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*Research Article*

## **Associated Risk Factors of Pregnancy-Induced Hypertension In Aljouf, Saudi Arabia**

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### **ABSTRACT**

Pregnancy-induced hypertension is a serious medical issue in pregnant women globally that consequently causes maternal and perinatal morbidity and mortality. Several risk factors are associated with it. Although significantly associated risk factors of pregnancy-induced hypertension have not yet been satisfactorily identified in the Aljouf area, so we aimed to identify the risk factors of pregnancy-induced hypertension. This is a hospital-based retrospective unmatched case-control study that was conducted at Maternity and children hospital Aljouf Saudi Arabia to identify the associated risk factors of pregnancy-induced hypertension over a period of January 2020 to December 2020. Bivariate logistic regression was applied as required in the multivariate logistic regression. In the end, multivariate analysis was done to identify risk factors for pregnancy-induced hypertension. Of a total of 261 pregnant women divided into 87 cases, among them, 57 (65%) pre-eclampsia/ eclampsia and 30 (34%) gestational hypertension. The multivariable analysis applied for required multiple logistic regression, and tracing significantly associated risk factors for pregnancy-induced hypertension such as ANC visited (adj. OR= 10.22, 95%CI: 3.66 – 28.50,  $p<0.001$ ), maternal excessive weight gain period of pregnancy (>13 kg) (adj. OR=7.33, 95%CI: 3.05 -17.68,  $p<0.001$ ), history of abortion (adj. OR=3.56, 95%CI: 1.32-9.56,  $p=0.012$ ), in addition, history of diabetes mellitus (adj OR= 2.59, 95%CI: 1.02 – 6.47,  $p=0.043$ ) Our study determined that pregnancy-induced hypertension women develop a greater risk of adverse pregnancy outcomes as compared to pregnant women without hypertension. Therefore, identification of these risk factors would be beneficial for the prevention, management, and reduction of complications of both perinatal and maternal morbidity and mortality.

**Keywords:** *Risk factors, pregnancy-induced hypertension, pregnancy outcomes*

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### **INTRODUCTION**

It is estimated that Pregnancy-induced hypertension (PIH) is considered a key reproductive health issue in women, and it occurred in approximately 6–8% of all pregnancies worldwide (Alongkone *et al*, 2018). Pregnancy-induced hypertension is one of the major leading causes of high maternal and fetal mortality and morbidity. It is referring to the state of PIH when the blood pressure level is  $\geq 140/90$  in a period of resting condition which apart from two occasions or  $\geq 160/110$  mmHg on one occasion during (after 20 weeks) the pregnancy those who have no previous history of hypertension (Sibai *et al*, 2003). However, the categories of PIH included gestational

hypertension (without proteinuria), preeclampsia (with proteinuria), and eclampsia (associated with convulsions) (Arshad *et al*, 2011). Conversely, the National High Blood Pressure Education Program of the USA, (National High Blood Pressure Education Group, 2000) reported preeclampsia to define as state hypertension and associated with proteinuria and/or edema occurs definitely after 20 weeks of gestation, while gestational hypertension developing after 20 weeks of gestation absence of preeclampsia signs (W.K.B.A *et al*, 2012). Previously reported that around 9.1 % of maternal deaths in Africa and the main reason for hypertensive disorders of pregnancy (Palacios *et al*, 2014) and

are considered the second most common source of maternal death in China (You *et al.*, 2009). Despite this, globally estimated higher significance of maternal death mainly pregnancy association causes such as hypertension, with 50% occurring in the African region, and almost 12% of death of pregnant mothers related to pregnancy-induced hypertension (Gökhan *et al.*, 2011; Min Xue *et al.*, 2017; Queensland Clinical Guidelines 2015; Institute of Health 2014). Therefore, globally it is considered a major public health issue. Several studies have reported that the effects of PIH in a woman are between 4.6% to 13.1% which subsequently to neonatal death of around 9.2% (Morikawa *et al.*, 2014; Xu *et al.*, 2014). Besides, Pregnancy-Induced Hypertension is responsible for premature delivery, intrauterine growth restriction (IUGR), placental abruption, and finally fetal death with maternal mortality, and morbidity. So far, the etiology of PIH remains unidentified, though there were a certain number of risk factors recognized (W.K.B.A *et al.*, 2012). Several data determined that woman with PIH is at risk who has a history of hypertension, previous history of PIH, family history of hypertension, gestational diabetes mellitus, pre-existing diabetes, obesity as well as multi pregnancies (Ye *et al.*, 2014; Umesawa *et al.*, 2017).

While some studies recommended pre-pregnancy obesity is a significant risk for developing preeclampsia and gestational hypertension (Mbah *et al.*, 2010). PIH women higher chance of developing chronic conditions in their later life such as cardiovascular disease (Chaim *et al.*, 2008). Thus, it is essential to identify the associated risk factors for PIH to reduce the burden of this ailment. Consequently, the present study was conducted to identify the associated risk factors of PIH in Sakaka, Aljouf, due to no previous research done on this topic.

## MATERIALS AND METHODS

**Study design:** This is a hospital-based retrospective study that was conducted at Maternity and Children Hospital (MCH) Sakaka, Aljouf Saudi Arabia, over a period of January 2020 to December 2020 to identify the associated risk factors of pregnancy-induced hypertension (PIH).

**Participants:** All pregnant women who delivered at the Maternity and Children Hospital (MCH).

**Case group:** Pregnancy-induced hypertensive women delivered at Maternity and Children Hospital (MCH) between January 2020 to December 2020.

**Control group:** Pregnant women delivered at the Maternity and Children Hospital (MCH) without a history of hypertension.

**Sample size calculated:** We calculated the sample size 261 by the following formula:  $N = \frac{deff \cdot u^2 \cdot P \cdot (1-P)}{d^2}$ , where deff is the design effect; N, the sample capacity; u, 1.96 when the confidence coefficient is 95%; P, the probability value.

**Sampling technique and procedure:** A total of 261 records of women with pregnancy who delivered in the study area between January and December 2020 were enrolled with criteria of PIH and without PIH then divided into 87 for the case group and 174 for the control group ((case: control ratio

of 1:2). From hospital record files we collected detailed history and laboratory investigation reports including ultrasound assessment of fetal growth (Table 2) of all participants in both the control and case groups who gave birth at this hospital. We collected information such as age, gravida, parity, history of abortion, pre-existing hypertension, diabetes, and family history of hypertension.

**Data collection:** We reviewed the record files and collect data from them by using a designed checklist. Training was given to the research assistant for the collection of data from the record file and then transferred into the data collecting sheet. Two research co-authors were assigned to collect the data and the primary investigator supervised the quality of data collection.

Reviewed record files showed that pregnant women had hypertension after 20 weeks of gestation in those taken as case group and those who has no history of hypertension during their pregnancy duration that was taken as control group. Records files showing types of PIH such as gestational hypertension, preeclampsia or eclampsia were included in the case group and control group obtained who gave birth without a history of hypertension. The criteria of blood pressure and laboratory reports were assessed. Data analysis was done by applying STATA 10.016 version. Descriptive statistics were applied to characteristic descriptions of cases and controls including presenting frequencies, percentages, and logistic regression with a p-value.

**Data Analysis:** The data were entered into a Microsoft Excel Worksheet and analyzed, descriptive analysis on KAP to measure relative frequencies, percentages, averages, and relative frequencies of the variables using SPSS version 23.

## RESULTS

There were a total of 261 pregnant women in this study, with 87 cases, among them, 57 (65%) pre-eclampsia/ eclampsia and 30 (34%) gestational hypertension (Figure 1). The study also included 174 pregnant women which served as a control group.

**Demographic criteria of case and control groups:** In this study, the mean age was 26.2 years (SD:  $\pm 6.1$ ) for cases and 24.2(SD:  $\pm 4.8$ ) for the control group. However, a total of one hundred and seventy-four (66.6%) of the control group and eighty-seven (33.3%) of the cases were below the age of 20 years. 8.04% of cases and 9.19% of the control groups, whereas 19(21.8) of cases and 20(11.49) of controls were age above the 35 years old respectively (Table1). Maternal excessive weight gain ( $>13$  kg) in cases 58(66.6%) was significantly higher than controls 40 (22.9%). Abortion was significantly greater than 62 (35.6%) in controls compared to cases 20(22.9) represented in Tables 1 and 3.

**Medical history of all participants:** Concerning medical disease factors, 76(87.3) of cases and 16 (9.1) of controls had positive diabetes mellitus, whereas 11(12.6) of cases and 158(90.8) of controls had no diabetes mellitus (Table 3).

**Obstetrical history of case and control groups:** The present study identified PIH as comparatively common in primigravida 50(57.4 %) in the case than 44 (25.2%) in the controls. Conversely, multigravida was found in 37 (42.5%) and 58(33.3%) in the case and control groups respectively which are represented in table 3. Our data also addressed 57 (66%) pre-eclampsia/ eclampsia and 30 (34%) gestational hypertension among all participants (Fig.1)

**Table .1**  
Demographic criteria of all participants (n = 261)

Characteristics	Case (n=87)	Control (n=174)	P-value	
Age	<20	7 (8.04)	17 (9.19)	
	20 – 35	61(70.1)	140(80.45)	
	>35	19 (21.8)	20(11.49)	
	Mean (SD)	26.2(6.1)	24.2(4.8)	
Weeks of pregnancy	Term	70(80.4)	163(93.6)	< 0.05
	Preterm	17 (19.5)	11 (6.3)	-
Pre-pregnancy body mass index	Overweight (≥25.0)	21(24.1)	14 (8.04)	< 0.05
	Excessive (>13)	58(66.6)	40(22.9)	< 0.05
Status of weight gain in current pregnancy (kg)	Yes	76(87.3)	16 (9.1)	0.043
	No	11(12.6)	158(90.8)	

**Table. 2.**  
Ultrasound assessment of fetal condition among the cases.

Variables	Number(n=87) %
Fetal distress	32(36) %
Intrauterine Growth restriction	31(35) %
Lower amniotic fluid	24(27) %

**Assessment of risk factors for case and control groups by Multivariate analysis:** In the multivariable analysis using qualified multiple logistic regression, the analysis found some factors significantly related to pregnancy-induced hypertension that was: ANC visited (adj. OR= 10.22, 95%CI: 3.66 – 28.50, p<0.001), maternal excessive weight gain period

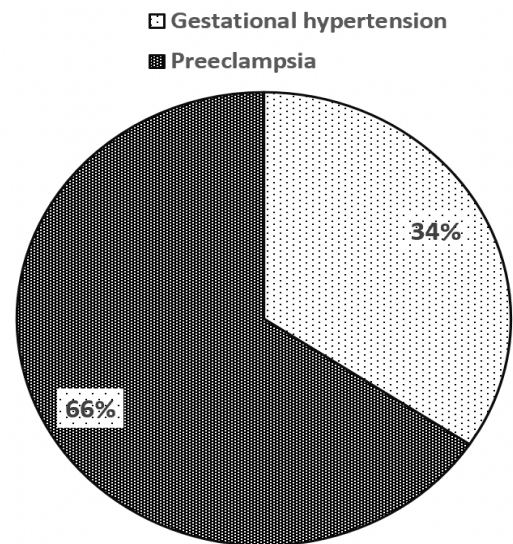
**Table 4.**  
Multivariable analysis of risk factors in relation to PIH.

Variables	Case (n=87)	Control (n=174)	Crude OR (95%CI)	Adjusted OR (95% CI)	P-value
ANC follow up	Adequate	44(50.5)	163(93.6)	1	1
	Inadequate	43(49.4)	11 (6.3)	3.25 (5.61 to 31.27)	10.22 (3.66 to 28.50)
History of abortion	Yes	20 (22.9)	62 (35.6)	1	1
	No	67 (77.01)	112 (64.3)	2.27 (1.14 to 4.53)	3.56 (1.32 to 9.56)
Family history of hypertension	Yes	66 (75.8)	61(35.05)	1	1
	No	21(24.1)	113(64.9)	2.29 (1.16 to 4.54)	3.55 (1.31 to 9.58)
Maternal weight gain	Non-excessive weight gain	29(33.3)	133(76.4)	1	1
	Excessive weight gain	58(66.3)	41 (23.5)	7.7 (3.76-15.98)	7.33 (3.05-17.68)
History of diabetes mellitus	Yes	76(87.3)	16 (9.1)	1	1
	No	11(12.6)	158(90.8)	4.03 (1.97 to 8.22)	2.59(1.02 to 6.47)

of pregnancy (>13 kg) (adj. OR=7.33, 95%CI: 3.05 -17.68, p<0.001), history of abortion (adj. OR=3.56, 95%CI: 1.32-9.56, p=0.012), in addition, history of diabetes mellitus (adj OR= 2.59, 95%CI: 1.02 – 6.47, p=0.043) and that all represent in Table 4.

**Table.3.**  
Obstetrical history of all participants

Variables	Case (n=87) %	Control (n=174)	P-value
<b>Current pregnancy history: Gravida</b>			
Primigravida	50(57.4)	44(25.2)	.000
Multigravida	37(42.5)	58(33.3)	
<b>Current pregnancy history: Abortion</b>			
Yes	20(22.9)	62(35.6)	.000
No	67(77.01)	112(64.3)	
<b>ANC follow up history</b>			
Adequate	44(50.5)	163(93.6)	.000
Inadequate	43(49.4)	11(6.32)	



**Figure 1:**  
Type of PIH among case group in the present study

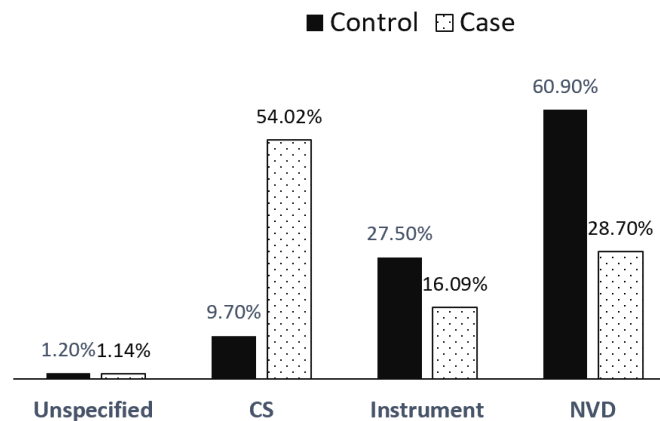
**Maternal outcomes in the case and control groups.:**

Concerning the delivery approach, a higher rate of a cesarean section or induced labor was found in 47(54.02%) cases in comparison to 17(9.7%) controls that were considered strong significant at a p-value (p = .000) (Table 5 and Fig 2). Our results also showed normal and instrumental vaginal deliveries were significantly higher in the controls (60.9%), (27.5%) compared to the (28.7%) (16.09%) in the case respectively.

**Perinatal outcomes of case and control groups:** Our data found significantly higher low birth weight babies 31(35.6%) in the cases compared to 6(3.4%) in the controls which were statistically at a p-value (p = .000) (Table5).

**Table 5.** Differences in Pregnancy outcomes between women with and without pregnancy-induced hypertension attended for delivery.

Variables		Case (n=87) %	Control (n=174) %	P value
<b>Onset of labor</b>	Spontaneous vaginal delivery	25(28.7)	106(60.9)	.000
	Instrumental vaginal delivery	14(16.09)	48(27.5)	
	Cesarean section /Induced labor	47(54.02)	17(9.7)	
	Unspecified	1(1.14)	3(1.2)	
<b>Abruption placenta</b>	No	77(88.05)	168(96.5)	.000
	Yes	9(13.4)	1(0.57)	
	Unspecified	1(1.4)	5(2.8)	
<b>Perinatal outcomes</b>				
<b>Low birth weight</b>	No	53(60.9)	167(95.9)	.000
	Yes	31(35.6)	6(3.4)	
	Unspecified	3(3.4)	1(0.57)	
<b>Admission to NICU</b>	No	54(62)	147(84.4)	.019
	Yes	24(27.5)	13(7.4)	
	Unspecified	8(9.1)	14(8.04)	



**Figure 2.** The delivery approach of a pregnant woman with and without PIH. (PIH= pregnancy-induced hypertension, CS=cesarean section, NVD=normal vaginal delivery, and instrumental vaginal delivery).

**DISCUSSION**

Our study is the case-control which is the retrospective type depending on the hospital-based data. To our concern, there was no previous data available in the Aljouf area. The present study enrolled pregnant women with and without pregnancy-induced hypertension at Maternity and Children Hospital (MCH) Sakaka, Aljouf Saudi Arabia. The present study determined inadequate antenatal care visits had a considered strong association factor for PIH and our data found inadequate ANC visits in 43(49.4%) cases compared to 11(6.32%) in the control group and only 44(50.5%) cases taken adequate ANC follow-up than control163(93.6%). Therefore, it is essential for a pregnant woman may close monitored can lower the complications and improve the pregnancy outcomes (Macdonald-Wallis *et al*, 2013; Chasan-Taber *et al*, 2016). While excessive weight gain 58(66.3) and a history of diabetes Mellitus 76(87.3%) also supported to development of the PIH respectively. However, a similar study reported may increase the risk of preeclampsia (Seyedeh *et al*, 2017). In the present study, we noticed primigravida (57.4%) higher development PIH compared with their (25.2%) in the control group, while similar reported in another study, this may be because of first time getting pregnancy leading to physically and mentally upset that making progress to PIH. (Subburaman *et al*, 2017). Conversely, our study found family history of hypertension was increasing the risk for the development of PIH which indicates a positive relationship to PIH. In the present study, our data evidence that there was a statistically significant difference in maternal and perinatal outcomes of a case and control group, and consequently a delivery approach such as cesarean section and induction of delivery was indicated significantly increased in cases 54.2% than in control 9.7%. besides normal vaginal delivery more common in the control group. The present study also found abruption placenta complications during pregnancy in 13.4% of cases and considered statistically significant, several similar reported found in different studies (Chun *et al*, 2014; Gulseren *et al*, 2005). On the other hand, it has been evidenced that low birth weight babies and preterm delivery are more in the case of PIH (Eshetu *et al*, 2015) while an estimated 21.2% of newborn babies with PIH mothers were in a neonatal intensive care unit. Our study also found 27.5% in NICU. However, several studies declared that PIH is one of the reasons that cause significantly maternal and perinatal mortality and morbidity. Therefore, the present study identified some common risk factors of PIH that are considered key factors for maternal and perinatal death. The limitation to this study is that there is only one hospital data available. This is because in Sakaka there is only one maternity and children hospital (MCH) where all related patients from the primary health care center are referred.

In conclusion, pregnancy-induced hypertension has a risk of adverse pregnancy outcomes compared to without PIH women. Aged over the 35 years, positive family history, excessive weight gain, history of abortion, positive diabetes

mellitus, and inadequate ANC monitoring were identified as risk factors for developing the PIH in our study.

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