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Pregnancy-Induced Hypertension among Pregnant Women Attending Health Care Centers in Irbid, Jordan

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Abstract

Background: *Pregnancy-induced hypertension is considered one of the major causes of maternal morbidity and mortality worldwide alongside bleeding and infection. The prevalence of pregnancy-induced hypertension ranges from 4.6% to 13.1% globally. The pathophysiology of pregnancy-induced hypertension is unclear so far. But, there are some risk factors that predispose to it. The aim of this study is to measure the prevalence of pregnancy-induced hypertension and to determine the risk factors which predispose to it among pregnant women who attend the maternal health care centers in Irbid, Jordan.*

Methods: *A total of 317 pregnant women who attended maternal health care centers for antenatal care were interviewed face-to-face using a structured questionnaire and got their height, weight, and blood pressure measured. The process started in December 2019, paused during the covid-19 pandemic, and terminated in January 2021. Gestational age was calculated in weeks using the date of the*

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last menstrual period. Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 16.

Results: *The prevalence of pregnancy-induced hypertension was (7.6%). Having a positive family history of chronic hypertension (Adjusted OR=3.43, p=0.021), and pre-pregnancy obesity (Adjusted OR=4, p =0.009) were significantly associated with pregnancy-induced hypertension. Being in the third trimester of pregnancy was marginally significant (adjusted odds ratio=3.13, p=0.06).*

Conclusion: *the prevalence of pregnancy-induced hypertension was (7.6%). Positive family history of chronic hypertension, body mass index before pregnancy, and gestational age were significantly associated with pregnancy-induced hypertension.*

Keywords: Pregnancy-induced hypertension, Risk factors, Body mass index, Jordan

Significance

Our study aimed to measure the prevalence of pregnancy-induced hypertension and to determine the risk factors predisposing to it among women who attend health care centers in Irbid province. Findings from this study are added to the limited literature of pregnancy-induced hypertension in Jordan.

Also, knowing the risk factors helps health care providers to early identify women who are in need for closer follow-up and appropriate medical care.

INTRODUCTION

Pregnancy-induced hypertension is considered a common pregnancy-related complication (Zhuang et al., 2019). It is a major cause of maternal and infant morbidity and mortality worldwide (Irwinda, Surya, & Nembo, 2016). It is defined as systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg or both, and occurs after 20 weeks of gestation in women with normal blood pressure before being pregnant (Gudeta & Regassa, 2019a).

Pregnancy-induced hypertension is defined as systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg that

develops in pregnancy after 20 weeks of gestation and resolves before 12 weeks postpartum in the absence of proteinuria or seizures. (Ghulmiyyah & Sibai, 2012; Lo, Mission, & Caughey, 2013; Walle & Azagew, 2019).

The pathophysiology of pregnancy-induced hypertension is unclear (Bryson, Ioannou, Rulyak, & Critchlow, 2003). But, there are factors that seem to be responsible for this disease such as advanced maternal age (over 35 years), nulliparity, increased body mass index (BMI), pre-pregnancy obesity, diabetes mellitus, gestational diabetes, pre-existing renal disease, family history of pregnancy-induced hypertension, history of pinduced hypertension-regnancy in previous pregnancies, psychological stress, and history of chronic hypertension (Bryson et al., 2003; Gudeta & Regassa, 2019a; Irwinda et al., 2016; Kintiraki, Papakatsika, Kotronis, Goulis, & Kotsis, 2015). The prevalence of pregnancy-induced hypertension ranges from 4.6% to 13.1% globally (Zhuang et al., 2019). According to the World Health Organization, one woman dies every seven minutes from complications of hypertensive disorders of pregnancy (Gudeta & Regassa, 2019a). One in 250 women in their first pregnancy will give birth before 34 weeks due to preeclampsia (Khader, Batieha, Al-njadat, & Hijazi, 2018). In the United States, hypertension is considered the second leading cause of maternal mortality. And is responsible for 15% of maternal deaths (Gudeta & Regassa, 2019a). Also, It is considered the most common cause of maternal death in Europe, the second cause in China, and the third cause in India (Kintiraki et al., 2015). In Ghana, 40% of maternal deaths were due to hypertensive pregnancy in 2001 (Owiredu, Ahenkorah, Turpin, Amidu, & Laing, 2012).

A mother with hypertensive disorders has an increased probability to give birth through cesarean section (Kazemian, Sotoudeh, Dorosty-Motlagh, Eshraghian, & Bagheri, 2014). Also, she is vulnerable to complications such as hepatocellular injury, acute disseminated intravascular coagulation (DIC), thrombocytopenia, oliguria, pulmonary edema, stroke, central nervous system dysfunction, and placental abruption. Other long-term health risks include diabetes mellitus, cardiovascular disease, hypertension, and kidney disease (Kintiraki et al., 2015).

On the other hand, fetal complications include poor placental oxygen transmission, intrauterine growth restriction (IUGR), low birth weight, small for gestational age, premature delivery, and fetal death (Berhe, Ilesanmi, Aimakhu, & Mulugeta, 2020; Gudeta & Regassa, 2019a; Owiredu et al., 2012; Zhang, Zeisler, Hatch, & Berkowitz, 1997).

Those who were born to hypertensive mothers have an increased risk to develop higher blood pressure and impaired lipid profile during their childhood and adulthood, in addition to increased stroke risk, lower cognitive ability, and mental disorders in later life (Kintiraki et al., 2015).

In less developed countries including Jordan, there is limited research regarding pregnancy-induced hypertension and risk factors predisposing to it. The above-mentioned risk factors are related to other populations. knowing the risk factors in a specific population helps health care providers to early identify women at risk who are, in need for special attention.

METHODS

Study design, population, and area

This study is a health facility-based cross-sectional study. All pregnant women who attended maternity health care centers for antenatal care services were considered as the population for this study.

This study was performed in Kufur yoba comprehensive health care center, Al-Husun comprehensive health care center, Biet Ras primary health care center, Al-Razi primary health care center, and Al-Ramtha primary health care center. The mentioned centers were chosen because these centers have specific days a week for antenatal care services, thus, making it easier for the researcher to invite pregnant women to participate in the study.

Sample size and sampling technique

The sample size needed for this study was calculated using the following formula:

$$N= Z^2_{a/2} PQ/D^2$$

Where Z= 1.96 for a 95% confidence level, P is the expected prevalence of 10% based on available literature, Q is the complement (90%), and D is the margin of error acceptable to the investigator. With a sample size of 317, the corresponding margin of error is 3.3%.

Operational definitions

Pregnancy-induced hypertension is defined as systolic blood pressure ≥ 140 mmHg or a diastolic blood pressure ≥ 90 mmHg or both in previously normotensive women (based on the average of at least two measurements taken at least 5 minutes apart).

Data collection

Data collection started in December 2019, paused during the covid-19 pandemic, and terminated in January 2021.

During the existence of the researcher in the antenatal care units, all pregnant women who were present on that day were invited to participate in the study. All women who agreed to participate were included in the study. All data were collected by the researcher (Rawan Jaradat). Data included a face-to-face interview using a structured questionnaire prepared for the purpose of this study, as well as measuring blood pressure, weight, and height.

Blood pressure was measured twice for each participant after rest for at least 5 minutes. The second measurement was taken after 5 minutes of the first one, and the average for both measurements was calculated.

All participants were in a fasting state since they are required to perform some routine laboratory tests as a part of antenatal care services.

Gestational age was calculated in weeks for each participant using the date of the last menstrual period.

Body mass index was calculated before and during pregnancy using the following formula:

$$BMI = \text{weight (kg)} / \text{height(m)}^2$$

If any participant failed to recall her pre-pregnancy weight, the record of her weight during her first visit to antenatal care was used in order to minimize missing data as much as possible.

Statistical analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 16. After data were entered, organized, coded properly, and cleaned, frequencies and percentages were calculated for all study variables. Then, relevant study variables were cross-tabulated with the outcome variable. Regression was performed to remove any confounding effect.

(P-value <= 0.05 was considered significant)

Ethical consideration

The Institutional Review Board (IRB) approval was obtained first, followed by the approval of the Education and Human Resource Development department in the Ministry of Health. Eventually, Irbid Health Directorate and Al-Ramtha Health Directorate approvals were obtained as well.

The study carried no harm for participants, included no experiments or any invasive procedures. Participation was optional, and an informed consent was obtained from every participating woman. The data were used only for scientific purposes and kept strictly confidential. Identifying information were not collected.

RESULTS

Characteristics of the study population:

Among 317 pregnant women, the highest proportion was 25-29 years of age (31.5%). Women less than 20 years of age and women more than 35 comprised (7.6%) and (14.2%) respectively. The highest proportion of women were in their third trimester of pregnancy (44.2%). Gestational diabetes was present in only (1.3%) of the participants. Diabetes mellitus was absent in all the participants (0%). Regarding the medical and family history of the disease, (13.9%) of the participating women had had pregnancy-induced hypertension during one of their previous pregnancies, (11.7%) either their mothers or sisters had suffered from pregnancy-induced hypertension, and (56.8%) had a positive family history of chronic hypertension. About parity, it ranged from 1 to 4 in a considerable number of the women (77.6%). Body mass index before pregnancy for the majority of the participating women was normal (51.5%) and (16.3%) were obese.

Finally, (2.5%) smoke cigarettes, and (9.8%) smoke waterpipe (Shesha).

Table 1. Charactaristics of the study population:-		
Variable	N	%
Age (mean=27.5, SD=5.89)		
<20 years	24	7.6%
20-24	85	26.8%
25-29	100	31.5%
30-34	63	19.9%
>35	45	14.2%
Gestational age		
First trimester	78	24.6%
Second trimester	99	31.2%
Third trimester	140	44.2%
Gestational diabetes		
Yes	4	1.3%
No	296	93.4%
Does not know	17	5.4%
PIH history		
Yes	44	13.9%
No	182	57.4%
First pregnancy	91	28.7%
Family history of PIH		
Yes	37	11.7%
No	270	85.2%
Does not know	10	3.2%
Family history of chronic hypertension		
Yes	180	56.8%
No	137	43.2%
Parity		
0	40	12.6%
1-4	246	77.6%
5+	31	9.8%
BMI before pregnancy (mean=24.87, SD=5.02)		
Underweight (<=18.4)	18	5.9%
Normal (18.5-24)	158	51.5%
Overweight (25-29)	81	26.4%
Obese >=30	50	16.3%
Smoking		
Yes	8	2.5%
No	309	97.5%
Shesha		
Yes	31	9.8%
No	268	84.5%
Stopped due to pregnancy	18	5.7%

Prevalence of pregnancy-induced hypertension:

The overall prevalence of pregnancy-induced hypertension among women who attended the maternity health centers was (7.6%). The mean of systolic blood pressure was (115) with a range of (84) mmHg

to (166) mmHg. The standard deviation was (12.96). The mean of diastolic blood pressure was (71) with a range of (45) mmHg to (107) mmHg. The standard deviation was (10.82).

Characteristics of mothers with and without PIH:

Table 2 illustrates the prevalence of pregnancy-induced hypertension by selected variables.

Table 2. Prevalence of pregnancy-induced hypertension by selected variables

variable	No	Yes	p value
Age group			0.067
<20	23 (95.8%)	1 (4.2%)	
20-24	83 (97.6%)	2 (2.4%)	
25-29	90 (90%)	10 (10%)	
30-34	59 (93.7%)	4 (6.3%)	
35+	38 (84.4%)	7 (15.6%)	
Gestational age			0.170
First trimester	74 (94.9%)	4 (5.1%)	
Second Trimester	94 (94.9%)	5 (5.1%)	
Third Trimester	125 (89.3%)	15 (10.7%)	
Gestational diabetes			0.398
Yes	4 (100%)	0 (0%)	
No	272 (91.9%)	24 (8.1%)	
Does not know	17 (100%)	0 (0%)	
Family history of PIH			0.688
Yes	33 (89.2%)	4 (10.8%)	
No	251 (93%)	19 (7%)	
Does not know	9 (90%)	1 (10%)	
tensionfamily history of chronic hyper			0.021
Yes	161 (89.4%)	19 (10.6%)	
No	132 (96.4%)	5 (3.6%)	
Parity			0.747
0	38 (95%)	2 (5%)	
1-4	227 (92.3%)	19 (7.7%)	
5+	28 (90.3%)	3 (9.7%)	
History of PIH			0.078
Yes	37 (84.1%)	7 (15.9%)	
No	171 (94%)	11 (6%)	
First pregnancy	85 (93.4%)	6 (6.6%)	
BMI before pregnancy			0.135
Underweight	17 (94.4%)	1 (5.6%)	
Normal	148 (93.7%)	10 (6.3%)	
Overweight	76 (93.8%)	5 (6.2%)	
Obese	42 (84%)	8 (16%)	
Total	24(7.6%)	293(92.4%)	

Among women who were 25-29 years of age, (10%) were hypertensive. Among women who were in their third trimester, (10.7%) were hypertensive.

Also, (15.9%) of women who had a history of pregnancy-induced hypertension were hypertensive and (10.6%) of women who

had a positive family history of chronic hypertension were hypertensive. Finally, (16%) of obese women were hypertensive.

Predictors of pregnancy-induced hypertension:

Using logistic regression analysis, the contributing factors which showed a statistically significant association with pregnancy-induced hypertension were body mass index before pregnancy, positive family history of chronic hypertension, and gestational age.

Pregnant women who had a positive family history of chronic hypertension were three times more likely to develop pregnancy-induced hypertension compared to women who had no family history of chronic hypertension (adjusted odds ratio =3.43, p=0.021). Obesity had increased the odds of pregnancy-induced hypertension four times (adjusted odds ratio =4, p=0.009).

Being in the third gestational trimester was approached statistical significance (adjusted odds ratio=3.13, p=0.06) but it will be considered statistically significant. Women who were in their third trimester of pregnancy were three times more likely to develop pregnancy-induced hypertension than those who were in their first or second trimester.

Maternal age, diabetes, positive history of pregnancy-induced hypertension, positive family history of pregnancy-induced hypertension, pregnancy body mass index, parity, and smoking were removed from the model because they have shown an insignificant association.

Table 3. Factors related to gestational hypertension using multivariate logistic regression

	Adjusted OR	P-value	**95% C.I**
Trimester		**0.05**	
1st trimester	1		
2nd trimester	1.30	**0.710**	0.33 , 5.21
3rd trimester	3.13	**0.06**	0.94 , 10.44
Family history of chronic hypertension		**0.023**	
Yes	3.43	**0.021**	1.21 , 9.72
No	1		
BMI		**0.023**	
Normal	1		
overweight	.987	**0.982**	.33 , 2.99
Obese	4	**0.009**	1.41 , 11.34

DISCUSSION

The aim of this study was to assess the prevalence of pregnancy-induced hypertension and the risk factors related to it. The prevalence of pregnancy-induced hypertension in the current study was (7.6%). Our reported prevalence is within the global range (4.6% to 13.1%) (Zhuang et al., 2019).

It is similar to two Ethiopian studies (Gudeta & Regassa, 2019b) (7.9%) and (Tessema, Tekeste, & Ayele, 2015) (8.4%). It is higher than a study performed in Saudi Arabia (Subki et al., 2018) (2.4%), and lower than (Khosravi, Dabiran, Lotfi, & Asnavandy, 2014) (9.8%), (Muti, Tshimanga, Notion, Bangure, & Chonzi, 2015) (19.4%), and (Walle & Azagew, 2019) (16.8%).

Differences in prevalence among the mentioned studies and our study might be due to differences in the populations.

In our study, women who were obese before pregnancy were four times more likely to develop pregnancy-induced hypertension than overweight or normal women. This result was consistent with (Kazemian et al., 2014). This study had indicated that obese women before pregnancy were nearly four times more likely to develop pregnancy-induced hypertension than overweight or normal women (adjusted odds ratio=4.44, 95%CI 1.84, 10.72). Similar results were reported by another study performed in Tigray region in Ethiopia (Kahsay, Gashe, & Ayele, 2018) (adjusted odds ratio =5.5, 95%CI 1.12, 27.6). The researchers of another study had found the mean of pre-pregnancy body mass index in women with pregnancy-induced hypertension higher than the mean in normotensive women (Lewandowska, Sajdak, Marciniak, & Lubiński, 2019).

The current study showed no significant association between increased body mass index during pregnancy and the risk of pregnancy-induced hypertension. A study performed in Saudi Arabia had reported similar results to us (Subki et al., 2018). However, other studies had demonstrated that maternal obesity during pregnancy increases the risk of pregnancy-induced hypertension (Kazemian et al., 2014; Owiredu et al., 2012; Parveen, Haider, Shaikh, & din Ujjan, 2009; Suleiman, 2014; Zhuang et al., 2019).

Maternal age in our study was not associated with pregnancy-induced hypertension. Our results were similar to (Kahsay et al., 2018). But, this is dissimilar to other studies results. Pregnant women

who were 35 years of age or more were four times more likely to develop pregnancy-induced hypertension than women aged 25-29 years of age (Tessema et al., 2015). As reported by a Ghanaian study, pregnant women aged between 35 and 39 years were nine times riskier to develop pregnancy-induced hypertension (Owiredu et al., 2012). In another study, it was reported that women between 30 and 40 years of age were at higher risk of developing pregnancy-induced hypertension (Parveen et al., 2009). Other studies that had confirmed the association between advanced maternal age and pregnancy-induced hypertension are (Subki et al., 2018; Walle & Azagew, 2019; Zhuang et al., 2019).

This association might be explained by the increased risk of cardiovascular disease development as the age increased, thus, increased risk of pregnancy-induced hypertension (Walle & Azagew, 2019).

Our study had demonstrated that smoking was neither responsible for an increased risk of pregnancy-induced hypertension or protect against it. This is similar to (Subki et al., 2018; Suleiman, 2014; Tessema et al., 2015; Walle & Azagew, 2019).

Some studies, unlike us, had declared maternal cigarette smoking as a protective factor against pregnancy hypertensive disorders (Marcoux, Brisson, & Fabia, 1989; Zhang, Klebanoff, Levine, Puri, & Moyer, 1999). The protective effect becomes stronger as the woman continues to smoke after 20 weeks of gestation (Marcoux et al., 1989). The protective effect of smoking persists even after smoking abandonment (Zhang et al., 1999).

A positive family history of chronic hypertension was considered a predictor for pregnancy-induced hypertension. This is similar to (Kazemian et al., 2014). Also, it's consistent with (Owiredu et al., 2012; Tessema et al., 2015; Walle & Azagew, 2019). These studies had reported seven times increased risk of pregnancy-induced hypertension for women with a positive family history of chronic hypertension. The odds ratio for the studies are (adjusted odds ratio=6.8, 95%CI 2.3, 19.6), (adjusted odds ratio =7.19, 95%CI 3.24, 15.2), (adjusted odds ratio =7.77, 95%CI 3.04, 19.62) respectively. Our results after adjusting for any confounders had shown that women with a positive family history of chronic hypertension were three times more likely to develop pregnancy-induced hypertension.

However, these results contradict the finding of (Kahsay et al., 2018) which had found family history of chronic hypertension insignificant.

Our study has shown no significant association for both family history of pregnancy-induced hypertension and previous history of pregnancy-induced hypertension.

Family history of pregnancy-induced hypertension was significantly associated with developing pregnancy-induced hypertension (Gudeta & Regassa, 2019b; Suleiman, 2014). Also, the previous history of pregnancy-induced hypertension was significantly associated with developing pregnancy-induced hypertension. Studies that were in support of this association are (Parveen et al., 2009; Suleiman, 2014; Zhuang et al., 2019).

Our study could not prove whether diabetes mellitus or gestational diabetes are significantly associated with pregnancy-induced hypertension or not. However, diabetes mellitus was declared a significantly associated factor according to these studies (Kahsay et al., 2018; Parveen et al., 2009; Subki et al., 2018; Suleiman, 2014; Zhuang et al., 2019), and gestational diabetes was also declared a significantly associated factor according to these studies (Bryson, Ioannou et al. 2003) (Khalimova, Ibragimova et al. 2020).

Parity was not found significantly associated with pregnancy-induced hypertension in our study. Likewise, these studies had reported the same results (Owiredu et al., 2012; Walle & Azagew, 2019; Zhuang et al., 2019). However, nulliparity was found to be significantly associated (Li, Binongo, & Kancherla, 2019; Suleiman, 2014). On the other hand, multiparity was found significantly associated with pregnancy-induced hypertension (Parveen et al., 2009).

In our study, women who were in their third trimester of pregnancy were three times more likely to develop pregnancy-induced hypertension than those who were in their first or second trimester. Compared to (Gudeta & Regassa, 2019b) it was different. They had found that being in the third trimester of gestation (greater than or equal to 37 weeks) is a protective factor against pregnancy-induced hypertension (adjusted odds ratio= 0.096, 95%CI 0.04, 0.23).

Pregnancy-induced hypertension was less frequent among pregnant women who received folic acid supplementation during pregnancy. Thus, folic acid intake was considered a protective factor

as mentioned by (Hernández-Díaz, Werler, Louik, & Mitchell, 2002) and (Xu et al., 2020). Unfortunately, we could not assess the protective effect of folic acid in our study since pregnant women and women who intend to get pregnant receive folic acid supplementation. Consequently, it makes no difference. But this might explain the low prevalence of pregnancy-induced hypertension in this study.

Calcium supplements intake was found to be associated with a lower risk of pregnancy-induced hypertension (Purwar, Kulkarni, Motghare, & Dhole, 1996; Ritchie & King, 2000; Zhuang et al., 2019). But for the same reason in folic acid assessment, we could not assess the effect of calcium intake as well.

CONCLUSION

The prevalence of pregnancy-induced hypertension among pregnant women who attended antenatal care units in health care centers is 7.6%. Family history of chronic hypertension, pre-pregnancy obesity, and being in the third gestational trimester were found to be significantly associated with pregnancy-induced hypertension.

Our findings suggest that more efforts should be targeting pre-pregnancy obesity to prevent pregnancy-induced hypertension.

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