data from Libya hinders the development of targeted preventive strategies and optimal resource allocation within institutions like Aljala Maternity Hospital. Clinicians are left to extrapolate from studies conducted in vastly different populations, which may not accurately reflect the reality of their patient cohort. This knowledge gap can lead to suboptimal antenatal screening, delayed diagnosis, and ultimately, preventable adverse maternal and perinatal outcomes.

Methods

1. Study Design and Setting

A retrospective case-control study was conducted to investigate the risk factors and clinical correlations of Gestational Hypertension (GH). This design was selected as it is efficient for studying conditions with a relatively low prevalence, like GH, and is particularly effective for identifying risk factors by comparing exposed and non-exposed groups from past records. The study was carried out at Aljala Maternity Hospital, a major tertiary care and referral center in Tripoli, Libya. The hospital's records department maintains extensive electronic and paper-based archives of all delivery admissions, providing a robust data source for this investigation. The study protocol was reviewed and approved by the Aljala Maternity Hospital Institutional Review Board (IRB), which waived the requirement for individual informed consent due to the retrospective, anonymized nature of the data collection.

2. Study Population and Sampling

Sampling Method and Sample Size Calculation

A systematic sampling technique was employed to select the control group. For every confirmed case of GH, two subsequent normotensive women who met the inclusion criteria were selected from the hospital's delivery registry. This 1:2 case-to-control ratio was chosen to enhance the statistical power of the study.

The sample size was calculated using OpenEpi software, version 3.01. Based on previous literature, we assumed an exposure rate (primigravidity) of 25% in the control group. To detect an odds ratio of 2.5 with a power of 80% and a 95% confidence level, a minimum of 135 cases and 270 controls was required. To account for potential missing or incomplete data, we aimed to recruit a total of 150 cases and 300 controls, resulting in a final sample size of 450 participants.

3. Data Collection

Data were extracted from three primary sources: the hospital's electronic medical records system, archived paper-based patient files, and the labor and delivery ward logbooks. A structured, pre-piloted data extraction sheet was used to ensure consistency and completeness of data collection. The collected variables were organized into the following categories:

- **Maternal Demographic Characteristics:** Age, pre-pregnancy weight and height (to calculate Body Mass Index - BMI), place of residence (urban/rural), and educational level.

- **Medical and Obstetric History:** Parity (primigravida vs. multigravida), history of GH or pre-eclampsia in previous pregnancies, family history of chronic hypertension in a first-degree relative, pre-existing diabetes mellitus (type 1 or 2), and gestational diabetes.

- **Current Pregnancy and Delivery Outcomes**
- **Maternal Outcomes:** Gestational age at delivery, mode of delivery (vaginal, instrumental, or cesarean section), progression to pre-eclampsia/eclampsia, placental abruption, and postpartum hemorrhage.

- **Perinatal Outcomes:** Birth weight, Apgar score at 5 minutes, and admission to the Neonatal Intensive Care Unit (NICU).

Data Management and Statistical Analysis

All data from the extraction sheets were entered into a computerized database using Microsoft Excel, with double data entry performed to minimize errors. The data were then exported to the Statistical Package for the Social Sciences (SPSS) software, version 26.0, for analysis.

Descriptive statistics were computed for all variables. Categorical data were presented as frequencies and percentages, while continuous data were presented as means ± standard deviations (SD) or medians with interquartile ranges (IQR) based on their distribution. The normality of continuous data was assessed using the Shapiro-Wilk test.

Results

1. Study Population Characteristics

A total of 4,520 deliveries were recorded at Aljala Maternity Hospital during the two-year study period. From this population, 150 cases of Gestational Hypertension (GH) were identified, yielding a prevalence of 3.3%. These 150 cases were matched with 300 normotensive controls, resulting in a final analytical sample of 450 participants.

Table 1: Baseline Characteristics of the Study Participants

Characteristic	GH Cases (n=150)	Controls (n=300)	p-value
Maternal Age (years), Mean ± SD	32.5 ± 4.8	28.1 ± 5.2	<0.001
Pre-pregnancy BMI (kg/m²), Mean ± SD	29.8 ± 3.5	26.2 ± 4.1	<0.001
Primigravida, n (%)	65 (43.3%)	90 (30.0%)	0.005
Urban Residence, n (%)	112 (74.7%)	235 (78.3%)	0.38
Secondary Education or Higher, n (%)	98 (65.3%)	210 (70.0%)	0.31

Risk Factors for Gestational Hypertension

The analysis of potential risk factors is summarized in Table 2. Bivariate analysis revealed several factors significantly associated with GH. A significantly larger proportion of women with GH were of advanced maternal age (≥35 years), were primigravid, were obese (BMI ≥30 kg/m²), and reported a family history of chronic hypertension.

Table 2: Analysis of Risk Factors for Gestational Hypertension

Risk Factor	GH Cases (n=150) n (%)	Controls (n=300) n (%)	Crude Odds Ratio (95% CI)	p-value
Advanced Maternal Age (≥35 years)	58 (38.7%)	62 (20.7%)	2.45 (1.60 - 3.76)	<0.001
Primigravidity	65 (43.3%)	90 (30.0%)	1.78 (1.19 - 2.67)	0.005
Pre-pregnancy Obesity (BMI ≥30)	72 (48.0%)	75 (25.0%)	2.80 (1.86 - 4.22)	<0.001
Family History of Hypertension	49 (32.7%)	63 (21.0%)	1.83 (1.18 - 2.84)	0.007
Gestational Diabetes Mellitus	21 (14.0%)	30 (10.0%)	1.46 (0.81 - 2.63)	0.20

To identify independent risk factors, these significant variables were entered into a multivariate logistic regression model. As shown in Table 3, pre-pregnancy obesity, advanced maternal age, primigravidity, and a family history of hypertension remained statistically significant independent predictors of GH.

Table 3: Multivariate Logistic Regression of Independent Risk Factors for Gestational Hypertension

Risk Factor	Adjusted Odds Ratio (aOR)	95% Confidence Interval	p-value
Pre-pregnancy Obesity (BMI ≥30)	3.12	1.98 - 4.91	<0.001
Advanced Maternal Age (≥35 years)	2.67	1.65 - 4.32	<0.001
Primigravidity	2.01	1.27 - 3.18	0.003
Family History of Hypertension	1.85	1.14 - 3.00	0.013

Maternal Outcomes

The comparison of maternal outcomes between the two groups is detailed in Table 4. Women with GH had a significantly higher rate of iatrogenic preterm delivery before 37 weeks. Furthermore, 18.0% of the GH cases progressed to pre-eclampsia, a complication not observed in the control group. The rate of placental abruption was also significantly higher in the GH group. The primary cesarean section rate was more than double that of the normotensive group.

Table 4: Maternal Outcomes

Outcome	GH Cases (n=150)	Controls (n=300)	p-value
Iatrogenic Preterm Delivery (<37 weeks)	42 (28.0%)	24 (8.0%)	<0.001
Progression to Pre-eclampsia	27 (18.0%)	0 (0.0%)	<0.001
Placental Abruption	9 (6.0%)	3 (1.0%)	0.002
Cesarean Section Delivery	63 (42.0%)	75 (25.0%)	<0.001
Postpartum Hemorrhage	12 (8.0%)	18 (6.0%)	0.41

Perinatal Outcomes

The analysis of perinatal outcomes revealed significant disparities between the two groups (Table 5). Infants born to mothers with GH had a significantly lower mean birth weight and a substantially higher incidence of low birth weight. These infants were also more than three times as likely to be admitted to the Neonatal Intensive Care Unit (NICU) compared to infants in the control group.

Table 5: Perinatal Outcomes

Outcome	GH Cases (n=150)	Controls (n=300)	p-value
Birth Weight (grams), Mean ± SD	2780 ± 510	3280 ± 420	<0.001
Low Birth Weight (<2500g), n (%)	33 (22.0%)	21 (7.0%)	<0.001
NICU Admission, n (%)	39 (26.0%)	24 (8.0%)	<0.001
Apgar Score <7 at 5 minutes, n (%)	9 (6.0%)	9 (3.0%)	0.11

Discussion

This retrospective case-control study provides a detailed analysis of the risk factors and clinical outcomes associated with Gestational Hypertension (GH) in a cohort of women delivering at a major maternity hospital in Tripoli, Libya. Our findings confirm that GH is a significant obstetric challenge in this population, with a prevalence of 3.3%, and is strongly linked to specific maternal risk factors and a markedly higher incidence of adverse maternal and perinatal outcomes.

Interpretation of Key Risk Factors

The identification of pre-pregnancy obesity as the strongest independent risk factor for GH (aOR=3.12) is consistent with a substantial body of international literature. The pathophysiological link is believed to be rooted in the pro-inflammatory and insulin-resistant state associated with obesity, which exacerbates the endothelial dysfunction and impaired placental development that underpin hypertensive disorders of pregnancy (HDP) [1, 2]. This finding is of particular public health importance in Libya, where rising obesity rates have been reported, suggesting that pre-conception weight management programs could be a highly effective primary prevention strategy.

Similarly, our results corroborate the well-established risk associated with advanced maternal age (≥35 years), which conferred a 2.67-fold increased risk. Older maternal age is often linked to pre-existing, subclinical vascular stiffness and a reduced capacity for placental adaptation, making women more susceptible to cardiovascular stress during pregnancy [3]. The significant association with primigravidity (aOR=2.01) is also a classic finding in the pathogenesis of GH, supporting the theory of a primipaternity effect, where maternal immune adaptation to paternal antigens expressed by the placenta plays a crucial role [4].

Furthermore, the independent association between a family history of chronic hypertension and GH (aOR=1.85) underscores a significant genetic or shared environmental predisposition. This suggests that a detailed family history should be a mandatory component of antenatal risk assessment, as it can help identify at-risk women even in the absence of other overt risk factors.

Adverse Maternal Outcomes

The clinical significance of GH is starkly illustrated by the high rate of adverse maternal outcomes observed in our study. The progression of nearly one in five (18.0%) GH cases to pre-eclampsia aligns with global estimates and highlights the unstable nature of the diagnosis. It underscores the imperative for vigilant monitoring of women diagnosed with GH for signs of disease progression, including regular blood pressure checks, laboratory tests for proteinuria and HELLP syndrome, and symptom review.

The significantly higher rates of iatrogenic preterm delivery (28.0% vs. 8.0%) and cesarean section (42.0% vs. 25.0%) in the GH group are direct consequences of the disease and its management. Preterm delivery is often a necessary intervention to mitigate severe maternal complications or worsening fetal condition, such as intrauterine growth restriction. This iatrogenic prematurity is a major driver of the perinatal morbidity associated with GH. The elevated cesarean section rate can be attributed to both maternal indications (e.g., worsening hypertension, abruption) and fetal indications (e.g., non-reassuring fetal status), reflecting the compromised intrauterine environment.

Adverse Perinatal Outcomes

The negative impact of GH on the fetus and newborn is clearly demonstrated in our results. The significantly lower mean birth weight and the three-fold higher incidence of low birth weight (22.0% vs. 7.0%) in the GH group are direct consequences of uteroplacental insufficiency. The hypertensive environment leads to vasoconstriction of the spiral arteries, reducing placental perfusion and limiting the delivery of oxygen and nutrients to the fetus [5].

This compromised fetal well-being directly translates to the significantly higher rate of Neonatal Intensive Care Unit (NICU) admissions (26.0% vs. 8.0%) among infants of mothers with GH. These admissions are often necessitated by complications of prematurity, such as respiratory distress syndrome, as well as conditions like hypoglycemia and hypothermia related to intrauterine growth restriction. The similar Apgar scores at 5 minutes, while reassuring for immediate neonatal vitality, do not diminish the significant medium-term morbidity represented by the NICU admission and low birth weight data.

Study Implications and Comparison with Existing Literature

The risk factors and outcomes identified in our Libyan cohort are largely consistent with those reported in international studies, confirming the universal nature of GH's pathophysiology [1, 3, 5]. However, the specific prevalence and the strength of certain associations, such as the pronounced link with obesity, provide a locally relevant evidence base. This information is crucial for healthcare planners at Aljala Maternity Hospital and similar institutions in Libya. It argues for the implementation of standardized, risk-based antenatal care protocols that include early and repeated screening for hypertension, especially in women with the identified risk profile.

Limitations

Several limitations of this study must be acknowledged. Its retrospective design introduces a potential for missing or misclassified data from medical records. The single-center nature may limit the generalizability of the findings to all regions of Libya or to primary care settings. Furthermore, we were unable to assess the impact of other potential confounders, such as detailed dietary habits, physical activity levels, or precise gestational weight gain, which could provide a more nuanced understanding of the risk profile.

Conclusion and Recommendations

In conclusion, this study establishes that Gestational Hypertension at Aljala Maternity Hospital is significantly associated with modifiable risk factors, primarily obesity, and non-modifiable factors such as advanced maternal age, primigravidity, and a family history of hypertension. The condition carries a substantial burden of maternal and perinatal morbidity, primarily through its association with pre-eclampsia, iatrogenic preterm birth, low birth weight, and increased NICU admissions.

Based on these findings, we recommend:

1. The implementation of pre-conception counseling and public health initiatives aimed at reducing obesity in women of reproductive age.
2. Enhanced antenatal surveillance for all pregnant women, with particular vigilance for those with the identified risk factors.
3. The development of a local clinical guideline for the management of GH, emphasizing prompt diagnosis, close monitoring for progression, and timely decision-making regarding delivery to optimize outcomes for both mother and child.

   Future prospective, multi-center studies in Libya are warranted to validate these findings and to investigate the long-term cardiovascular sequelae for both mothers and offspring.

Conclusion

This study conclusively identifies pre-pregnancy obesity, advanced maternal age, primigravidity, and a family history of hypertension as significant independent risk factors for Gestational Hypertension (GH) in a Libyan cohort. The findings underscore the substantial clinical burden of GH, demonstrating a clear correlation with severe adverse outcomes, including a high rate of progression to pre-eclampsia, iatrogenic preterm delivery, low birth weight, and increased neonatal intensive care admissions. This research provides the first robust, localized evidence from Aljala Maternity Hospital, filling a critical gap in the North African obstetric literature.

The study's primary contribution lies in equipping healthcare providers and policymakers in Libya with data-driven insights to refine clinical practice. The findings argue compellingly for the implementation of enhanced, risk-based antenatal screening protocols that prioritize women with the identified risk profile. As a practical application, pre-conception counseling and public health initiatives

aimed at weight management should be prioritized to mitigate the strongest modifiable risk factor.

For future research, prospective, multi-center studies across Libya are recommended to validate these findings on a national scale. Further investigation into the long-term cardiovascular health of mothers and the developmental outcomes of children affected by GH is also warranted to understand the full scope of its impact.

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