Research Article

Determinants of Preeclampsia among Women Attending Delivery Services in Public Hospitals of Central Tigray, Northern Ethiopia: A Case-Control Study

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Background. Preeclampsia occurs in up to 5% of all pregnancies, in 10% of first pregnancies, and 20–25% of women with a history of chronic hypertension. Objective. This study aims to assess the determinants of preeclampsia among women attending delivery services in public hospitals of central Tigray, Ethiopia. Methods. Hospital-based unmatched case-control study design was conducted. Women diagnosed with preeclampsia were cases, and women who had no preeclampsia were controls admitted to the same hospitals. A systematic sampling technique was used to select study participants for both cases and controls. The data were entered in EPI data 3.1 statistical software and, then, exported to SPSS Version 22 for cleaning and analysis. Results. Family history of hypertension (AOR: 2.60; 95% CI: 1.15, 5.92), family history of preeclampsia (AOR: 5.24; 95% CI: 1.85, 14.80), history of diabetes mellitus (AOR: 4.31; 95% CI: 1.66, 11.21), anemia (AOR: 3.23; 95% CI: 1.18, 8.86), history of preeclampsia on prior pregnancy (AOR: 5.55; 95% CI: 1.80, 17.10), primigravida (AOR: 5.41; 95% CI: 2.85, 10.29), drinking alcohol during pregnancy (AOR: 4.06; 95% CI: 2.20, 7.52), and vegetable intake during pregnancy (AOR: 0.39; 95% CI: 0.21, 0.74) were significantly associated with preeclampsia. Conclusion. This study concludes that a family history of hypertension and preeclampsia; a history of diabetes mellitus and anemia; and a history of preeclampsia on prior pregnancy, primigravida, and drinking alcohol were found to be risk factors for preeclampsia. However, vegetable intake was found to be a protective factor for the development of preeclampsia.

1. Introduction

Preeclampsia is a hypertensive condition common to pregnancy that usually occurs after 20 weeks of gestation and affects both the mother and the fetus [1]. It is one of the leading causes for the admission of pregnant women to intensive care units in the world [2]. Annually, it also accounted for about 50,000 maternal mortality worldwide [3].

According to the World Health Organization, the prevalence of preeclampsia is estimated to be seven times higher in developing countries (2.8% of live births) than in developed countries (0.4%) [4], while preeclampsia is the leading cause of high neonatal and maternal mortality in developing countries where maternal resources like prenatal care are scarce, especially in sub-Saharan Africa [5]. Preeclampsia occurs in up to 5% of all pregnancies, in
10% of first pregnancies, and 20–25% of women with a history of chronic hypertension [6].

Preeclampsia leads to adverse health consequences, and it is also costly because of the needed medical services to treat pregnant and postpartum women and their infants, who are often born preterm [7, 8]. In the United States, from the total cost of $2.18 billion found to the health care system, $1.03 billion was in maternal health care and $1.15 billion for infants born from mothers with preeclampsia, and from this, about one-third of the total $6.4 billion short-term estimated health care costs for preeclampsia pregnancies [9].

In Ethiopia, preeclampsia is one of the five major obstetric causes of maternal mortality, and the proportion of maternal mortality from severe preeclampsia or eclampsia shows an increasing trend [10]. Another report from the Felege Hiwot referral hospital indicated that the number of women diagnosed to have preeclampsia was increasing at an alarming rate. For example, from 2012 to 2013, the occurrence of preeclampsia was increased by 83% from 233 to 426 without any change in the diagnosis and reporting system [11].

Identifying the determinants of preeclampsia among women attending delivery services will enable healthcare professionals to successfully tackle its impact on mothers and the fetus. Moreover, it will help health policymakers to design an appropriate strategy to reduce health-associated costs.

So far, there is no established evidence on the determinants of preeclampsia among pregnant women in Tigray, Northern Ethiopia. Hence, this study was aimed to assess the determinants of preeclampsia among women attending delivery services in public hospitals of central Tigray, Northern Ethiopia.

2. Methods

An unmatched case-control research design based at the hospital was conducted among women attending delivery service in central Tigray, Ethiopia, public hospitals. The Central Zone is one of seven federal zones in the state of Tigray. There are three general public hospitals in this area (Saint Mary General Hospital, Adwa General Hospital, and Abyi Adi General Hospital) and one full specialized hospital (Axum University comprehensive specialized Hospital).

EPI info software version 7.1.1 was used to calculate the sample size using the double population proportion formula to estimate the sample size required for an unmatched case-control study. The following assumptions were considered to estimate the required sample size for the study: a 95% confidence level, 80% power, primigravida as a risk factor with a lowest odds ratio of 2.16 [12], the proportion of controls with exposure 39%, and the proportion of cases with exposure 58%. Case to control the ratio of 1:3 was employed. The final estimated sample size with assuming of 10% nonresponse rate was 344 with 86 cases and 258 controls.

The selection of study participants was made using a systematic sampling technique. $K$, for cases and controls, was calculated by dividing the total number of cases and controls ($N$) to the total samples of $(n)$ of cases and controls, respectively. This was computed for each selected hospital. Using the $K$ value, the patients were selected in every $K$ interval for cases and controls, and the first study subject was selected by the lottery method.

The questionnaire has been adapted from various related literature including preeclampsia-related studies from the WHO and EDHS. Data were collected using interviewer-administered semistructured, pretested questionnaires. Additionally, a record review of participants was conducted to identify cases and controls from the client’s registry. After cases and controls were differentiated, data were collected from record review cards and interviews of the study participants. Continuous follow-up and supervision were made by the supervisors and principal investigator throughout the data collection period. All participants were evaluated and privately interviewed. Preeclampsia was the dependent variable, and the independent variables were sociodemographic factors, medical disease factors, obstetric history factors, and maternal behavior factors.

To ensure data quality, the questionnaire was initially prepared in English and then translated into the local language (Tigrigna) by an individual with a good two-language ability and, then, translated back into English by an individual with good translation ability to ensure continuity. The training was given by the principal investigator for data collectors and supervisors in Axum town for two days. The questionnaire was pretested on five percent of the total sample size in Suhul General Hospital one week before the actual data collection period. Data were collected by eight BSc trained midwives and two supervisors having a BSc degree in health. The data collected were reviewed and tested at the spot by supervisors and principal investigators on a daily basis for completeness and accuracy.

Data were entered into the EPI Data version 3.1 statistical software and, then, exported to SPSS version 22 for analysis. Descriptive statistics were used to characterize the sample, and numerical data was presented as frequency, proportion, or percentages. Bivariable was used to examine the statistical association between the dependent variable and independent variables. Variables with a $p$ value of $\leq 0.25$ in the bivariable analysis were entered into a multivariable logistic regression to isolate an independent effect of the predictors. The Hosmer-Lemeshow test was used to check the appropriateness of the model for analysis. Multicollinearity was assessed by a variance inflation factor (VIF). Finally, multivariable logistic regression analysis was carried out to evaluate the combined effect of several factors associated with preeclampsia after adjusting for confounding variables. Adjusted odds ratios (AOR) with 95% CI were used to express the magnitude of the effect of each category on the outcome relative to the reference category. $p$ value $< 0.05$ was used to determine the level of statistical significance.

3. Results

3.1. Sociodemographic Factors of Study Participants. In this research, a total of 86 women who had preeclampsia (cases) and 258 women who had no preeclampsia (controls) were completed the interview with a response rate of 100%.
Sixty-four (74.4%) of the cases and 200 (77.5%) of the controls were in the age group of 20 to 34 years. Eighty-five (98.8%) of the cases and 255 (98.8%) of the controls were Tigrayan by ethnicity. Eighty-three (96.5%) cases and 223 (86.4%) controls were orthodox Christians by religion, and fifty-two (60.5%) cases and 175 (67.8%) controls were living in the urban area. Eighty (93.0%) cases and 246 (95.3%) controls were found married or living together with their partner. Concerning the occupational status of study participants, fifty-four (62.8%) cases and 137 (53.1%) controls were found to be a housewife. Regarding the educational status, thirty-two (37.2%) of the cases and ninety-five (36.8%) of the controls completed primary school (Table 1).

3.2. Medical Disease History of Study Participants. Of the total participants, fifteen (17.4%) cases and twenty-six (10.1%) controls had a family history of hypertension, and seven (8.1%) cases and six (2.3%) controls had a family history of diabetes mellitus. Thirty (15.1%) cases and twelve (4.7%) controls had a family history of preeclampsia. Eleven (12.8%) cases and sixteen (6.2%) controls were found having a history of diabetes mellitus, while ten (11.6%) cases and fourteen (5.4%) controls were found having anemia. Nine (10.5%) cases and fourteen (5.4%) controls had a history of preeclampsia on their prior pregnancy (Table 2).

3.3. Obstetric History Factors of Study Participants. Of the total participants, fifty (58.1%) of the cases and eighty-eight (34.1%) of the controls were primigravida, and thirty (83.3%) cases and one hundred and forty-one (82.9%) controls were found with interpregnancy interval <3 years. Seventy-four (86.0%) cases and two hundred and thirty-five (91.1%) controls reported that their pregnancy was planned. Eighty-one (94.2%) cases and two hundred and fifty-one (97.3%) controls had singleton birth. Of the total participants, fifty-two (60.5%) of the cases and one hundred and thirty-seven (53.1%) of the controls had a male baby (Table 3).

3.4. Pregnancy Behavior Factors of Study Participants. Of the total participants, thirty-eight (44.2%) cases and fifty-one (19.8%) controls reported that they drink alcohol during their current pregnancy. Eighty (93.0%) of the cases and two hundred and forty-seven (95.7%) of the controls attended ANC at least once for their current pregnancy, while five (6.3%) of the cases and fourteen (13.8%) of the controls had more than four visits. Fifty-eight (67.4%) of the cases and two hundred and fourteen (82.9%) of the controls reported to have had fruit intake during this pregnancy, and fifty-six (65.1%) cases and two hundred and twelve (82.2%) controls reported they used vegetables (Table 4).

After considering all assumptions of binary logistic regression, those variables which had p value ≤ 0.25 at bivariate analysis entered into multivariable logistic regression. In
the multivariable logistic regression analysis, eight variables are identified as determinants of preeclampsia among women attending delivery services at a 5% level of significance. The multivariable analysis revealed that women who had a family history of hypertension had 2.60 times higher risk of preeclampsia compared to women who had no family history of hypertension (AOR: 2.60 at 95% CI: 1.15, 5.92). Those who had a history of DM had 4.31 times higher risk of developing preeclampsia compared to women who had no history of DM (AOR: 4.31 at 95% CI: 1.66, 11.21).

The pregnant women who had a family history of preeclampsia were 5.24 times more likely to develop preeclampsia when compared to women who had no family history of preeclampsia (AOR: 5.24 at 95% CI: 1.85, 14.80). Women who had anemia also showed a relationship with preeclampsia among pregnant women. The odd of developing preeclampsia was 3.23 times associated with those who had anemia than those who had no anemia (AOR: 3.23 at 95% CI: 1.18, 8.86).

The participants with a history of preeclampsia on their prior pregnancy were strongly associated with preeclampsia development. The odds of developing preeclampsia were 5.55 times higher for women with a history of preeclampsia compared to women who had no history of preeclampsia (AOR: 5.55 at 95% CI: 1.80, 17.10).

From factors related to the obstetric history of pregnant women, primigravida was found to be a risk factor for preeclampsia on multivariable analysis. The odds of developing preeclampsia were 5.41 times higher in women with primigravida comparing to women who had no history of preeclampsia (AOR: 5.41 at 95% CI: 1.80, 17.10).

In the multivariable analysis, women who reported drinking alcohol during their pregnancy period had an increased risk of preeclampsia as compared to those women who did not drink alcohol (AOR: 4.06 at 95% CI: 2.20, 7.52). Women who reported to have taken fruit during pregnancy were found to be protective of preeclampsia in the bivariable analysis. But, the effect did not remain significant after adjusting for potential confounding variables while running the last model. However, women who reported taking vegetables during pregnancy were found to be a protective factor for preeclampsia in the multivariable analysis (Table 5).

4. Discussion

The study provides information about the determinants of preeclampsia among pregnant women attending delivery service in public hospitals in Central Tigray, Ethiopia. This study found that a family history of hypertension; a family
history of preeclampsia; a history of DM, anemia, and primigravida; a history of preeclampsia on prior pregnancy; and alcohol drinking during pregnancy are risk factors, whereas taking vegetable during pregnancy was a protective factor for developing preeclampsia.

Those who had a family history of hypertension were significantly associated with preeclampsia among pregnant women. The odds of developing preeclampsia were 2.60 times more than those who had no family history of hypertension. This finding is also consistent with other

**Table 3:** Obstetric history of women attending delivery service in public hospitals in the central zone, Tigray, Northern Ethiopia, 2019.

| Variables             | Category       | Cases Number (%) | Controls Number (%) |
|-----------------------|----------------|------------------|---------------------|
| Gravidity             | Primigravida   | 50 (58.1%)       | 88 (34.1%)          |
|                       | Multigravida   | 36 (41.9%)       | 170 (65.9%)         |
| History of abortion   | Yes            | 7 (19.4%)        | 22 (12.9%)          |
|                       | No             | 29 (80.6%)       | 148 (87.1%)         |
| Number of abortions   | 1              | 5 (71.4%)        | 21 (95.5%)          |
|                       | ≥2             | 2 (28.6%)        | 1 (4.5%)            |
| Parity                | Nullipara      | 50 (58.1%)       | 88 (34.1%)          |
|                       | One delivery   | 11 (12.8%)       | 54 (20.9%)          |
|                       | Multipara      | 25 (29.1%)       | 116 (45.0%)         |
| Planned pregnancy     | Yes            | 74 (86.0%)       | 235 (91.1%)         |
|                       | No             | 12 (14.0%)       | 23 (8.9%)           |
| Multiplicity of pregnancy | Singleton  | 81 (94.2%)       | 251 (97.3%)         |
|                       | Twin           | 5 (5.8%)         | 7 (2.7%)            |
| Sex of newborn        | Male           | 52 (60.5%)       | 137 (53.1%)         |
|                       | Female         | 34 (39.5%)       | 121 (46.9%)         |
| Pregnancy interval    | <3Year         | 30 (83.3%)       | 141 (82.9%)         |
|                       | ≥3Year         | 6 (16.7%)        | 29 (17.1%)          |

**Table 4:** Behavior factors of pregnant women attending delivery service in public hospitals in the central zone, Tigray, Northern Ethiopia, 2019.

| Variables                     | Category       | Cases Number (%) | Controls Number (%) |
|-------------------------------|----------------|------------------|---------------------|
| Alcohol intake                | Yes            | 38 (44.2%)       | 51 (19.8%)          |
|                               | No             | 48 (55.8%)       | 207 (80.2%)         |
| Attending ANC                 | Yes            | 80 (93.0%)       | 247 (95.7%)         |
|                               | No             | 6 (7.0%)         | 11 (4.3%)           |
| Frequency of attending ANC    | <4             | 75 (93.8%)       | 213 (86.2%)         |
|                               | ≥4             | 5 (6.3%)         | 34 (13.8%)          |
| Use of modern contraceptive  | Yes            | 47 (54.7%)       | 177 (68.6%)         |
|                               | No             | 39 (45.3%)       | 81 (31.4%)          |
| Fruit intake                  | Yes            | 58 (67.4%)       | 214 (82.9%)         |
|                               | No             | 28 (32.6%)       | 44 (17.1%)          |
| Frequency of fruit intake per week | Daily    | 6 (10.3%)       | 8 (3.7%)            |
|                               | 1-6 days/week  | 52 (89.7%)       | 206 (96.3%)         |
| Vegetable intake              | Yes            | 56 (65.1%)       | 212 (82.2%)         |
|                               | No             | 30 (34.9%)       | 46 (17.8%)          |
| Frequency of vegetable intake per week | Daily    | 3 (5.4%)        | 3 (1.4%)            |
|                               | 1-6 days/week  | 53 (94.6%)       | 209 (98.6%)         |
studies conducted in Ethiopia, Uganda, and South India [13–15].

History of DM showed a significant association with pre-eclampsia among pregnant women than those who had no history of DM. Those who had a history of DM were 4.31 times more related to developing preeclampsia compared to their counterparts. This finding is supported by different studies conducted in different countries; such as South India, Gaza Strip, and Ethiopia [13, 15, 16]. This is explained by epidemiological and clinical data document has shown that DM is closely associated with insulin resistance [17]. Besides, hyperinsulinemia is stimulating the proliferation of vascular smooth muscle cells, enhances acute sympathetic nervous system activity, and modifies transmembrane cation transport, as well as renal sodium retention, the release of the potent vasoconstrictor angiotensin II, and associated endothelial dysfunction. All of these alterations may contribute to blood pressure elevation and thus preeclampsia [18].

In this study, the multivariable analysis revealed that a family history of preeclampsia was significantly associated with preeclampsia development. Women who had a family history of preeclampsia were 5.55 times higher risk of developing preeclampsia than their counterparts. This finding is in agreement with the study conducted in India and Yemen [19, 20]. This might have occurred because of genetic and/or behavioral factors that contribute to the pathophysiological susceptibility of preeclampsia that cluster in families [21].

The participants diagnosed with anemia were significantly associated with preeclampsia development. The odds of developing preeclampsia among women diagnosed with anemia is 3.23 times more than women who had no anemia. Similarly, other studies conducted in India and Ethiopia reported that anemia was significantly associated with preeclampsia [13, 19]. Contrary to this, the study conducted in Iran showed that anemia was protective for preeclampsia [22]. This difference could be due to variation in sample size and study participants. The participants in the Iranian study were excluded those who are over 35 years of age or below 18 years of age, history of any maternal disease including diabetes unlike this study.

Those participants who had a history of preeclampsia on prior pregnancy had 5.55 times higher risk of developing preeclampsia than their counterparts. This finding is supported by studies conducted in the Gaza Strip, Yemen, and Ethiopia [16, 20, 23]. This showed that women with a history of preeclampsia on their previous pregnancy need to have a focus and could be an acceptable means of screening for preeclampsia, especially in limited resourced locations.

| Variables                                   | Category | Cases Number (%) | Controls Number (%) | COR (95% CI)     | AOR (95% CI)     |
|---------------------------------------------|----------|------------------|---------------------|------------------|------------------|
| Family history of DM                       | Yes      | 7 (8.1%)         | 6 (2.3%)            | 3.72 (1.21, 11.40) | 3.45 (0.92, 12.90) |
|                                            | No       | 79 (91.9%)       | 252 (97.7%)         | 1                | 1                |
| Use of modern contraceptive               | Yes      | 47 (54.7%)       | 177 (68.6%)         | 0.55 (0.33, 0.91) | 0.65 (0.36, 1.17)  |
|                                            | No       | 39 (45.3%)       | 81 (31.4%)          | 1                | 1                |
| Family history of hypertension             | Yes      | 15 (17.4%)       | 26 (10.1%)          | 1.88 (0.95, 3.75) | 2.60 (1.15, 5.92)  |
|                                            | No       | 71 (82.6%)       | 232 (89.9%)         | 1                | 1                |
| Family history of preeclampsia             | Yes      | 13 (15.1%)       | 12 (4.7%)           | 3.65 (1.60, 8.35) | 5.24 (1.85, 14.80)  |
|                                            | No       | 73 (84.9%)       | 246 (95.3%)         | 1                | 1                |
| History of DM                              | Yes      | 11 (12.8%)       | 16 (6.2%)           | 2.22 (0.99, 4.99) | 4.31 (1.66, 11.21)  |
|                                            | No       | 75 (87.2%)       | 242 (93.8%)         | 1                | 1                |
| Diagnosed with anemia                      | Yes      | 10 (11.6%)       | 14 (5.4%)           | 2.29 (0.98, 5.37) | 3.23 (1.18, 8.86)  |
|                                            | No       | 76 (88.4%)       | 244 (94.6%)         | 1                | 1                |
| History of preeclampsia on prior pregnancy | Yes      | 9 (10.5%)        | 14 (5.4%)           | 2.04 (0.85, 4.89) | 5.55 (1.80, 17.10)  |
|                                            | No       | 77 (89.5%)       | 244 (94.6%)         | 1                | 1                |
| Gravida                                     | Primigravida | 50 (58.1%)   | 88 (34.1%)          | 2.68 (1.63, 4.42) | 5.41 (2.85, 10.29)  |
|                                            | Multigravida | 36 (41.9%)   | 170 (65.9%)         | 1                | 1                |
| Alcohol drinking                           | Yes      | 38 (44.2%)       | 51 (19.8%)          | 3.21 (1.90, 5.43) | 4.06 (2.20, 7.52)  |
|                                            | No       | 48 (55.8%)       | 207 (80.2%)         | 1                | 1                |
| Fruit intake                               | Yes      | 58 (67.4%)       | 214 (82.9%)         | 0.43 (0.24, 0.74) | 0.89 (0.37, 2.10)  |
|                                            | No       | 28 (32.6%)       | 44 (17.1%)          | 1                | 1                |
| Vegetable intake                           | Yes      | 56 (65.1%)       | 212 (82.2%)         | 0.40 (0.23, 0.70) | 0.39 (0.21, 0.74)  |
|                                            | No       | 30 (34.9%)       | 46 (17.8%)          | 1                | 1                |

NB: *p value < 0.05; **p-value < 0.001.
This study showed that primigravida was found independently associated with preeclampsia development. The odds of developing preeclampsia in primigravida women were 5.41 times higher than multigravida women. This finding is consistent with studies conducted in the Gaza Strip, Egypt, and Ethiopia [16, 23, 24], as they declared that primigravida was a risk factor for preeclampsia. Preeclampsia generally considered a disease of the first pregnancy [25] which is due to the immunological incompetence seen in the first pregnancy between fetoplacental and maternal tissues [26].

Alcohol consumption also showed an association with preeclampsia development among pregnant women. The odds of developing preeclampsia were 4.06 times more common among women who had drink alcohol than those who did not drink alcohol. This finding is consistent with a study conducted in other areas of Ethiopia [23, 27]. In contrast to this finding, a study conducted in India [28] was found that no significant association between alcohol drinking during pregnancy and preeclampsia. Unlike the current study, a cross-sectional study conducted in India was based on the women’s report of clinical manifestation for preeclampsia and was not diagnosed by physicians. The discrepancy could be due to the difference in study design and study subjects.

Those participants who reported consumption of vegetables had a 61% lower risk of developing preeclampsia than their counterparts. This finding is supported by other studies conducted in Ethiopia [23, 29]. This is because vegetables are rich in micronutrients such as antioxidants, vitamins, minerals, and dietary fiber. A diet rich in vegetables decreased the risk of hyperhomocysteinemia, which is one of the risk factors for the occurrence of preeclampsia [30].

5. Conclusion

The results of this study suggest that there are protective and risk factors for preeclampsia. Factors such as a family history of hypertension, family history of preeclampsia, history of DM, diagnosed with anemia, and history of preeclampsia on prior pregnancy, primigravida, and drinking alcohol during pregnancy were found to be risk factors for preeclampsia. However, vegetable intake during pregnancy was found to be a protective factor for the development of preeclampsia.

Abbreviations

ANC: Antenatal care  
AOR: Adjusted odds ratio  
COR: Crude odds ratio  
DM: Diabetes mellitus.

Data Availability

This is our original work and has not been submitted and considered for publish in any journal and all sources of materials and data used for this research have been secured and acknowledged. All raw data generated or analyzed during the current study are available from the corresponding author on request.

Ethical Approval

The study was approved by Haramaya University College of Health and Medical Sciences Institutional Health Research Ethics Review Committee on 18 February 2019 with ethical number IHRER/006/2019. Written informed consent was taken from each study participant, and for those participants under the age of 18 years, written informed consent was received from their legal guardians. This research is original and not considered in another journal for publication.

Conflicts of Interest

The authors declared that they have no competing interests.

Authors’ Contributions

TG conceived and designed the study, analyzed the data, and interpretation of the data. NA and TA contributed to the study design, advised throughout the study, and critically reviewed the manuscript. TM participated in the data analysis, data interpretation, and draft manuscript. DB and GG contributed in the developing methods and draft manuscript. GM, HG, and TG participated in the data analysis and data interpretation and critically revised the manuscript. All authors have read and approved the final version of the manuscript.

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References

[1] American College of Obstetricians and Gynecologists, Hypertension in Pregnancy, Task Force on Hypertension in Pregnancy, 2013.
[2] J. M. Roberts and H. S. Gammill, “Preeclampsia: recent insights,” Hypertension, vol. 46, no. 6, pp. 1243–1249, 2005.
[3] L. Duley, “The global impact of pre-eclampsia and eclampsia,” Seminars in Perinatology, vol. 33, no. 3, pp. 130–137, 2009.
[4] L. Trosgstad, P. Magnus, R. Skjaerven, and C. Stoltenberg, “Previous abortions and risk of pre-eclampsia,” International Journal of Epidemiology, vol. 37, no. 6, pp. 1333–1340, 2008.
[5] P. C. F. M. Bezerra, M. D. Leão, J. W. Queiroz et al., “Family history of hypertension as an important risk factor for the development of severe preeclampsia,” Acta Obstetrica et Gynecologica Scandinavica, vol. 89, no. 5, pp. 612–617, 2010.
[6] U. Shamsi, J. Hatcher, A. Shamsi, N. Zuberi, Z. Qadri, and S. Saleem, “A multicentre matched case control study of risk factors for preeclampsia in healthy women in Pakistan,” BMC Women’s Health, vol. 10, no. 1, p. 14, 2010.
[7] American College of Obstetricians and Gynecologists, “Hypertension in pregnancy. Report of the American College of Obstetricians and Gynecologists’ Task Force on hypertension in pregnancy,” Obstetrics and Gynecology, vol. 122, no. 5, pp. 1122–1131, 2013.
A. N. Q. Al-Tairi, Z. M. Isa, and H. F. Ghazi, "Preterm birth: causes, consequences, and prevention, National Aca, 2007.

W. Stevens, T. Shih, D. Incerti et al., “Short-term costs of pre-eclampsia to the United States health care system,” American Journal of Obstetrics and Gynecology, vol. 217, no. 3, pp. 237–248.e16, 2017.

A. Abdella, “Maternal mortality trend in Ethiopia,” Ethiopian Journal of Health Development, vol. 24, no. 1, 2010.

L. C. Chappell, F. Milne, and A. Shennan, “Obstetric outcomes after treatment of periodontal disease during pregnancy: systematic review and meta-analysis,” BMJ, vol. 341, no. dec29 1, p. c7017, 2010.

M. Shegaze, Y. Markos, W. Estifaos, I. Taye, and E. Gemeda, “Magnitudes and associated factors of preeclampsia among pregnant women who attend antenatal Care Service in Public Health Institutions in Arba Minch town, southern Ethiopia, 2016,” Obstetrics & Gynecology, vol. 6, no. 419, article 2161-0932.1000419, 2016.

S. Agrawal and G. Walia, “Prevalence and risk factors for symptoms suggestive of pre-eclampsia in Indian women,” Journal of Women’s Health, vol. 3, no. 6, pp. 2–9, 2014.

M. Endeshaw, F. Abebe, M. Bedimo, A. Asrat, A. Gebeeyehu, and A. Keno, “Family history of hypertension increases risk of preeclampsia in pregnant women: a case-control study,” Universa Medicina, vol. 35, no. 3, pp. 181–191, 2016.

J. Wandabwa, P. Doyle, K. Kiondo, O. Campbell, N. Maconichie, and G. Welishe, “Risk factors for severe pre-eclampsia and eclampsia in Mulago Hospital, Kampala, Uganda,” East African Medical Journal, vol. 87, no. 10, 2010.

K. S. Ganesh, B. Unnikrishnan, K. Nagaraj, and S. Jayaram, “Determinants of pre-eclampsia: a case-control study in a district hospital in South India,” Indian Journal of Community Medicine, vol. 35, no. 4, pp. 502–505, 2010.

S. El-Nakhal, “Case-control study of risk factors associated with preeclampsia in the Gaza strip,” Journal of Medicine and Medical Sciences, vol. 6, no. 9, pp. 229–233, 2015.

Z. Wolde, H. Segni, and M. Weldie, “Hypertensive disorders of pregnancy in Jimma University specialized hospital,” Ethiopian Journal of Health Sciences, vol. 21, no. 3, 2011.

N. P. Polyzos, I. P. Polyzos, A. Zavos et al., “Obstetric outcomes after treatment of periodontal disease during pregnancy: systematic review and meta-analysis,” BMJ, vol. 341, no. dec29 1, p. c7017, 2010.

M. K. Verma, P. Kapoor, R. Yadav, and R. K. Manohar, “Risk factor assessment for preeclampsia: a case control study,” International Journal of Medicine and Public Health, vol. 7, no. 3, pp. 172–177, 2017.

A. N. Q. Al-Tairi, Z. M. Isa, and H. F. Ghazi, “Risk factors of preeclampsia: a case control study among mothers in Sana’a, Yemen,” Journal of Public Health, vol. 25, no. 6, pp. 573–580, 2017.

L. C. Chappell, F. Milne, and A. Shennan, “Is early induction or expectant management more beneficial in women with late preterm pre-eclampsia?,” BMJ, vol. 350, no. 9, article h191, 2015.

M. Kashanian, H. R. Baradaran, S. Bahasadri, and R. Alimoohammadi, “Risk factors for pre-eclampsia: a study in Tehran, Iran,” Archives of Iranian Medicine, vol. 14, no. 6, pp. 412–415, 2011.

T. Grum, A. Seifu, M. Abay, T. Angesom, and L. Tsegay, “Determinants of pre-eclampsia/eclampsia among women attending delivery Services in Selected Public Hospitals of Addis Ababa, Ethiopia: a case control study,” BMC Pregnancy and Childbirth, vol. 17, no. 1, p. 307, 2017.

E. A. El-Moselhy, H. O. Khalifa, S. M. Amer, K. I. Mohammad, and H. M. Abd El-Aal, “Risk factors and impacts of pre-eclampsia: an epidemiological study among pregnant mothers in Cairo, Egypt,” Journal of American Science, vol. 7, no. 5, pp. 311–323, 2011.

A. Harutyunyan, Investigation of Risk Factors for Preeclampsia Development Among Reproductive Age Women Living in Yerevan, Armenia, College of Health Sciences American University of Armenia, 2009.

B. M. Sibai, “Diagnosis and management of gestational hypertension and preeclampsia,” Obstetrics & Gynecology, vol. 102, no. 1, pp. 181–192, 2003.

M. Endeshaw, F. Abebe, M. Bedimo, and A. Asart, “Diet and pre-eclampsia: a prospective multicentre case-control study in Ethiopia,” Midwifery, vol. 31, no. 6, pp. 617–624, 2015.

S. W. Wen, J. Champagne, R. Rennicks White et al., “Effect of folic acid supplementation in pregnancy on preeclampsia: the folic acid clinical trial study,” Journal of Pregnancy, vol. 2013, Article ID 294312, 9 pages, 2013.