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The Relationship between Demographic-Obstetrics Variables and Quantitative Adequacy Index of Prenatal Care with Preeclampsia

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Abstract

Background: Preeclampsia is one high blood pressure (hypertension) disorder occurring during pregnancy with adverse effects on both mother and fetus.

Aim: The present study was performed with aim to determine the relationship between demographic-obstetrics variables and quantitative adequacy index of prenatal care with preeclampsia.

Method: This case-control study was performed on 90 preeclampsia and 150 non-preeclampsia women referred to the university hospitals in Mashhad. The samples in the case group were selected from the hospitalized individuals with a definite diagnosis of preeclampsia, and those in the control group among pregnant women without preeclampsia referred to receive prenatal care. Data were analyzed by SPSS software (version 22). $P<0.05$ was considered statistically significant.

Results: The prevalence of preeclampsia was 2 times in women with a history of infertility. Also, 13.3% of women with preeclampsia had anemia ($p=0.026$), 4.4% had a history of chronic hypertension and the odds of developing preeclampsia in these women was 16 times. The women with preeclampsia received 50% inadequate care, which was 47.2% in the control group.

Implications for Practice: Age, body mass index, maternal pre-pregnancy weight, LMP-based gestational age, multiple births, nulliparity, first pregnancy of current spouse, history of infertility and use of assisted reproductive technology, chronic hypertension and history of preeclampsia in individual and first grade relatives, and inadequate prenatal care were the risk factors for preeclampsia. Planning to moderate risk factors, early identification of high-risk individuals, and adequate prenatal care coverage should be considered by healthcare providers to decrease the complications of preeclampsia.

Keywords: Obstetrics care, Preeclampsia, Pregnancy, Prenatal care

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Introduction

Preeclampsia is a condition that occurs in the second half of pregnancy (from 20 weeks), which is associated with protein excretion in urine (proteinuria) (1). Preeclampsia disrupts the functioning of the cardiovascular, endocrine, metabolic and brain systems, and also causes major changes in peripheral blood flow (2). The prevalence of preeclampsia in developing countries is between 1.8 and 16.7% depending on the diagnosis criteria and the study population (3). It is the second most widespread cause of maternal mortality in Iran that accounts for 14% of maternal mortality (4,5). Preeclampsia seems to cause long-term complications in later stages of mother-infant life (6). Since there is no screening test for preeclampsia, finding the risk factors for the disease during pregnancy care can also alert the caregiver for the possibility of disease. Several risk factors have been suggested for preeclampsia, including a history of previous preeclampsia, maternal age, diabetes, chronic hypertension, neonatal parity, birth intervals, and history of miscarriage, increased body mass index, twins, migraine and maternal RH and blood group (8,9). Liu et al. (2012) reported that independent risk factors for mild preeclampsia include chronic hypertension, history of miscarriage, body mass index and for severe preeclampsia, it only includes the history of previous preeclampsia. Negative RH is the only common risk factor for mild to severe preeclampsia that is associated with different types of preeclampsia (10).

Quan et al. (2018) considered BMI more than 24 kg/m^2, age over 35 years, and history of previous hypertension as the risk factors for preeclampsia (7). The results of the study by Shiozaki et al. (2018) indicated that preeclampsia was more common in older and obese women with insulin resistant and a history of hypertension or kidney disease, diabetes, and gestational hypertension. In contrast, maternal smoking and physical activity reduced the risk of preeclampsia (8). Other risk factors for preeclampsia include a history of thromboembolism, a personal or family history of preeclampsia, chronic hypertension, metabolic syndrome, Systemic Lupus Erythematosus (4), and passing 10 years or more than previous pregnancy (9).

Sufficient prenatal care is an effective intervention to improve pregnancy outcomes that provides an opportunity for counseling and reduction of complications associated with childbirth and infants (10). It is now affirmed that the provision of prenatal care is more cost-effective than any intervention to reduce the rate of maternal and neonatal mortality and morbidity (11). On the other hand, adequacy of prenatal care is an important factor to predict maternal and neonatal mortality (11). Women who receive inadequate care during pregnancy are more likely to experience problematic situations (12). Bostani Khalesi et al. (2015) reported that most cases of preterm birth, neonatal death, low birth weight and neonatal jaundice were in the group with inadequate prenatal care (13). Chung et al. (2008) in a research showed that, the birth rate of a low birth weight baby was higher in women who have not received any prenatal care than those who started prenatal care in the first trimester (14).

As preeclampsia remains a serious and poorly understood complication of pregnancy, it is necessary to recognize the epidemiological and clinical risk factors to predict the disease especially in high risk pregnant women before it threatens the survival of both mother and fetus. Given the importance of preeclampsia as a research priority, contradictory results in some risk factors, limited studies in this field in Iran and the importance of identifying risk factors for preeclampsia in order to prevent and reduce the incidence and complications of the disease, as well as the lack of studies on the relationship between the quantitative adequacy index of prenatal care and preeclampsia, the present study was performed with aim to determine the relationship between demographic-obstetrics variables and quantitative adequacy index of prenatal care with preeclampsia.

Methods

This case-control study was performed on 240 women (90 in preeclampsia group with (40 with severe preeclampsia and 50 with non-severe preeclampsia) and 150 patients in the control group (healthy) who referred to the university hospitals in Mashhad (Imam Reza, Ghaem, Umm Al-Banin, and Hasheminejad hospitals). All the hospitals in the present study have a prenatal clinic and operate according to the same protocols in terms of variables. The sample size was calculated using a priori power calculation to achieve80% power, accordingly, the final sample size was estimated to be 240; 90 with preeclampsia and 150 without preeclampsia.

Inclusion criteria were Iranian nationality, gestational age of 28 to 40 weeks, having preeclampsia in the case group and not having preeclampsia in the control group. Exclusion criteria were

unwillingness of the participants to continue the study. The diagnosis of preeclampsia was based on having blood pressure equal to or greater than 140/90 mmHg with proteinuria greater than 300 mg in 24-hour urine (4). Data was obtained by studying the clinical record and measuring blood pressure by the researcher and approval of a gynecologist. The control group (healthy) was selected among non-preeclampsia pregnant women referred to the obstetrics clinic for prenatal care and maternity wards of the mentioned hospitals. In the control group, follow-up was performed up to 24 hours after delivery so that in case of preeclampsia, the person was transferred from the control group to the case group. Data collection tools included demographic information form and obstetric records, clinical evaluation form to determine the symptoms and severity of preeclampsia and standard index of quantitative adequacy of pregnancy care. The demographic information form and obstetric records were made by research team and their validity were determined through content validity using the opinions of seven faculty members of the Mashhad University of Medical Sciences. Their reliability was also confirmed by Cronbach's alpha coefficient (r=90%). The clinical evaluation form to determine the symptoms and severity of preeclampsia was taken according to national laws reference (4).

Quantitative adequacy index of prenatal care, based on gestational age, month of care and number of pregnancy visits from the first visit to delivery compared to the expected number (American College of Obstetrics and Gynecology), one visit per month for up to 28 weeks, and then every two weeks up to 36 weeks and then every week until delivery in four special groups: adequate, moderate and inadequate. Intensive care includes prenatal care which starts during the first 4 months and the number of visits is 110% or more than the recommended number. Adequate care starts during the first 4 months and the number of visits is 80 to 109% of the recommended number. Moderate care starts during the first 4 months and the number of visits was 50 to 79% of the recommended number and inadequate care starts after the first 4 months and is less than 50% of the recommended number (1). In Iran, according to the national program "Safe Mothers", the number of routine pregnancy care is 8 times, during the first half of pregnancy, the first week (two cares at weeks 6-10 and 16-20), and in the second half of pregnancy, six cares should be carried out at weeks 24-30, 34-31, 35-37, 38, 39 and 40 (10).

Mean and standard deviation indices were used for quantitative variables and relative and absolute frequency distribution indices for relative qualitative variables in order to describe demographic characteristics of the participants. Data were analyzed using SPSS software (version 20) and Chi-square, Mann-Whitney and logistic regression models. $p<0.05$ was considered statistically significant.

Results

Socio-demographic characteristics

The mean age of mothers in the case group (31.5±0.7 years) was higher than the control group (29.0±6.5 years); Mann-Whitney test showed a statistically significant difference between the two groups ($p=0.008$). Logistic regression test showed that the odds of preeclampsia was 1.056 times higher in older women ($p<0.008$, CI: 1.014-1.099, OR: 1.056). All independent variables were pooled.

Mean of body mass index (28.3±6.8 kg/m^2) and mean weight before pregnancy (70.7±17.5 kg) were higher in preeclampsia group; a statistically significant difference was observed between the two groups ($p<0.005$). According to the logistic regression test, women with higher pre-pregnancy weight ($p<0.004$, CI: 1.009-1.048, OR: 1.028) and more body mass index ($p<0.033$, CI: 1.071-0.991, OR: 1.030) were 1.028 and 1.030 times more likely to develop preeclampsia, respectively (Table 1 and 2).

Midwifery Characteristics

The mean gestational age based on LMP in preeclampsia group (34.2 ± 4.5 weeks) was lower than the control group (37.2±3.6 weeks) ($p<0.001$). Moreover, 4 (2.6%) of healthy individuals and 8(8.8%) of individuals with preeclampsia had multiple pregnancies; Fisher Exact test reported a statistically significant difference between the two groups ($p=0.061$). In addition, 19.3% of women in the control group and 26.6% in the case group were nulliparous ($p=0.085$).

Table 1: Demographic characteristics of the participants in two groups of healthy and preeclampsia

Variable	N (%)		*p*-value*
	Preeclampsia	Healthy	
Mother's education			
Illiterate	5(5.5)	4(2.6)	0.213
Primary school	27(30)	39(26)	
Secondary school	24(26.6)	41(27.3)	
High school	23(25.5)	56(37.3)	
University	11(12.2)	10(6.6)	
Mother's job			
Housewife	81(90)	137(91.3)	0.118
Employee	4(4.4)	0(0) 13(8.6)	
Freelance	5(5.5)		
Place of residence			
City	61(67.7)	98(65.3)	0.623
Village	29(32.2)	52(34.6)	
Income status			
Less than enough	55(61.1)	91(60.6)	0.583
Enough	34(37.7)	59(39.3)	
More than enough	1(1.1)	0(0)	
Spouse job			
Unemployed	5(5.6)	5(3.3)	
Student	0(0.0)	2(1.3)	0.010
Freelance	48(53.3)	102(68.0)	
Employee	8(8.9)	12(1.3)	
Worker	29(32.2)	39(26.0)	

*Chi-square test

Table 2: The result of logistic regression, the effect of some demographic-obstetrics characteristics and more important contexts on the incidence of preeclampsia

Variable	Coefficient	Coefficient of standard error	Parent statistics	Odds ratio	Odds ratio		*p*-value
					Low limit	Upper line	
Mother's age	0.055	0.021	7.072	1.056	1.014	1.099	0.008
Mother's height	0.012	0.017	0.459	1.012	0.978	1.047	0.498
Maternal current weight at the time of diagnosis (kg)	0.039	0.012	10.410	1.040	1.015	1.064	0.001
Maternal weight before pregnancy (kg)	0.028	0.010	8.202	1.028	1.009	1.048	0.004
Gestational age based on LMP (weeks)	-0.182	0.043	17.561	0.834	0.766	0.908	<0.001
The first pregnancy of the current spouse (Yes)	0.632	0.293	4.648	1.881	1.059	3.340	0.031
History of infertility (Yes)	0.697	0.346	4.046	2.007	1.018	3.958	0.044
Anemia in the current pregnancy (Yes)	1.196	0.565	4.481	0.302	0.100	0.915	0.034
Chronic hypertension in the current pregnancy (Yes)	2.807	1.063	6.970	16.556	2.061	133.000	0.008
History of chronic hypertension in previous pregnancy (Yes)	2.925	1.058	7.642	18.625	2.342	148.117	0.006
History of preeclampsia in first-degree relatives of mother or sister (Yes)	1.758	0.536	10.771	5.800	2.030	16.571	0.001

There was a statistically significant difference between the two groups in terms of the first pregnancy of the current spouse (p=0.030), so that 34 (41%) of women with preeclampsia had their first pregnancy with their current spouse and the odds of developing preeclampsia in them was 1.8 times (p<0.031, CI: 1.059-3.340, OR: 1.8). Also, 13.3% (n=20) of healthy individuals and 23.6% (n=21) of individuals with preeclampsia had a history of infertility, which was statistically significant between the two groups (p=0.042), so that the odds of developing preeclampsia in individuals with a history of infertility was 2 times (p<0.440, CI: 1.018-3.95, OR: 2). Moreover, 4.6% (n=7) of healthy women and 10 (11.1%) of infected women had a history of using assisted reproduction (p=0.066) (Table 2 and 3).

Table 3: Obstetrics characteristics of the participants in two groups of healthy and preeclampsia

Variable	Mean±SD		p-value
	Preeclampsia	Healthy	
Maternal systolic blood pressure (mmHg)	131.5±15.6	108.6±9.6	<0.001*
Maternal diastolic blood pressure (mmHg)	81.4±13.9	68.4±9.0	<0.001*
Mother's age (years)	31.5±7.0	29.0±6.5	<0.008*
Mother's height (cm)	159.1±13.1	158.0±8.7	<0.035*
Maternal current weight at the time of diagnosis (kg)	85.3±18.4	73.9±15.9	<0.001*
Maternal weight before pregnancy (kg)	70.7±17.5	63.7±14.6	<0.009*
Pre-pregnancy BMI (kg/m^2)	28.3±6.8	26.2±8.9	<0.010*
Gestational age Based on LMP (week)	34.2±4.5	37.2±3.6	<0.001*
	N (%)		
Number of deliveries			
Nulliparous	24(26.6)	29 (19.3)	0.085**
One delivery	30 (33.3)	49 (32.6)	
2 deliveries and more	36 (0.4)	79 (52.6)	
First pregnancy of the current spouse			
Yes	34(41.0)	38(27.0)	0.030**
No	49(59.0)	103(73.0)	
Anemia in the current pregnancy			
Yes	4(4.4)	20(13.3)	0.026**
No	86(95.0)	130(86.7)	
History of infertility			
Yes	21(23.6)	20(13.3)	0.042**
No	68(76.4)	130(86.7)	
Preeclampsia in previous pregnancies			
Yes	10(11.1)	1(0.7)	<0.001***
No	80(88.9)	149(99.3)	
History of chronic hypertension in previous pregnancy			
Yes	4(4.4)	0(0.0)	<0.019***
No	86(95.6)	150(100.0)	
Chronic hypertension in the current pregnancy			
Yes	9(10.0)	149(99.3)	<0.001***
No	81(90.0)	1(0.7)	
History of preeclampsia in first-degree relatives of mother or sister			
Yes	15(16.7)	5(3.3)	<0.001**
No	75(83.3)	145(96.7)	

*Mann-Whitney U; **Chi-square; ***Fisher's exact test

Disease Background

According to the results, 20 (13.3%) of patients with preeclampsia had anemia, which was 4 (4.4%) in the control group; there was a statistically significant difference between the two groups (p=0.026). In addition, 4 (4.4%) of women with preeclampsia had a history of chronic hypertension and the odds of developing preeclampsia in these women was 16 times (p<0.008, CI: 2.061-133.000, OR: 16). Moreover, in preeclampsia group, 3 (3.3%) had a history of asthma (p=0.052), 3 (3.3%) had autoimmune disease (p=0.052), 3 (3.3%) had a history of preterm labor (p=0.052), 4 (4.4%) had a history of diabetes in previous pregnancies (p=0.067), which based on Fisher test, the difference between the two groups was significant (p<0.05). Also, in preeclampsia group, 10 (11.1%) had a history of preeclampsia in previous pregnancies with 18-times odds of preeclampsia (p<0.006, CI: 2.342-148.117, OR: 18); 15 (16.6%) had a history of preeclampsia in first degree relatives (siblings) (p<0.001, CI: 2.03-16.57, OR: 5) who were 5 times more likely to have preeclampsia.

Pregnancy Care

The majority of women received prenatal care in the health center, so that 94% of healthy women and 84.4% of women with preeclampsia referred to health centers for prenatal care (p=0.015). According to the quantitative adequacy index of prenatal care, 50% women with preeclampsia and 47.2% of healthy women received inadequate care. In addition, 43.2% of healthy individuals and 32.6% of patients with preeclampsia received adequate care. The results showed that the amount of inadequate care in the preeclampsia group was more than the healthy group (p<0.002) and the amount of adequate care in the healthy group was more than the preeclampsia group (p=0.001). Also, the odds of preeclampsia is decreased upon the rise of pregnancy cares (p<0.002, CI: 95% 1.040-1.191, OR: 1.04) and pregnancy care in health centers (p<0.019, CI: 95% 0.838-0.143, OR: 0.34).

Discussion

The results of the present study showed that 64.4% (n=58) of women with preeclampsia and 47.3% (n=71) of healthy women were over 30 years old and the probability of developing preeclampsia was 1.056 times higher in older mothers. Logistic regression test showed that women with higher pre-pregnancy weight and higher body mass index in pregnancy were 1.028 and 1.030 times more likely to be infected to preeclampsia, respectively. In the study by Verma et al. (2017), age over 30 years, overweight and obesity were identified as the risk factors for preeclampsia (15). Aksornphusitaphong et al. (2013) also showed that body mass index greater than 25 kg/m^2 is a risk factor for preeclampsia, which is consistent with the result of the present study (16). Women who experience chorionic villi for the first time and women who have a large number of chorionic villi are more prone to preeclampsia, such as in twin pregnancies (1). Preeclampsia is four times more common in multiple pregnancies (17). In the present study, the risk of preeclampsia was significantly higher in nulliparous women with multiple pregnancies.

Preeclampsia is an immune-mediated disorder. The risk of preeclampsia is significantly increased in cases where the formation of blockade antibodies against placental antigen regions is disrupted. Therefore, the first pregnancy is associated with a higher risk of getting preeclampsia (1). In the present study, the chance of developing preeclampsia was 1.8 times higher in patients who had their first pregnancy with their current partner. In the study of Das et al. (2019), maternal age over 35 years, gestational age less than 37 weeks, and twin pregnancy were the risk factors for preeclampsia (18). In the present study, the mean gestational age based on LMP in women with preeclampsia was lower than the control group. In the study of Li et al. (2019), frozen embryo transfer in assisted reproductive technology was an independent risk factor for preeclampsia (19), but in the study by Moini et al. (2012), assisted reproductive technology (ART) was associated with a lower risk for preeclampsia (20). In the present study, people with a history of infertility were twice as likely to develop preeclampsia, and women with a history of assisted reproduction were more likely to be affected.

Several studies have considered the history of preeclampsia as a valuable clinical indicator for identifying pregnant women at risk for preeclampsia (20, 21). The risk of developing preeclampsia in those who had history of preeclampsia in a previous pregnancy was 17 times in the study of Luealon et al. (2010) (21) and 8 times in the study of Merviel et al. (2009) (22). In the present study, the

strongest risk factor for preeclampsia was a history of preeclampsia in a previous pregnancy and chronic hypertension, so that women with a history of preeclampsia in a previous pregnancy were 18 times more likely to develop preeclampsia, and those who had chronic hypertension were 16 times more likely to develop preeclampsia. A possible explanation for the association between chronic hypertension and preeclampsia is that endothelial dysfunction is involved in the pathogenesis of both (1,23,24). Preeclampsia is a multi-factorial and multigenetic disorder. The risk of preeclampsia in daughters of mothers with preeclampsia is 20-40% and in sisters of women with preeclampsia is 11-37%. This inherited predisposition to preeclampsia is probably due to the interaction of hundreds of inherited genes that control thousands of enzymatic and metabolic functions throughout the body (1). In the present study, women with a history of preeclampsia in first-degree relatives (siblings) were 5 times more likely to develop preeclampsia. The majority of women in the preeclampsia group (50%) had received insufficient care in terms of the adequacy index of pregnancy care.

In the present study, the number of prenatal care in preeclampsia group was significantly less than the control group. In the study of Saha et al. (2017), out of 400 primiparous women, 206 (51.5%) received inadequate pregnancy care based on the Adequacy of Prenatal Care Utilization (APNCU) index and only 7 (1.7%) received adequate care. The incidence of preterm labor, cesarean delivery, Apgar score less than 7, meconium aspiration and stillbirth was higher in those with inadequate care (27). In the study by Fang et al. (2009), non-use of prenatal care services was considered as a risk factor for preeclampsia (CI: 951.26-32.27, OR: 6.37) (28).

According to findings of the present study, with decreasing the number of pregnancy care, the risk of developing preeclampsia increased 1.1 times, which is in line with the results of some studies (14). The factors such as the implementation of a program to reduce the number of visits (according to the new protocol in Iran), referring late to the health centers to receive pregnancy care, due to late diagnosis of pregnancy and their lack of knowledge about the time of the disease onset are among the effective factors in the inadequacy of prenatal care. Although there is no known screening method for preeclampsia (1), considering the risk factors for preeclampsia based on scientific evidence can help early identify women at risk for preeclampsia.

The limitations of the present study include socioeconomic status and maternal health behaviors, which were uncontrollable and could affect care patterns and pregnancy outcomes. Of course, the women in two groups were homogeneous in terms of income level. Another limitation is the retrospective nature of the study, which raises the possibility of accidental error in data collection. Of course, most of the information was collected at the time of hospitalization. Conducting longitudinal studies in larger populations and in different communities to investigate the risk factors of preeclampsia could help the determination of high risk pregnant women and designing of effective interventions. It is recommended that further studies be conducted using other research approaches, including qualitative methods.

Implications for practice

As evidenced in the current study, age, body mass index, maternal pre-pregnancy weight, LMP-based gestational age, multiple births, nulliparity, first pregnancy of current spouse, history of infertility and use of assisted reproductive technology, chronic hypertension and history of preeclampsia in individual and first grade relatives were among risk factors for preeclampsia. The results of this study also reported that the amount of inadequate care in the preeclampsia group was more than the healthy group and the amount of adequate care in the healthy group was more than the preeclampsia group, which emphasized the importance of the quantity of prenatal care in preventing the negative consequences of preeclampsia. Therefore, planning to moderate individual and obstetrics risk factors and early identification of high-risk individuals, adequate prenatal care coverage, and removal of barriers to access to adequate prenatal care should be considered by healthcare providers to prevent and decrease the complications of preeclampsia.

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This research project with code of 970073was approved by Ethics Committee of Mashhad University of Medical Sciences with ethical code of IR.MUMS.NURSE.REC.1397.042. The authors hereby thank the Research Vice-Chancellor for funding this study and also appreciate all participants.

Conflicts of interest

The authors declared no conflict of interest.

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