

The Role of Risk Assessment at Antenatal Care Clinics in the Prediction of Pre-Eclampsia in a High Altitude Area

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Abstract

Background: Hypertensive disorders are common causes of maternal and fetal mortality and morbidity. **Objective:** This study aimed to examine the prognostic value of risk assessment at level of antenatal care clinics in predicting pre-eclampsia at a high altitude (3133 m above sea level). **Methods:** This cross-sectional study, carried out in Abha Maternity and Pediatric Hospital (AMPH), Saudi Arabia, between January and June 2013, included 176 patients (88 pre-eclamptic women and 88 with normal pregnancies). Patient data including age, parity, blood pressure, body mass index, and complete blood count components were recorded. **Results:** Physical examination of systolic blood pressure, diastolic blood pressure and BMI between two groups showed high statistical significance with a P value of <0.001 . Also, parity was found to be statistically significant with a P value of <0.05 . The mean hemoglobin among pre-eclamptic women was 12.27 ± 2.01 g/dL versus 11.92 ± 2.43 g/dL in the control group ($P = 0.291$). Mean plasma hematocrit levels in the study and the control groups were $38.49\% \pm 4.32\%$ and $37.92\% \pm 7.04\%$, respectively; this was not found to be statistically significant ($P = 0.518$). Although there was an increase in laboratory blood tests of maternal hematocrit and hemoglobin levels, both parameters failed to show any statistical significance. **Conclusion:** Risk assessment at level of antenatal care clinics can be considered as valuable prognostic tool for prediction of preeclampsia. Any pregnant lady with abnormal physical examination findings of: BMI, systolic and diastolic blood pressure and obstetric history following risk assessment in antenatal care clinics should be observed for possibility of pre-eclampsia.

Keywords

Pre-Eclampsia, BMI, Systolic, Diastolic, Pregnancy, Screening, Altitude, Saudi Arabia

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1. Introduction

Pre-eclampsia is a pregnancy-specific disorder that refers to the onset of hypertension (blood pressure [BP] of $\geq 140/90$ mmHg) and proteinuria (24-hour urinary protein excretion of >300 mg) after 20 gestational weeks in a previously normotensive female [1] [2]. Pre-eclampsia is a major cause of maternal and fetal mortality and morbidity [3] [4]. The incidence of this condition is 2% - 10%, depending on the population studied and the definition of pre-eclampsia [5]. A study in the Aseer region of Saudi Arabia observed that hypertensive disorders were present in 2.4% of all pregnancies, with a higher prevalence in high altitude areas than in those at sea level [6].

Numerous clinical and biochemical tests for the prediction or early detection of pre-eclampsia have been proposed [7]. However, most of these methods remain unrealistic for general use in the majority of developing countries. At present, there is no single reliable and cost-effective screening test for pre-eclampsia which can be recommended for use in developing countries [7]. As part of an antenatal care strategy, the World Health Organization (WHO) recommend screening for pre-eclampsia during the patient's third antenatal visit at 32 gestational weeks [8]. In contrast, strategies for risk assessment in developing countries should be based on the obstetric and medical history of the patient as well as a clinical examination. Pregnant women should be assessed at their first antenatal clinic for known risk factors of pre-eclampsia, such as young age, nulliparity, first pregnancy after the age of 35 years, obesity prior to the current pregnancy, multifetal gestation, a previous history of pre-eclampsia, diabetes mellitus and/or hypertension [9].

Studies have shown that the existing clinical, biophysical and biochemical tests for the diagnosis of pre-eclampsia in high-risk women, in addition to being expensive, have little predictive value in making an early diagnosis [10]-[12]. Haemoconcentration is a shared phenomenon in both pre-eclampsia and among those living in high altitude areas. In women who have hypertensive disorders of pregnancy, particularly those with pre-eclampsia, blood volume does not increase at the same proportion as it does in a normotensive pregnancy which results in a relatively higher hemoglobin concentration [10]-[12]. In a number of studies, maternal hemoglobin (Hb) concentration and plasma haematocrit (HCT) levels have been investigated as an early predictive test for pre-eclampsia [13] [14]. These two measurements are routinely taken in antenatal care clinics in order to form a predictive model for pre-eclampsia. This is achieved by combining the results of these tests with any risk factors apparent in the patient's history and physical examinations, including body mass index (BMI) and BP.

Abha, the capital of the Aseer region, is situated 3133 m above sea level in the mountains of south-western Saudi Arabia. It has the lowest average annual temperature and has highest level of rainfall among the regional areas [15]. This study aimed to examine the prognostic value of risk assessment at level of antenatal care clinics in predicting pre-eclampsia among women living in this high altitude area.

2. Methods and Materials

This study was carried out at Abha Maternity and Pediatric Hospital (AMPH), a tertiary care center, between January 2013 and June 2013. There were a total number of 6700 admissions during the study period. We enrolled 88 pre-eclamptic women and 88 pregnant women who were normotensive at the time of delivery (control group). Patients in their second trimester, after 20 gestational weeks on their first visit at the AMPH antenatal clinic were included in the study. Any patients with a history of pre-existing medical diseases and with incomplete medical records were excluded from the study.

Participants were then divided into two groups. The first group was comprised of pre-eclamptic women diagnosed at the time of the study and the second group was a control group of normotensive women with uncomplicated pregnancies. A diagnosis of pre-eclampsia was defined as the excretion of >300 mg of urinary protein over 24 hours and a systolic and diastolic BP of more than 140 mmHg and 90 mmHg, respectively.

Patients in both groups were compared for the following factors: maternal age, parity, physical risk factors—BMI and BP and blood investigations (including maternal Hb concentration and HCT levels). Blood and urine investigations were performed on all women and noted in their clinic records. Among the pregnant women, these investigations were carried out before 20 gestational weeks.

Data were analyzed using SPSS software package version 15.0 (SPSS, Chicago, IL, USA). Descriptive data was presented by mean \pm sd. Unpaired T-test was used for comparison of characteristics between the pre-eclampsia and control groups. Two sided *P* values of less than 0.05 were considered statistically significant.

Approval for this study was granted by the Ethical Committee of King Khalid University and the AMPH Director. All patients gave consent prior to their enrollment in the study.

3. Results

A total of 176 patients were enrolled during the study period, including 88 pre-eclamptic women and 88 normotensive women in the control group. The mean age of the pre-eclamptic group was 28.64 ± 7.40 years, while the control group of non-pre-eclamptic women had a mean age of 27.66 ± 6.43 years ($P > 0.05$). No statistically significant difference existed between the two groups with respect to age. The mean parity between the cases ($1.54\% \pm 0.661\%$) and the controls ($1.79\% \pm 0.667\%$; $P < 0.05$) respectively. Significant differences exist between the cases and controls with respect to the characteristics of parity, systolic BP, diastolic BP and BMI ($P < 0.05$) in **Table 1**. The mean systolic BP in the pre-eclamptic group and the control group was 160.3 ± 17.6 mmHg and 121.1 ± 11.4 mmHg, respectively, while the mean diastolic BP was 103.9 ± 11.0 mmHg and 74.8 ± 7.8 mmHg, respectively. BMI was significantly higher among the pre-eclamptic group as compared to the control group ($P < 0.001$).

Mean maternal Hb concentration in the study and control groups were 12.27 ± 2.01 g/dL and 11.92 ± 2.43 g/dL, respectively while the mean plasma HCT levels in the study and control groups were $38.49\% \pm 4.32\%$ and $37.92\% \pm 7.04\%$, respectively. No significant difference is found in the mean maternal Hb concentration and mean plasma HCT levels between the two groups (with and without preeclampsia) ($P > 0.05$) [**Table 2**].

4. Discussion

The aim of this study was to set a model for the prediction of pre-eclampsia in a high altitude area through a combination of simple routine laboratory investigations and risk assessment via patient history and physical risk factors. Significant differences were observed between the pre-eclamptic study group and the control group in terms of BMI and BP measurements as well as parity. The results indicate that high altitude was associated with pre eclampsia and this is positively correlated to BMI and BP.

Given the high degree of concern with regards to this disorder, many studies have been carried out to evaluate the risk factors for pre-eclampsia—including nuliparity, advanced maternal age, race, genetic and environmental factors (e.g. high altitude), obesity, chronic hypertension and multiple pregnancies—all of which are considered

Table 1. Characteristics of pregnant patients in their second trimester with and without pre-eclampsia at an antenatal clinic in Abha, Saudi Arabia (N = 176).

Characteristic	Mean \pm SD		P value
	Pre-eclamptic group (n = 88)	Control group (n = 88)	
Age in years	28.64 ± 7.400	27.66 ± 6.432	0.348
Parity	1.54 ± 0.661	1.79 ± 0.667	0.013
Systolic BP in mmHg	160.3 ± 17.651	121.17 ± 11.408	<0.001
Diastolic BP in mmHg	103.90 ± 11.021	74.88 ± 7.856	<0.001
BMI in kg/m ²	29.621 ± 6.7809	24.582 ± 4.4895	<0.001

SD = standard deviation; BP = blood pressure; BMI = body mass index. *A P value of <0.05 was considered statistically significant.

Table 2. Mean maternal HB concentration and Hct values of pregnant patients in their second trimester with and without pre-eclampsia at an antenatal clinic in Abha, Saudi Arabia (N = 176).

Value	Mean \pm SD		P value*
	Pre-eclamptic group (n = 88)	Control group (n = 88)	
Hb in g/dL	12.279 ± 2.0167	11.921 ± 2.4311	0.291
Hct in %	38.497 ± 4.3221	37.923 ± 7.0447	0.518

*A P value of <0.05 was considered statistically significant.

contributory [16] [17]. A previous study also carried out in Abha found that the incidence of pre-eclampsia and eclampsia was high in both nulliparous women and those aged 20 - 29 years [18]. Siddiqui *et al.* reported that the average age of pre-eclamptic women in their cohort of women in Riyadh, Saudi Arabia, was 29.0 ± 6.1 years [19]. The mean age of the pre-eclamptic group in the current study was therefore consistent with those of the aforementioned studies.

It has been found that the maternal risk of pre-eclampsia rises with an increasing degree of obesity; this risk persists even after other potential confounding factors have been accounted for [20]. Other reported risk factors include a previous history of pre-eclampsia, family history of hypertension and a high BMI [21]. The findings of the current study support the validity of BMI as a risk factor as the mean BMI was observed to be significantly higher in the pre-eclamptic group than in the control group.

The measurement of BP is a routine practice in antenatal care clinics worldwide. Sibai *et al.* found that higher systolic and diastolic BP measurements at the first antenatal visit were associated with an increased incidence of pre-eclampsia (3.8% in women with diastolic BP of <55 mmHg and 7.4% in those with diastolic BP of 70 - 84 mmHg) [22]. Pre-eclamptic women in the present study had significantly higher systolic and diastolic BP measurements than those in the control group. This was consistent with the findings of Siddiqui *et al.* who reported a mean systolic BP of 143.1 ± 7.8 mmHg versus 125.1 ± 19.6 mmHg and mean diastolic BP of 94.3 ± 4.9 mmHg versus 78 ± 13.3 mmHg in the pre-eclamptic and control groups, respectively ($P < 0.05$) [19].

Timely treatment is vital in preventing the development of severe and possibly life-threatening pre-eclampsia. The only conclusive treatment for this condition is to deliver the fetus [23]. When making treatment decisions, physicians should consider the severity of the condition, the potential for maternal complications, the length of the pregnancy and the possible risks to the fetus [23]. Currently, there are few recommendations to prevent pre-eclampsia. There is some evidence to suggest that regular low-dose aspirin and calcium supplements, taken both before and during early pregnancy, may help to prevent the development of this condition in some women [24]. The WHO recommends that low-dose aspirin be initiated before 20 gestational weeks to prevent pre-eclampsia in high-risk women [24]. Calcium supplementation (at least 1 g per day) is also recommended during pregnancy as it prevents pre-eclampsia where dietary calcium intake is low, especially for those at high risk. Magnesium sulfate is preferential to anticonvulsants for the prevention of eclamptic seizures in women with severe pre-eclampsia [24]. In general, thorough prenatal care should be made available to all pregnant women in order to minimize pre-eclampsia-related deaths.

Effective screening tests for pre-eclampsia should be simple, safe, rapid, inexpensive and reproducible. They should also provide intervention opportunities to prevent the development of pre-eclampsia or, at a minimum, result in a better outcome [13]. The investigations for maternal Hb concentration and plasma HCT levels used in the current fulfill these criteria. Mean maternal Hb concentrations and plasma HCT levels were found to be higher in pre-eclamptic women than among women with normal pregnancies. Although, the results of maternal Hband HCT levels between the groups were not statistically significant.

However, a number of other studies, including that of Siddiqui *et al.*, did not observe significant differences between HCT levels in pre-eclamptic women and women with normal pregnancies [19] [25] [26]. Pregnancy at high altitudes, compared to sea level, is characterized by an increased blood viscosity as a result of increased HCT and plasma viscosity [27]. Some evidence suggests that the plasma volume in patients with pre-eclampsia is lower than normal [28] [29]. Decreased plasma volume induces a high Hb concentration [12]. These factors contributed to high maternal hemoglobin levels in our study, the question around absence of statistical significance can be answered by increased Hb and HCT levels in control group as well as the low sample size.

This fact, combined with the results of this study, signal the need for specific pre-eclampsia screening programmes tailored to different locations. These programmes may be different even within a single country, due to the effect of altitude on this condition.

The results of this study should be considered in view of the following limitation. Clear cut-off values for HCT and Hb could not be defined. This resulted in the overlapping of values between the control and study groups and wider standard deviations.

5. Conclusion

The importance of risk assessment at level of antenatal care clinics in prediction of preeclampsia is stressed in our study. Findings of high BMI, systolic and diastolic BP measurements could be the base for a predictive

model for pre-eclampsia in high altitude areas when combined with other risk assessments. Using a predictive model may help achieve timely interventions according to the WHO recommendations for the prevention of pre-eclampsia. However, more studies on this topic are necessary.

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