A Predictive Study of Risk Factors for Hypertensive Disorders in Myanmar Pregnant Women*

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Abstract

Purposes: To identify age, parity, pre-pregnancy body mass index (BMI), family history of hypertension, and gestational diabetes mellitus (GDM) as the predictive factors for hypertensive disorders in Myanmar pregnant women.

Design: A predictive design.

Methods: The sample consisted of 388 pregnant women who attended the antenatal clinic of two tertiary teaching hospitals in Yangon, Myanmar. Study factors and personal data were collected with questionnaire. Data were analyzed by descriptive statistics, chi-square test, fisher's exact test and binary logistic regression analysis.

Main findings: Parity, pre-pregnancy BMI, family history of hypertension, and GDM were significantly accounted for 56.1% of variance to predict hypertensive disorders in Myanmar pregnant women. Primiparous women had 2.6 times higher risk of hypertensive disorders than those multiparous women (95%CI 1.1-5.9, $p < .05$). Women who had pre-pregnancy BMI ≥ 23 kg/m^2 had 14.8 times higher risk of hypertensive disorder than those who had pre-pregnancy BMI < 23 kg/m^2 (95%CI 3.4-65.2, $p < .05$). Pregnant women who had family history of hypertension had 3.3 times higher risk of hypertensive disorder than those who no family history of hypertension (95%CI 1.4-8.0, $p < .05$). Pregnant women who diagnosed with GDM had 24.6 times higher risk of hypertensive disorder than those who no GDM (95%CI 8.4-72.5, $p < .05$).

Conclusion and recommendations: Screening and monitoring risk factors of hypertensive disorders such as parity, pre-pregnancy BMI ≥ 23 kg/m^2, family history of hypertension and GDM, should be concerned. Pregnant women who are at risk of hypertensive disorders should be advised to change their lifestyle to control pre-pregnancy body weight.

Keywords: hypertensive disorders, risk factors, pregnant women

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การศึกษาปัจจัยเสี่ยงต่อการทำนายการเกิดภาวะความดันโลหิตสูงขณะตั้งครรภ์ในสตรีตั้งครรภ์ชาวพม่า*

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บทคัดย่อ

วัตถุประสงค์: ศึกษาอำนาจการทำนายของอายุ จำนวนครั้งของการคลอด ดัชนีมวลกายก่อนการตั้งครรภ์ ประวัติโรคความดันโลหิตสูงในครอบครัว และภาวะเบาหวานในขณะตั้งครรภ์ ต่อการเกิดภาวะความดันโลหิตสูงขณะตั้งครรภ์ในสตรีตั้งครรภ์ชาวพม่า

รูปแบบการวิจัย: การศึกษาเชิงทำนาย

วิธีดำเนินการวิจัย: กลุ่มตัวอย่างเป็นสตรีตั้งครรภ์ จำนวน 388 ราย ที่มาฝากครรภ์ที่โรงพยาบาลระดับตติยภูมิจำนวน 2 แห่งในกรุงย่างกุ้ง ประเทศพม่า เก็บรวบรวมข้อมูลโดยใช้แบบบันทึกข้อมูลส่วนบุคคล วิเคราะห์ข้อมูลด้วยสถิติเชิงพรรณนา ไคว์สแควร์ การทดสอบของฟิชเชอร์ และการวิเคราะห์การถดถอยโลจิสติก

ผลการวิจัย: จำนวนครั้งของการคลอด ดัชนีมวลกายก่อนการตั้งครรภ์ ประวัติโรคความดันโลหิตสูงในครอบครัว และภาวะเบาหวานในขณะตั้งครรภ์สามารถร่วมกันทำนายการเกิดภาวะความดันโลหิตสูงขณะตั้งครรภ์ของสตรีชาวพม่าได้ร้อยละ 56.1 โดยสตรีที่ตั้งครรภ์แรกมีโอกาสเสี่ยงต่อการเกิดภาวะความดันโลหิตสูงขณะตั้งครรภ์ 2.6 เท่าของสตรีตั้งครรภ์หลัง (95%CI 1.1-5.9, $p < .05$) สตรีที่มีดัชนีมวลกายก่อนการตั้งครรภ์ ≥ 23 กิโลกรัม/เมตร^2 มีโอกาสเสี่ยงต่อการเกิดภาวะความดันโลหิตสูงขณะตั้งครรภ์ 14.8 เท่าของสตรีที่มีดัชนีมวลกายก่อนการตั้งครรภ์ < 23 กิโลกรัม/เมตร^2 (95%CI 3.4-65.2, $p < .05$) สตรีตั้งครรภ์ที่มีประวัติบุคคลในครอบครัวเป็นโรคความดันโลหิตสูง มีโอกาสเสี่ยงต่อการเกิดภาวะความดันโลหิตสูงขณะตั้งครรภ์ 3.3 เท่าของสตรีตั้งครรภ์ที่ไม่มีประวัติบุคคลในครอบครัวเป็นโรคความดันโลหิตสูง (95%CI 1.4-8.0, $p < .05$) และสตรีที่มีภาวะเบาหวานในขณะตั้งครรภ์ มีโอกาสเสี่ยงต่อการเกิดภาวะความดันโลหิตสูงขณะตั้งครรภ์ 24.6 เท่าของสตรีที่ไม่มีภาวะเบาหวานในขณะตั้งครรภ์ (95%CI 8.4-72.5, $p < .05$)

สรุปและข้อเสนอแนะ: การคัดกรองและติดตามความเสี่ยงต่อการเกิดภาวะความดันโลหิตสูงขณะตั้งครรภ์ควรคำนึงถึงสตรีตั้งครรภ์แรก ดัชนีมวลกายก่อนการตั้งครรภ์ ≥ 23 กิโลกรัม/เมตร^2 มีประวัติบุคคลในครอบครัวเป็นโรคความดันโลหิตสูง และภาวะเบาหวานในขณะตั้งครรภ์ ซึ่งสตรีที่พบปัจจัยเสี่ยงเหล่านี้ควรได้รับคำแนะนำการปรับเปลี่ยนวิถีการดำเนินชีวิต เพื่อควบคุมน้ำหนักตัวก่อนการตั้งครรภ์

คำสำคัญ: ภาวะความดันโลหิตสูงขณะตั้งครรภ์ ปัจจัยเสี่ยง สตรีตั้งครรภ์

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Background and significance

Hypertensive disorders in pregnancy (HDP) is common medical complications for pregnant women that contribute to global burden of diseases in both developed and developing countries.1 Globally, hypertensive disorders are complicated in 5% to 10% of pregnancies.[1] It is complicated in 7.4% of pregnancies in Central Women Hospital, Myanmar.[2] World Health Organization's Review identified hypertensive disorders as the second leading cause of maternal mortality with 14% of all maternal deaths worldwide.[3] It was responsible for 12.9% of all maternal deaths in developed countries, 14.5% of all maternal deaths in Southeast Asia[3] and 21% of all maternal deaths in Myanmar.[4]

Hypertensive disorders in pregnancy is associated with serious complications to both mother and fetus which include eclampsia, hemolytic, elevated liver enzymes, low platelets (HELLP syndrome), disseminated intravascular coagulation (DIC), placental abruption, post-partum hemorrhage, intrauterine growth restriction, and preterm birth. In addition, women who had hypertensive disorders in pregnancy is at increased risk of recurrent complications in future pregnancy.[1]

The study of risk factors is the most important evidence to establish the guidelines for screening and monitoring of hypertensive disorders in order to reduce morbidity and mortality rate. Reviewing the previous literature found that extreme maternal age, primiparity, high pre-pregnancy BMI, family history of hypertension and GDM were not only the significant risk factors but also cause joint effect on hypertensive disorders.[5-8]

Extreme maternal age, high pre-pregnancy BMI, and GDM are associated with the risk of developing hypertensive disorders by means of increased insulin resistance.[5-7] Advancing maternal age is associated with increased insulin resistance due to age-related impairment of insulin-mediated glucose uptake.[7] Increased insulin resistance may adversely affect on blood pressure regulation by adipocytes dysfunction, elevated free fatty acid, and hyperinsulinemia.[7] Likewise, increased secretion of growth hormone is associated with decreased insulin sensitivity; relative increased insulin secretion and increased the ratio of fat-glucose oxidation during puberty.[9] The risk of hypertensive disorders was 2.6 times higher in those aged 13 to 16 years, 1.8 times higher in those aged 35 to 39 years and 2.4% higher in those aged over 40 years.[6]

High pre-pregnancy BMI is associated with inflammatory response which may contribute to increased insulin resistance, dyslipidemia, oxidative stress, and ultimately resulting hypertensive disorders.[10] Obesity is responsible for 30.6% and 36.5% of hypertensive disorders in primiparity and multiparity respectively.[5] The risk of hypertensive disorders is 7 times higher in overweight women.[11]

GDM leads to increase risk of hypertensive disorders by activation of sympathetic nervous system, hyperinsulinemia, adipocytes dysfunction, and alteration of angiogenic growth factors due to increased insulin resistance.[12] Women with GDM were 2.45 times more likely to develop hypertension compared with women without GDM.[13]

Maternal immune-maladaptation is one of the key issues for the development of hypertensive disorders in primiparous women.[14] The exaggerated immune response inhibits trophoblast invasion to certain extent and which may lead to very poor trophoblast invasion of the arteries, defective remodeling, constricted blood flow, hypoxia, and resulting in endothelial dysfunction with the development of hypertensive disorders.[15] The risk of hypertensive disorders range from 1.4 to 5.5 times increase in primiparous women compared with multiparous women.[8]

Family history of hypertension is significant risk factors for atherosclerosis cardiovascular diseases such as chronic hypertension, atherosclerosis and hypertensive

disorders during pregnancy.[16] Women who had genetic predisposition of chronic hypertension are at greatest risk for poor vascular compliance during pregnancy. Increased vascular wall thickness in women with familial predisposition of hypertension may predispose to decreased placental perfusion and endothelial dysfunction with manifestation of hypertensive disorders.[16] The risk of hypertensive disorders is two times higher in women who had family history of hypertension.[17]

In Myanmar, several studies focused on magnitude of the relationship between risk factors and the occurrence of hypertensive disorders, and the impact of hypertensive disorders on adverse pregnancy outcomes.[11,18-19] The causality of these risk factors to hypertensive disorders is still limited. Therefore, this study is developed to predict the risk of hypertensive disorders in Myanmar pregnant women using the combination of significant risk factors in previous studies. In addition, it was found that universally applied BMI cut-off points have been used to classify overweight and obesity in most of the previous studies.[11,20] Generally, there is a difference in association of BMI and body fat between Asian and non-Asian population. The magnitude of the association of BMI and risk of hypertensive disorders was stronger in Asian population than non-Asian population with lower BMI cut-off point.[21] Therefore, BMI cut-off point 23 kg/m^2 for overweight and obesity in Asian population will be used as a reference in this study.

Objective

To identify extreme age, primiparity, pre-pregnancy BMI ≥ 23kg/m^2, family history of hypertension, and GDM as predictive factors for hypertensive disorders in Myanmar pregnant women.

Methodology

Research design

A predictive research design aimed to identify the significant risk factors for hypertensive disorders in Myanmar pregnant women.

Population and sample

The population was comprised of pregnant women who visited antenatal clinic of Central Women Hospital and North Okkalapa General Hospital in Yangon, Myanmar. The sample size was calculated by using General power analysis (G* Power 3.1) with power (1-β error probability) of .80, an alpha probability of .05.[22] The effect size (Pr: H_0 = .62; Pr: H_1 = .68, OR = 1.30) was calculated based on the odds of pre-pregnancy BMI and parity in the previous study[23] with the formula of OR/1 +OR. Based on the calculation, the total sample size was 388 pregnant women. The 120 pregnant women from Central Women Hospital and 268 pregnant women from North Okkalapa General Hospital who met the inclusion criteria were recruited by using convenient sampling method. The inclusion criteria included singleton pregnancy, gestational age between 36 weeks and 42 weeks, age ≥18 years, Burmese language literacy and able to read and write Burmese language, well-oriented and able to communicate.

Research instrument

The personal data questionnaire was developed by the researcher which divided into two parts. The first part was self-administered questionnaire, containing socio-demographic characteristics such as age, race, education, occupation and family income, history of previous pregnancy, medical history, and family history. The second part of questionnaire was used to complete the information from the women's antenatal record sheet by the researcher and research assistant, including gestational age, pre-pregnancy body weight, height, body mass index, and pregnancy complications. The questionnaire was validated by three experts and was back translated from the English version to Burmese version. For reliabilities and consistencies of the questionnaire, the researcher explained the research assistant who is a lecturer with Bachelor Nursing degree at

the Central Midwifery Training School, regarding the contents of questionnaire and method of data collection. Afterwards, the research assistant collected the data from 20 pregnant women who attended the Antenatal Clinic of North Okkalapa General Hospital before the data collection was commenced. After checking the data, the researcher discussed with the research assistant regarding inconsistent data and explained the research assistant again until the data are clearly understood.

Procedures

1. Prior to data collection, the researcher gain an ethic approval from the Institutional Review Board (IRB) of Faculty of Nursing, Mahidol University in Bangkok, Thailand (COA No.IRB-NS 2016/325.1502) and Ethical and Research Committee, University of Nursing, Yangon, Myanmar (March 3rd, 2016).

2. After getting the approval, the researcher submitted an introduction letter from the Faculty of Graduate Studies, Mahidol University to the Director of the Central Women Hospital, and North Okkalapa General Hospital in Yangon for permission to conduct the research.

3. Following approval to conduct the study, potential participants were identified, informed about the study and asked, by the nurse in the antenatal clinics used as the study sites, if they would be interested in taking part in the study.

4. The participants were informed about the purpose, procedure, risk and benefits of participating in the study, and their rights to withdraw from the study at any time.

5. Once participants signed on the consent form, they were informed about the method of completing questionnaire and were asked to answer the first part of questionnaire for 15 to 20 minutes. The confidentiality of the participants was carefully protected using code number on the questionnaire instead of their name. The second part of questionnaire was completed by the researcher and research assistant using the information from the participant's antenatal record sheet.

6. This study, the diagnosis of hypertensive disorders was recorded from the women's antenatal record sheet. The participants were followed by telephone at the sixth week after delivery to rule out the possibility of chronic hypertension.

The data analysis was conducted as follows:

1. Descriptive statistics was used to describe the demographic characteristics of pregnant women.

2. Chi-square test or Fisher's exact test was used to compare the variables among pregnant women with hypertensive disorders and those without hypertensive disorders.

3. The risk factors that contribute to hypertensive disorders were examined using the binary logistic regression analysis with a significant level of .05. In this study, binary logistic regression analysis with enter method was applied to calculate adjusted odds ratio for the effect of other variables.

Results

1. General characteristics of the participants

The pregnant women with gestational age between 36 weeks and 42 weeks were invited to participate in the study during their regular antenatal visit at two tertiary teaching hospitals in Yangon in March, 2016. One hundred and twenty pregnant women from Central Women Hospital and 268 pregnant women from North Okkalapa General Hospital who met the inclusion criteria were recruited in this study. In 388 pregnant women, there were 52 (13.4%) pregnant women diagnosed with hypertensive disorders. Of these patients, 31 (8%) was diagnosed with gestational hypertension, 20 (5.1%) was diagnosed with pre-eclampsia, and only 1 (0.3%) was diagnosed with superimposed pre-eclampsia. The participants were followed by telephone at sixth week after delivery to rule out the possibility of chronic hypertension. The blood pressure of these women had returned

to normal which was lower than 140/90 mmHg. This meant all 52 pregnant women were correctly diagnosed as hypertensive disorders of pregnancy defined by this study. No participants dropped out from the study.

2. Demographic characteristics of the participants

Chi-square or Fisher's exact test was used to compare the demographic characteristics of participants including race, education, occupation, family income, gravida, complications in previous pregnancy, medical history, family history of diabetes mellitus, and family history of hypertensive disorders during pregnancy. Statistically significant differences were found in gravida, complications in previous pregnancy, and family history of diabetes mellitus between pregnant women diagnosed with hypertensive disorders and those who without hypertensive disorders ($p < .05$) (Table 1).

Table 1 Demographic characteristics of the participants

Demographic characteristics	HDP n = 52 (%)	Without HDP n = 336 (%)	Total n = 388 (%)	χ^2	P Value
Race				1.52	.468
Burmese	39 (75.0)	262 (78.0)	301 (77.6)		
Karin, Chin, Mon, Rakhine, Shan	7 (13.5)	28 (8.3)	35 (9.0)		
Indian	6 (11.5)	46 (13.7)	52 (13.4)		
Education				1.68	.641
Elementary	11 (21.2)	72 (21.4)	83 (21.4)		
Middle	13 (25.0)	74 (22.0)	87 (22.4)		
High	14 (26.9)	118 (35.2)	132 (34.0)		
≥ Diploma	14 (26.9)	72 (21.4)	86 (22.2)		
Occupation					.794[F]
Housewife	37 (71.2)	244 (72.6)	281 (72.4)		
Wage-employment	5 (9.6)	38 (11.3)	43 (11.1)		
Self-employment	10 (19.2)	49 (14.6)	59 (15.2)		
Student	0 (0)	5 (1.5)	5 (1.3)		
Family income (MMK)				2.93	.231
< 150,000	6 (11.6)	38 (11.3)	44 (11.3)		
150,000-300,000	36 (69.2)	261 (77.7)	297 (76.6)		
> 300,000	10 (19.2)	37 (11.0)	47 (12.1)		
Mean (±SD)	262500 (±135832.58)	37098.21 (±140181.61)	240502.58 (±139703.24)		
Minimum	100,000	100,000	100,000		
Maximum	600,000	1,500,000	1,500,000		
Gravida				9.73	.002
Primigravida	31 (59.6)	123 (36.6)	154 (39.7)		
Multigravida	21 (40.4)	213 (63.4)	234 (60.3)		
- 2 times	8 (15.4)	133 (39.6)	141 (36.3)		
- 3 times	7 (13.5)	56 (16.7)	63 (16.2)		
- ≥4 times	6 (11.5)	24 (7.1)	30 (7.7)		
Maximum	7	7	7		

[F] = Fisher's exact test

Abbreviation: MMK = Myanmar Kyat (1200 MMK equal to 1 USD), HDP = Hypertensive Disorders of Pregnancy

Table 1 Demographic characteristics of the participants (cont.)

Demographic characteristics	HDP n = 52 (%)	Without HDP n = 336 (%)	Total n = 388 (%)	χ^2	P Value
Complications in previous pregnancy					**.000[F]**
No	**42 (80.8)**	**324 (96.4)**	**366 (94.3)**		
Yes	**10 (19.2)**	**12 (3.6)**	**22 (5.7)**		
- GH	6 (11.5)	1 (0.3)	7 (1.8)		
- PE	4 (7.7)	5 (1.5)	9 (2.3)		
- GDM	0 (.0)	6 (1.8)	6 (1.6)		
Medical history					**.181[F]**
No	**45 (86.5)**	**310 (92.3)**	**355 (91.5)**		
Yes#	**7 (13.5)**	**26 (7.7)**	**33 (8.5)**		
- HT	7 (13.5)	8 (2.4)	15 (3.9)		
- RD	0 (.0)	1 (0.3)	1 (0.3)		
- DM	1 (1.9)	2 (0.6)	3 (0.8)		
- CVD	0 (.0)	10 (3.0)	10 (2.6)		
- Asthma	0 (.0)	1 (0.3)	1 (0.3)		
- Athritis	0 (.0)	2 (0.6)	2 (0.5)		
- TB	0 (.0)	1 (0.3)	1 (0.3)		
- SLE	0 (.0)	1 (0.3)	1 (0.3)		
Family history of DM				**7.36**	**.004**
No	**36 (69.2)**	**287 (85.4)**	**323 (83.2)**		
Yes#	**16 (30.8)**	**49 (14.6)**	**65 (16.8)**		
- Father	5 (9.6)	15 (5.0)	20 (5.2)		
- Mother	12 (23.1)	26 (7.7)	38 (9.8)		
- Siblings	0 (.0)	14 (4.2)	14 (3.6)		
Family history of HDP					**.155[F]**
No	**47 (90.4)**	**322 (95.8)**	**369 (95.1)**		
Yes	**5 (9.6)**	**14 (4.2)**	**19 (4.9)**		
- Mother	5 (9.6)	6 (1.8)	11 (2.8)		
- Siblings	0 (.0)	8 (2.4)	8 (2.1)		

[F] = Fisher's exact test; # 1 participant has more than one disease; Abbreviation: HDP = Hypertensive Disorders of Pregnancy, GH = Gestational Hypertension, PE = Preeclampsia, GDM = Gestational Diabetes Mellitus, HT = Hypertension, RD = Renal Diseases, DM = Diabetes Mellitus, CVD = Cardiovascular Diseases, TB = Tuberculosis, SLE = Systemic Lupus

3. Characteristics of independent variables

Chi-square or Fisher's exact test were used to compare the characteristics of independent variables including age, parity, pre-pregnancy BMI, family history of hypertension and GDM. Statistically significant difference were found in characteristics of independent variables between the pregnant women diagnosed with hypertensive disorders and those who without hypertensive disorders ($p < .05$) (Table 2).

Table 2 Characteristics of independent variables

Demographic characteristics	HDP n = 52 (%)	Without HDP n = 336 (%)	Total n = 388 (%)	χ^2	P Value
Age (years)				**33.77**	**.000**
< 20	0 (0.0)	19 (5.6)	19 (4.9)		
20-34	26 (50.0)	264 (78.6)	290 (74.7)		
≥ 35	26 (50.0)	53 (15.8)	79 (20.4)		
Mean (± SD)	34.6 (± 6.06)	28.4 (± 5.77)	29.2 (± 6.18)		
Minimum	20	19	19		
Maximum	47	47	47		
Parity				**6.14**	**.013**
Primipara	32 (61.5)	145 (43.2)	177 (45.6)		
Multipara	20 (38.5)	191 (56.8)	211 (54.4)		
- 1 time	9 (17.3)	126 (37.5)	135 (34.8)		
- 2 times	7 (13.5)	44 (13.1)	51 (13.1)		
- ≥ 3 times	4 (7.7)	21 (6.3)	25 (6.4)		
Maximum	4	7	7		
Pre-pregnancy BMI (kg/m²)				**97.06**	**.000**
- Underweight (≤ 18.49)	0 (0.0)	32 (9.5)	32 (8.2)		
- Normal weight (18.50-22.99)	2 (3.9)	157 (46.8)	159 (41.0)		
- Over weight (23.00-27.49)	18 (34.6)	114 (33.9)	132 (34.0)		
- Obese (≥ 27.5)	2 (61.5)	33 (9.8)	65 (16.8)		
Mean (±SD)	28.90 ± 3.89)	22.82 (± 3.56)	23.64 (± 4.16)		
Minimum	21.8	15.9 15.9	15.9		
Maximum	38.6	37.7	38.6		
Family history of HT				**27.40**	**.000**
No	13 (25.0)	213 (63.4)	226 (58.2)		
Yes#	39 (75.0)	123 (36.6)	162 (41.8)		
- Father	16 (30.8)	40 (11.9)	56 (14.4)		
- Mother	23 (44.2)	70 (20.8)	93 (24.0)		
- Sibling	3 (5.8)	9 (2.7)	12 (3.1)		
GDM					**.000[F]**
No	24 (46.2)	329 (97.9)	353 (91.0)		
Yes	28 (53.8)	7 (2.1)	35 (9.0)		

[F] = Fisher's exact test; # 1 participant has more than one disease; Abbreviation: HDP = Hypertensive Disorders of Pregnancy, GDM = Gestational Diabetes Mellitus, HT = Hypertension

Predictive factors

The results illustrated that the four factors significantly predict the risk of hypertensive disorders which were primiparity (OR 2.55, 95% CI 1.10-5.93, p < .05), BMI ≥23 kg/m² (OR 14.83, 95% CI 3.38-65.18, p < .05), family history of hypertension (OR 3.34, 95% CI 1.40-8.00, p < .05), and gestational diabetes mellitus (OR 24.60, 95% CI 8.35-72.45, p < .05) (Table 3).

Table 3 Binary logistic regression analysis

Risk factors	Women with HDP n = 52 (%)	Women without HDP n = 336 (%)	B	OR	95% CI	p-value
Age (years)						
20-34[R]	26 (50)	264 (78.6)	-	-	-	-
< 20 or ≥ 35	26 (50)	72 (21.4)	0.756	2.13	0.88-5.15	.093
Parity						
Multiparity[R]	20 (38.5)	191 (56.8)	-	-	-	-
Primiparity	32 (61.5)	145 (43.2)	0.937	2.55	1.10-5.93	.030
Pre-pregnancy BMI (kg/m²)						
< 23[R]	2 (3.8)	189 (56.3)	-	-	-	-
≥ 23	50 (96.2)	147 (43.7)	2.697	14.83	3.38-65.18	.000
Family history of HT						
No[R]	13 (25)	213 (63.4)	-	-	-	-
Yes	39 (75)	123 (36.6)	1.207	3.34	1.40-8.00	.007
GDM						
No[R]	24 (46.2)	329 (97.9)	-	-	-	-
Yes	28 (53.8)	7 (2.1)	3.203	24.60	8.35-72.45	.000
Constant			**-5.941**			

Nagelkerke R^2 = .561; -2 LL = 163.91; Cox & Snell R^2 = .306; χ^2 = 12.560, df = 8, Sig = .128
[R] = Reference group; Abbreviation: HDP = Hypertensive Disorders of Pregnancy; BMI = Body Mass Index; HT = Hypertension, GDM = Gestational Diabetes Mellitus; OR = Odds Ratio; CI = Confident Interval

Discussion

The findings reveal that primiparous women were associated with a 2.55 times risk of hypertensive disorders. Maternal immune-maladaptation is one of the key issues for the development of hypertensive disorders in primiparous women.[14] The exaggerated immune response inhibits trophoblast invasion to certain extent and which may lead to very poor trophoblast invasion of the arteries, defective remodeling, constricted blood flow, hypoxia, and resulting in endothelial dysfunction with the development of hypertensive disorders.[8] Similarly with the previous study, the risk of hypertensive disorders range from 1.4 to 5.5 times increase in primiparous women compared with multiparous women.[8]

Pre-pregnancy BMI ≥ 23 kg/m² was an important predictor of hypertensive disorders of pregnancy with adjusted OR of 14.83. Increased insulin resistance in obesity could precipitate the risk of hypertensive disorders.[10] In a recent study, the magnitude of the association of BMI and the risk of hypertensive disorders was higher than previous study in Myanmar, which found that the risk of hypertensive disorders was significantly associated with high BMI with adjusted OR of 7.37.[11] It was assumed due to discrepancy in BMI categories. In general, a mean BMI of Asian population is lower than non-Asian population.[21] The magnitude of the association of BMI and risk of hypertensive disorders was stronger among Asian population though high pre-pregnancy weight was rare.

Similarly, the pregnant women who had family history of hypertension were 3.3 fold higher the risk of developing hypertensive disorders compared to those without family history of hypertension. It was congruent with

the finding that family history of hypertension could predict the risk of hypertensive disorders with adjusted OR 7.05.[16] Increased vascular wall thickness in women with familial predisposition of hypertension may predispose to decreased placental perfusion and endothelial dysfunction with manifestation of hypertensive disorders.[16-17]

In addition, the pregnant women who had GDM had significantly higher risk of hypertensive disorders compared to those without GDM ($p < .05$). GDM leads to increase risk of hypertensive disorders by activation of sympathetic nervous system, hyperinsulinemia, adipocytes dysfunction, and alteration of angiogenic growth factors due to increased insulin resistance.[12] Like the previous study, women with GDM were 2.45 times more likely to develop hypertension compared with women without GDM.[13]

Contrastingly, the research finding revealed that extreme age could not predict the risk of developing hypertensive disorders. The majority of women in this study were greater than 20 years (Table 2). Furthermore, the fact that Myanmar cultural value could attribute to delay in age of marriage and first birth.[24] In this study, the partial correlation of extreme age and the hypertensive disorders were lower than other risk factors ($r = .098$, $p = .056$). Thus, as a recent study revealed, extreme age seemed to have no effect on the hypertensive disorders. Other previous studies could support this study. Similarly, a case-control study described that extreme maternal age could not be demonstrated as a risk factor of hypertensive disorders.[16] It was also evidenced that advanced maternal age was strongly associated with chronic hypertension but not any forms of hypertensive disorders in pregnancy.[25]

Limitation

There was difference in preliminary test of glucose tolerance between two settings of recent study. In one setting, all pregnant women were underwent preliminary test of glucose tolerance by plasma glucose measurement. But another setting was done only in high risk women. It may lead to underestimation of the prevalence of GDM in low risk pregnant women.

Conclusion and recommendations

1. This study is useful for nursing and midwifery practice in screening and monitoring risk of hypertensive disorders in primiparous women, women who had pre-pregnancy BMI ≥ 23 kg/m^2, women with family history of hypertension and women diagnosed with GDM. In addition, the nurses-midwives could help the high risk pregnant women to control their pre-pregnancy body weight with diet and physical activity and to develop appropriated intervention strategies.

2. This research should be replicated in a large group of different ethnic backgrounds to increase generalization of the study. Moreover, the further research should study in other risk factors such as energy intake, calcium intake, fiber intake, and lifestyle.

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