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# Prevalence, predictors and management of pre-eclampsia among pregnant women attending antenatal clinics in Zanzibar

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**Abstract**

**Background:** Pre-eclampsia is a significant public health concern worldwide that is responsible for severe maternal and neonatal morbidity and mortality. This study determined pre-eclampsia's prevalence, predictors, and management among pregnant women attending antenatal clinics in Zanzibar.

**Methodology:** This was a cross-sectional study involving 138 pregnant women attending antenatal clinics randomly selected from all levels of healthcare facilities in Zanzibar. A protein-in urine test and blood pressure measurement were performed to diagnose pre-eclampsia, and the patient's case files were reviewed to assess pre-eclampsia management. The Chi-square test and logistic regression models determined the association between variables. The adjusted odds ratio and a 95% confidence interval were reported, and the significance level was set at 5%.

**Results:** The prevalence of pre-eclampsia was 20(14.25%), and it was predicted by a family history of pre-eclampsia (adjusted odds ratio=5.7, 95% confidence interval: 1.34-24.7), a previous history of pre-eclampsia (adjusted odds ratio =12.9, 95% confidence interval: 2.5-55.6), and current medication use (adjusted odds ratio =19.3, 95% confidence interval 3.9-95.6). A slight majority of mild pre-eclampsia cases were properly managed 7(53.8%), while only 9(29.50%) of severe pre-eclampsia cases were adequately managed. The proportion of cases of severe pre-eclampsia that were managed correctly was higher among cases admitted to national referral hospitals (68.5%) compared to those admitted to district hospitals (22.8%) and health centres (10.83%) ($p < 0.002$). However, for mild pre-eclampsia, there was no statistically significant difference in its management between facility levels ($p>0.05$).

**Conclusion:** The prevalence of pre-eclampsia among pregnant women attending antenatal clinics is high. The possible risk factors for pre-eclampsia are having a family history of pre-eclampsia, having a previous history of pre-eclampsia, and current medication use. The standard guidelines for the management of pre-eclampsia are not followed, and severe pre-eclampsia is mostly mismanaged at lower-level healthcare facilities. The findings are relevant to identifying high-risk pregnancies, improving maternal health care delivery, and saving lives.

**Keywords:** preeclampsia, eclampsia, prevalence, predictors, management, Zanzibar, Tanzania

## Introduction

Pre-eclampsia is a major public health concern that causes severe maternal and neonatal morbidity and mortality and contributes significantly to fetal prematurity (Kuklina et al., 2009). Pre-eclampsia is a hypertensive disorder of pregnancy that occurs after the 20$^{th}$ week of gestation. High blood pressure readings of at least 140 mmHg systolic and 90 mmHg diastolic measured 4-6 hours apart, accompanied

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by proteinuria of at least +1 mg on dipstick or at least 300 mg per 24 hours, or with signs of liver dysfunction, thrombocytopenia, pulmonary oedema, new onset of kidney dysfunction, or new onset of cerebral or visual disturbance (WHO, 2011). Eclampsia is when a woman with pre-eclampsia has a new onset of grand mal seizures (ACOG, 2002).

Pre-eclampsia affects about 2–8% of pregnancies globally, and it is associated with 10–15% of direct maternal deaths and up to 25% of stillbirths and newborn deaths (Say et al., 2014; WHO, 2017). The prevalence of pre-eclampsia in developed countries ranges from 2.2% to 6% (Fingar et al., 2006), while in developing countries, the prevalence is higher, ranging from 1.8 to 16.7% (Belay & Wudad, 2019; Otieno, 2012; Raghuraman et al., 2014; Wandabwa et al., 2010). In northern Tanzania, the prevalence of pre-eclampsia is 4.2% (Frank et al., 2020) and in Zanzibar (a united part of Tanzania), the prevalence among prenatal women is 9% (Tufton & Patel, 2011) and that of severe pre-eclampsia among postnatal women is 26.3% (Machano & Joho, 2020). The high prevalence of pre-eclampsia is reflected in the number of deaths and complications associated with it.

Tanzania has a maternal mortality rate of 556 per 100,000 live births, (Herklots et al., 2017; MoHCDGEC, 2016) with eclampsia-related complications accounting for 18.9% (Makuwani et al., 2020). And in Zanzibar, maternal mortality is 155 per 100,000 live births (MoHASWZ, 2018) and severe pre-eclampsia contributes to 25.8% of maternal morbidity and 21.8% of maternal mortality (Herklots et al., 2017).

Predictors of pre-eclampsia have been reported in many studies, and they include obesity, null parity, urinary tract infection, family history of pre-eclampsia, history of pre-eclampsia from a previous pregnancy, history of hypertension, occupation as a housewife, fewer Antenatal Clinic (ANC) visits, use of traditional medicine, multiple pregnancies, maternal age, anemia, pregnancy from a new partner, family history of high blood pressure, diabetic prior conception, paternal age of over 45 years, a pregnancy interval of more than 10 years, gestational age at presentation and pre-existing vascular disease (Adeline et al., 2018; Grum et al., 2017; Kashanian & Baradaran, 2011; Machano & Joho, 2020; Serrano et al., 2020). However, because women's social-cultural and lifestyle characteristics differ across regions, the determinants of pre-eclampsia or eclampsia may vary. Considering the different coastal-Islamic-based traditions in Zanzibar, which reflect differences in lifestyle, socioeconomic status, cultural norms, and the seeking and provision of medical care, it is important to explore more about the determinants of pre-eclampsia in Zanzibar.

Early diagnosis and management can help to reduce the dangers of pre-eclampsia and its complications; the majority of deaths related to this condition are avoidable when care is given in good time. In this regard, avoiding delays and "bottlenecks" that are currently occurring in diagnosis and management is critical (Baker et al., 2015). The definitive treatment of pre-eclampsia or eclampsia is delivery of the fetus based on the severity of pre-eclampsia, gestational age, and maternal and fetal conditions (Sarsam et al., 2008). In contrast, conservative treatment includes blood pressure control and seizure prevention. A management guideline has been developed (TMOH, 2013; 2017), and if adhered to, it is expected to minimize pregnancy-related complications, minimize prematurity, and promote maternal and infant survival. However, approximately half of the healthcare providers in Dodoma, Dar es Salaam, and Zanzibar, Tanzania, reported inadequate knowledge of pre-eclampsia and eclampsia management protocols (Joho et al., 2020; Maembe & Pembe, 2015; Seif & Rashid, 2022).

Unavailability of equipment and supplies, laboratory facilities, and medication required for the management of pre-eclampsia, inadequate knowledge and skills among healthcare providers, and non-adherence to the treatment guidelines are reported to fail to diagnose and provide proper management of pre-eclampsia (Barua et al., 2011; Oguntunde et al., 2015). According to the Zanzibar Ministry of Health Guidelines, the type of management of pre-eclampsia differs at different healthcare facility levels based on the severity of the illness. Mild pre-eclampsia is treated in the primary health

facilities, and the severe cases are referred to the next level of district hospital, regional hospital, and national hospital (Goverment of Zanzibar, 2019).

Despite the government initiatives to address maternal and neonatal mortality and morbidity in Zanzibar, including the implementation of Focused Antenatal Care Plus (FANC), sensitizing the community on the effective utilization of Antenatal Care (ANC) services, birth preparedness, and complications readiness, pre-eclampsia is still a significant problem that is associated with high morbidity and mortality (Herklots et al., 2017). To the best of the author's knowledge, only two studies about pre-eclampsia and eclampsia were published in Zanzibar, with one focusing on severe eclampsia only among postpartum women, (Machano & Joho, 2020) and the other focused on women at prenatal but neither identified the associated factors nor described how pre-eclampsia is managed at different healthcare facility levels. As a result, this study aimed to fill a knowledge gap about the prevalence of pre-eclampsia, its associated factors, and management in Zanzibar. The findings of this study will have a significant role in targeted interventions for overcoming the problems associated with pre-eclampsia, which in turn will help to reduce the maternal morbidity and mortality associated with pre-eclampsia.

## Methods

This study employed an analytical cross-sectional study design and was conducted within healthcare facilities in Zanzibar- a united part of Tanzania. The health delivery system in Zanzibar is organized into three levels: primary, secondary, and tertiary. The primary level includes primary health care units (PHCU), primary health care units plus (PHCU+), and primary health care centres or cottages (PHCC). The secondary level includes district and regional hospitals, and the tertiary level includes national referral hospital. According to the Zanzibar Ministry of Health, all facilities offering reproductive and child health services are supposed to screen for pre-eclampsia. Women detected with signs of pre-eclampsia in the PHCU and PHCU+ are sent to health centres, where they are given initial treatment and then referred to hospitals for further investigations and management. Those with severe pre-eclampsia are referred urgently to a hospital after receiving emergency treatment with anticonvulsants, preferably magnesium sulphate and a selected antihypertensive (Government of Zanzibar, 2019).

### Study population

The study population consisted of all pregnant women attending ANC at all levels of healthcare facilities in Zanzibar. The inclusion criteria were a gestational age of at least 20 weeks and consent to participate in the study.

### Sample size estimation Sampling procedure

The sample size was calculated by using the Cochran formula (Cochran, 1977), which is $n=Z^2P(1-P)/e^2$, where: n = minimum sample size, Z score value = 1.96 for 95% confidence level, P = proportion of pre-eclampsia in Zanzibar, which is 9% (Tufton & Patel, 2011), and e = the acceptable margin of error, which is 5%. Therefore, this study's sample size was 138 pregnant women.

A census method was used to obtain all health centres (n=4), district hospitals (n=2), regional hospitals (n=1) and national hospitals (n=1). At the same time, the PHCUs were selected using a systematic random sampling in which the $k^{th}$ interval of 3 was used, which was calculated using the formula $k^{th.} = N/n$ (Iachan, 1982), whereby N is the sampling frame (total number of PHCUs) = 154, n is the total number of PHCUs for this study = 46, which is 30% of the total number of PHCUs, (WHO, 2009). The number of pregnant women per selected healthcare facility level was calculated using the formula ni = (Ni/Nt)*n (Pandey & Verma, 2008), where ni = the number of pregnant women required

in each facility level, Ni = the total number of pregnant women attending ANC in each selected facility per month, Nt = the total number of pregnant women attending ANC in all selected facilities per one month, and n = the estimated sample size of pregnant women.
Simple random sampling was used to select study participants within healthcare facilities. Table 1 summarizes the sample selection of pregnant women per selected healthcare facility level.

**Table 1: Summary of Sample Selection of Pregnant Women Per Each Selected Healthcare Facility Level**

| Level of Healthcare Facility | Number of pregnant women attending ANC per month | Number of pregnant women selected for each facility |
|---|---|---|
| Tertiary level | 501 | 8 |
| Secondary level | 412 | 7 |
| Primary level | 7381 | 123 |
| **Total** | **8294** | **138** |

**Data collection procedure and data collection tools:**
Data was collected within the selected healthcare facilities for four weeks in 2021. The principal investigator and six research assistants who are registered nurses collected the data. In this study, several data collection methods were used depending on the data type needed to answer a particular study objective.

**Interviewer-administered questionnaire:** This method was used to obtain data from pregnant women to assess their background characteristics and signs and symptoms related to hypertensive disorders of pregnancy. A pre-tested, standardized, structured questionnaire with 18 closed-ended questions adopted from Andarge et al. (Andarge et al., 2020) and a Cronbach alpha of 0.79 was used.

**Measurement:** This method was used to get data on blood pressure readings of pregnant women to be used for making diagnoses of pre-eclampsia. In this method, a research assistant instructed a pregnant woman to relax for at least ten minutes and sit comfortably upright with her back and arms supported and both legs flat on the floor. A woman was then instructed to remove tight clothes around her arm. The proper cuff size was used to ensure that the cuff encircles at least three-fourths of the circumference of the arm, about 2 cm above the elbow area. The measurement was then taken using a digital blood pressure machine. The measurement was repeated if it was equal to or greater than 140/90 mm Hg by the same two observers (Tufton & Patel, 2011).

**Chemical investigations:** Urinalysis with a visual reagent strip, " the dipstick," was used to collect data on protein in urine. The data were used to make a diagnosis of pre-eclampsia. In this method, a pregnant woman was given a urine bottle and was instructed on how to collect a clean-catch urine sample. The research assistant dipped the end of the dipstick into the urine sample and shook off any excess urine by tapping the dipstick on the side of the urine bottle. After thirty seconds, a comparison of the dipstick pad with the colour chart on the dipstick container was made to check for the presence of protein in the urine, where the colour change was interpreted according to the manufacturer's guidelines.

**Documentary review:** This method was used to obtain information on the management of pre-eclampsia provided to women diagnosed with pre-eclampsia. The principal investigator or research assistant reviewed the case files of all patients diagnosed with pre-eclampsia admitted during the study period. The selection of the case files considered the patient to be still admitted, and confirmed

that she is suffering from pre-eclampsia, whether mild or severe, and has already started receiving pre-eclampsia management in the admitted hospital. The management was judged against the standard treatment guideline using a pre-prepared checklist during the review.
The tool was developed based on the guidelines (TMOH, 2013;2017; ). The documentary review was only conducted at healthcare facility levels that admit and provide management of patients with pre-eclampsia: three health centres, two district hospitals, one regional hospital, and one referral hospital.

**Variables Definition and Measurement**
**Pre-eclampsia:** In this study, refers to pregnancy complications that include high blood pressure after 20 weeks of pregnancy, excess protein in the urine and/or swelling of lower limbs, severe headache and or upper abdominal pain, blurred vision or light sensitivity. This was measured by a blood pressure reading of greater than or equal to 140 mmHg systolic and greater than or equal to 90 mmHg diastolic, accompanied by proteinuria of at least +1 mg on the dipstick, and/or swelling of the lower limbs, severe headache, upper abdominal pain, blurred vision, or light sensitivity in an individual with previously normal blood pressure and proteinuria in pregnancy. A woman who screened positive for pre-eclampsia was sent to a medical doctor on duty for confirmation of her diagnosis. The endpoint was dichotomized into positive and negative for pre-eclampsia.

**Management of pre-eclampsia:** In this study, "management" refers to all treatment provided, measurements taken, and tests done on a pregnant woman with signs of pre-eclampsia as per the Ministry of Health- Zanzibar guideline. This was measured by 16 YES/NO items on a ratio scale assessing whether pre-eclampsia management was carried out as per the established guidelines, which include providing appropriate medications, monitoring blood pressure and foetal heart rate, checking protein in urine, and performing liver and kidney function tests. Five items were for mild pre-eclampsia, and thirteen items were for severe pre-eclampsia. One point was awarded for the correct management carried out and zero for the incorrect or missed management. For mild pre-eclampsia, a total score of 4-5 points was regarded as proper management, and for severe pre-eclampsia, a total score of 11–13 points was regarded as proper management.

**Data Analysis**
The data was analyzed using SPSS version 25. Descriptive statistics were used to describe the magnitude of pre-eclampsia and its distribution within the background characteristics of pregnant women. The same statistics were used to describe the management of pre-eclampsia, and the results were reported in frequency and percentage. The chi-square test was used to show the relationship between pre-eclampsia and background characteristics of pregnant women, and the logistic regression model was used to determine the predictors of pre-eclampsia. The Odds Ratio (OR) and Adjusted Odds Ratio (AOR) with their 95% Confidence Intervals (CI) were computed, and the level of significance was set at 5%.

**Results**
**Background characteristics of pregnant women**
A total of 138 pregnant women participated in this study. This makes a response rate of 100%. The mean age was 28.96 (SD =7.105), with an age range of 17 to 46 years. Of these, a large majority, 121 (87.7%), were married, and half of them, 73 (52.9%), lived in rural areas. Most of the respondents, 98 (71.0%), had a secondary level of education, and a small majority, 71 (51.4%), were unemployed. Further, for obstetric characteristics, a small majority of the respondents, 72 (52.8%), were null parity, and 77 (55.5%) had a gestation age of between 20 and 30 weeks (Table 2).

**Table 2: Background Characteristics of Pregnant Women (N=138)**

| Variable | Number | Percentage |
|---|---|---|
| **Maternal age (years)** | | |
| <20 | 12 | 8.7 |
| 20-29 | 60 | 43.5 |
| 30-34 | 33 | 23.9 |
| > 35 | 33 | 23.9 |
| **Education level** | | |
| Non-formal education | 4 | 2.9 |
| Primary education | 23 | 26.7 |
| Secondary education | 98 | 71 |
| College and university | 13 | 9.8 |
| **Place of residence** | | |
| Urban | 65 | 47.1 |
| Rural | 73 | 52.9 |
| **Marital status** | | |
| Ever married | 17 | 12.3 |
| Married | 121 | 87.7 |
| **Occupation** | | |
| Employed | 25 | 18.1 |
| Not employed | 71 | 51.4 |
| Self employed | 42 | 30.4 |
| **Parity** | | |
| Null parity | 72 | 52.8 |
| Multi parity | 66 | 47.8 |
| **Gestation age (weeks)** | | |
| 20-30 | 77 | 55.8 |
| ≥31 | 61 | 44.2 |
| **Antenatal care visit** | | |
| 1-3 | 112 | 81.1 |
| 4-8 | 26 | 18.9 |
| **Has family history of pre-eclampsia** | | |
| Yes | 21 | 15.2 |
| No | 117 | 84.8 |
| **Has history of chronic illness** | | |
| Yes | 22 | 15.9 |
| No | 116 | 84.1 |

| | | |
|---|---|---|
| **Has previous history of pre-eclampsia** | | |
| Yes | 18 | 13.1 |
| No | 120 | 86.9 |
| **Has history of using medication in the current pregnancy** | | |
| Yes | 28 | 20.3 |
| No | 110 | 79.7 |
| **Has history of using supplement in the current pregnancy** | | |
| Yes | 93 | 67.4 |
| No | 45 | 32.6 |

**The prevalence of pre-eclampsia and its relationship with background characteristics of pregnant women**

The results of this study showed that 20 (14.5%) women out of 138 screened had systolic blood pressure greater than or equal to 140 mmHg and diastolic blood pressure greater than or equal to 90 mmHg, had proteinuria of 1+ mg or more, and/or had swelling of the lower limbs, severe headache, upper abdominal pain, or blurred vision, and thus were marked as positive for pre-eclampsia. Moreover, results showed that pre-eclampsia was related to maternal age, having a family history of pre-eclampsia, having a previous history of pre-eclampsia, having a history of chronic illness, and having a history of using medication in the current pregnancy.

Specifically, the results showed that the proportion of pregnant women who had pre-eclampsia was higher among women of 35 years (27.3%) vs. (15.2%) (p-value = 0.03), women with a family history of pre-eclampsia (47.61%) vs (8.7%) (p-value <0.001), women with a history of chronic illness (31.82%) vs (11.2%) (p-value = 0.01), women with a history of using medication in the index pregnancy (42.9 %) vs. (7.3%) (p-value <0.001)], and women with a previous history of pre-eclampsia (50%) (p-value <0.001). Other variables did not significantly correlate with pre-eclampsia (Table 3).

**Table 3: The relationship between pre-eclampsia and background characteristics of pregnant women (N=138)**

| Variable | Total (%) | Positive pre-eclampsia n(%) | Chi square | p-value |
|---|---|---|---|---|
| **Maternal age (years)** | | | 6.57 | 0.03 |
| ≤ 29 | 72 | 6(8.33) | | |
| 30-34 | 33 | 5(15.2) | | |
| ≥ 35 | 33 | 9(27.3) | | |
| **Education level** | | | 2.77 | 0.43 |
| No formal education | 4 | 1(25) | | |
| Primary education | 23 | 4(17.4) | | |
| Secondary education | 98 | 15(15.3) | | |
| College and university | 13 | 0(0.0) | | |
| **Place of residence** | | | 1.56 | 0.21 |
| Urban | 65 | 12(18.5) | | |
| Rural | 73 | 8(11.0) | | |

| | | | | |
|---|---|---|---|---|
| **Marital status** | | | 0.12 | 0.7 |
| Ever married | 17 | 2(11.8) | | |
| Married | 121 | 18(14.9) | | |
| **Occupation** | | | 1.51 | 0.5 |
| Employed | 25 | 5(20.0) | | |
| Not employed | 71 | 11(15.5) | | |
| Self employed | 42 | 4(9.5) | | |
| **Parity** | | | 0.44 | 0.83 |
| Null parity | 72 | 10(13.9) | | |
| Multi parity | 66 | 10(15.2) | | |
| **Antenatal care visit** | | | 0.02 | 0.89 |
| 1-3 | 112 | 16(14.3) | | |
| 4-8 | 26 | 4(15.4) | | |
| **Gestation age at first booking(weeks)** | | | 0.15 | 0.69 |
| ≤20 | 113 | 17(15.0) | | |
| ≥21 | 25 | 3(12.0) | | |
| **Has family history of pre-eclampsia** | | | 21.9 | <0.001 |
| Yes | 21 | 10(47.61) | | |
| No | 117 | 10(8.7) | | |
| **Has history of chronic illness** | | | 6.34 | 0.01 |
| Yes | 22 | 7(31.82) | | |
| No | 116 | 13(11.2) | | |
| **Has previous history of pre-eclampsia** | | | 21.06 | <0.001 |
| Yes | 18 | 9(50.0) | | |
| No | 120 | 11(9.2) | | |
| **Has history of using medication** | | | 22.81 | <0.001 |
| Yes | 28 | 12(42.9) | | |
| No | 110 | 8(7.3) | | |
| **Has history of using supplement in the current pregnancy** | | | 3.3 | 0.69 |
| Yes | 93 | 17(18.28) | | |
| No | 45 | 3(6.7) | | |

**Predictors of pre-eclampsia among pregnant women**

A simple binary logistic regression model was applied to determine predictors of pre-eclampsia, and the results showed that having a family history of pre-eclampsia, a history of chronic illness, a history of pre-eclampsia in the previous pregnancy, and a history of using medications in the index pregnancy were statistically significantly associated with pre-eclampsia ($p<0.05$).

In a multiple logistic regression model, which allows controlling for the effect of other variables, results showed that pregnant women with a family history of pre-eclampsia were 5.7 times more likely to have pre-eclampsia compared to those without a family history (AOR: 5.7, 95% CI: 1.3–24.7). Furthermore, pregnant women with a history of pre-eclampsia from previous pregnancies were

12.9 times more likely to have pre-eclampsia than those with no history (AOR: 12.9, 95% CI: 2.5-55.5), and pregnant women with a history of using medication in the index pregnancy were 19.3 times more likely to have pre-eclampsia than those without a history (AOR: 19.3, 95% CI: 3.9-95.7) (table 4).

**Table 4: Predictors of pre-eclampsia among pregnant women (N=138)**

| Variable | OR | 95 %CI | p-value | AOR | 95 %CI | p-value |
|---|---|---|---|---|---|---|
| **Maternal age (years)** | | | | | | |
| ≤ 29 | **Ref.** | | | | | |
| 30-34 | 1.96 | 0.5-6.9 | 0.24 | 0.71 | 0.1-3.6 | 0.68 |
| ≥ 35 | 4.13 | 1.3-12.8 | **0.01** | 2.89 | 0.6-13.8 | 0.18 |
| **Family history** | | | | | | |
| Yes | 9.73 | 3.3-28.4 | **<0.001** | 5.77 | 1.3-24.7 | **0.01** |
| No | **Ref.** | | | | | |
| **History of Pre-eclampsia** | | | | | | |
| Yes | 9.90 | 3.2-30.1 | **<0.001** | 11.9 | 2.5-55.5 | **0.001** |
| No | **Ref.** | | | | | |
| **History of chronic illness** | | | | | | |
| Yes | 3.69 | 1.2-10.7 | **0.01** | 0.22 | 0.03-1.4 | 0.121 |
| No | **Ref** | | | | | |
| **History of using medication in the current pregnancy** | | | | | | |
| Yes | 9.56 | 3.3-27.0 | **<0.001** | 19.3 | 3.9-95.6 | **<0.001** |
| No | **Ref** | | | | | |

OR = Odds Ratio, AOR: Adjusted Odds Ratio

### Management of Pre-eclampsia at Health Centers, Districts, Regional and Referral Healthcare Facilities

Seven healthcare facilities were assessed for the management of pre-eclampsia, and a total of 43 cases of pre-eclampsia were reviewed. Out of these cases, 12(27.9%) were mild pre-eclampsia and 31(72.1%) were severe pre-eclampsia. The distribution of reviewed cases per facility level is shown in Table 5.

**Table 5: Distribution of reviewed cases in each facility level (N = 43)**

| Facility level | Mild pre-eclampsia (n=12) n(%) | Severe pre-eclampsia(n=31) n(%) |
|---|---|---|
| Health center | 2 (16.7) | 12(38.7) |
| District hospital | 3(25.0) | 7(22.5) |
| Regional hospital | 0(0) | 5(16.1) |
| Tertiary hospital | 7(58.3) | 7(22.6) |

### Description of management in the reviewed files

All 12 cases of mild pre-eclampsia (100%) were kept on methyldopa and received dexamethasone as per protocol, and the slight majority of the cases, 8(66.7%) were checked for protein in urine and 7(58.3%) had their fetal heart rate monitored, while only 5(41.7%) had their blood pressure monitored. As for severe pre-eclampsia, all 31 cases (100%) received a magnesium sulphate loading dose, and a large majority 30(96.8%) received methyldopa and had their blood pressure monitored. However, only 4(12.9%) were evaluated for magnesium toxicity, and 14(45.2%) were checked for liver function tests

(Table 6). When the score of each management was summed up and categorized, the results revealed that a slight majority, i.e., 7(53.8%) of mild pre-eclampsia cases, were properly managed and 9(29.0%) of severe pre-eclampsia cases were properly manage

**Table 6: Management of Mild Pre-eclampsia and Severe Pre-eclampsia (N= 42)**

| Variable | Yes n(%) | No n(%) |
|---|---|---|
| **Mild pre-eclampsia (n=12)** | | |
| Blood pressure monitoring | 5(41.7) | 7(58.3) |
| Fetal heart rate monitoring | 7(58.3) | 5(41.7) |
| Urine for protein monitoring | 8(66.7) | 4(33.3) |
| Dexamethasone is given for pregnant women with GA 24-34 weeks | 12(100) | 0(0) |
| Patients are kept on methyldopa 500 mg TDS | 12(100) | 0(0) |
| **Severe pre-eclampsia (n=31)** | | |
| Hydralazine 5mg started | 14(45.2) | 17(54.8) |
| Patient kept nifedipine on 20mg (PO) eight hourly | 28(90.2) | 3(9.7) |
| Patient kept on methyldopa 500mg (PO) eight hourly | 30(96.8) | 1(3.2) |
| Loading dose (14g) of magnesium sulphate started | 31(100) | 0(0) |
| Patient received / on maintenance dose | 25(83.3) | 5(16.7) |
| Protein in urine measured | 28(90.3) | 3(9.7) |
| Blood pressure monitoring | 30(96.8) | 1(3.2) |
| Fetal heart rate monitoring | 28(90.3) | 3(9.7) |
| Given maintenance dose (5gm) magnesium sulphate IM | 25(83.3) | 5(16.7) |
| Magnesium sulphate toxicity evaluation | 4(12.9) | 27(87.1) |
| Full blood count checked | 30(96.8) | 1(3.2) |
| Renal function test checked | 16(51.6) | 15(48.4) |
| Liver function test checked | 14(45.2) | 17(54.8) |

**Comparing the difference between healthcare facility levels on the management of pre-eclampsia**

When comparing the management of pre-eclampsia between different healthcare facility levels using a Fisher exact test, the results showed that the proportion of patients with severe pre-eclampsia who were properly managed was higher among those who were admitted to referral national hospital compared to those who were admitted to district hospitals and health centres [n = 6 (85.7%) vs 2(28.6%) vs 1(8.3%), p = 0.002]. However, for mild pre-eclampsia, there was no statistically significant difference in its management between facility levels (p>0.05) (Table 7).

**Table 7: Comparison of the difference between healthcare facility levels on the management of pre-eclampsia (N=43)**

| Health facility level | Total | Properly managed n(%) | Not properly managed n(%) | p-value |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| **Mild pre-eclampsia** | | | | **1.0** |
| Health centre | **2** | 1(50) | 1(50) | |
| District hospital | **3** | 2(66.6) | 1(33.3) | |
| Tertiary hospital | **7** | 4(57.1) | 3(42.9) | |
| **Severe pre-eclampsia** | | | | **0.002** |
| Health centre | **12** | 1(8.3) | 11(91.7) | |
| District hospital | **7** | 2(28.6) | 5(71.4) | |
| Regional hospital | **5** | 0(0) | 5(100) | |
| Tertiary hospital | **7** | 6(85.7) | 1(14.3) | |

## Discussion

The present study estimated the prevalence of pre-eclampsia, diagnosed by blood pressure readings, investigation of protein in urine, and assessment of signs and symptoms. Moreover, the possible predictors of pre-eclampsia were assessed, along with how pre-eclampsia is managed at all levels of healthcare facilities in Zanzibar. The findings of this study will play a significant role in efforts to reduce pregnancy complications, which in turn will help decrease maternal morbidity and mortality.

The overall prevalence of pre-eclampsia among pregnant women attending ANC in this study is 14.5%. That means one in every ten pregnant women attending ANC in Zanzibar has abnormal placentation related to either immunological factors, genetic factors, a lowered threshold of placental perfusion, or increased demand on the placenta, which brings up the signs and symptoms of pre-eclampsia (Lavallee, 2015). This prevalence is higher compared to the global prevalence of 1.8%–4.4% (Umesawa & Kobashi, 2017), and higher compared to the prevalence reported in northern Tanzania of 4.2% (Mahande et al., 2013). However, the prevalence in this study is lower compared to the prevalence reported in Zanzibar, which was 26.3% (Machano & Joho, 2020). This disparity could be attributed to differences in study settings (resourced vs. under-resourced settings), participant types (age group differences, parity, gestation age), and methodological differences such as the method of case identification (use of secondary data vs. primary data). Our finding is more similar to the prevalence reported in Ethiopia of 12.4% (Andarge et al., 2020) and in Bangladesh, at 14.4% (Dutta Mou et al., 123 C.E.) both involved using primary data for pregnant women attending ANC at gestational weeks of 20 weeks and above.

In this study, pre-eclampsia was predicted by having a family history of pre-eclampsia or eclampsia. This is consistent with the findings in the literature (Adeline et al., 2018; Grum et al., 2017; Kashanian & Baradaran, 2011; Machano & Joho, 2020; Serrano et al., 2020). Family history represents the combination of risk within a family from shared genetic susceptibilities and clustering of environmental exposures, lifestyles, and behaviours (Serrano et al., 2020). The heritability of pre-eclampsia is estimated to be 30%–55% (Redman & Sargent, 2005), and it is suggested that its etiology involves both maternal and paternal genetic contributions and a substantial environmental component (Graves et al., 1993; Nilsson et al., 2004; Williams & Broughton Pipkin, 2011). To find a family history as a predictor of pre-eclampsia in this study was expected due to the widespread intermarriage practice in this setting grounded in the Islamic religion, which favours the marriage of close relatives, a permission which is welcomed by the majority. This suggests that healthcare providers should emphasize the use of family history in clinical risk assessments for pre-eclampsia to target available interventions to high-risk groups best.

This study also found that having a previous history of pre-eclampsia is a risk factor for pre-eclampsia in subsequent pregnancies. This has been well established in the literature. For example, a woman who had severe pre-eclampsia during her first pregnancy, the recurrence rate is very high, approaching 50%, and significant maternal and fetal complications are more common in recurrent pre-eclampsia than in the first episode (Dildy et al., 2007). The presence of risk factors from the initial

pregnancy increases the risk for recurrent pre-eclampsia, with the majority of these factors reported to persist in subsequent pregnancies (Dildy et al., 2007; Mostello et al., 2008). This finding suggests that healthcare providers should emphasize conducting a systematic evaluation of underlying risk factors for women who have experienced a pregnancy complicated by pre-eclampsia. Moreover, more research is needed to identify and refine a specific pathway suitable for a specific intervention to prevent the recurrence of pre-eclampsia.

Furthermore, this study found that having a history of using medications in the index pregnancy predicts pre-eclampsia. The use of certain drugs during pregnancy (e.g., antidepressants, antiretrovirals, migraine medications, antihistamines and antibiotics) has been linked to an increased risk of pre-eclampsia (Klln et al., 2011; Sahlman et al., 2019; Tooke et al., 2016; Uguz, 2017). The role of drugs in pre-eclampsia is still controversial, but some research explains that antidepressants have the effect of increasing placental chorionic vein and umbilical artery vasoconstriction, which could lead to uteroplacental under-perfusion and ischemia, which are associated with pre-eclampsia (Bernard et al., 2019). While antibiotics may alter the immunological profile and affecting placentation, which is associated with pre-eclampsia (Benner et al., 2021; Minassian et al., 2013). It is more common that pregnant women tend to use over-the-counter drugs or herbal medicine to alleviate symptoms caused by the physiological changes of pregnancy or to treat some medical conditions they may have. Therefore, more information about the types of drugs used during pregnancy and their role in pre-eclampsia is an area of concern for future studies. The findings suggest that healthcare providers should closely monitor pregnant women who are taking medication to reduce the risk of pre-eclampsia.

Although obesity, primigravida, pre-existing hypertension, advanced maternal age, and chronic illness are common risk factors for preeclampsia, we did not find any of them significantly associated with it. This variation between our study and other studies may be resulted from the relatively small number of participants in this study.

Findings from this study revealed that pre-eclampsia is not managed as per the established standard guidelines in many healthcare facilities. Severe pre-eclampsia cases are more mismanaged than mild pre-eclampsia. The underperformed management, i.e., in more than 50% of cases for mild pre-eclampsia, was monitoring of blood pressure. In contrast, for severe pre-eclampsia, it was magnesium sulphate toxicity evaluation, starting hydralazine at 5 mg, and a liver function test. A similar finding was reported in Afghanistan, where not all women with severe and mild pre-eclampsia were monitored for blood pressure and proteinuria as needed (Ansari et al., 2019). The reasons for not following the guidelines in this study were not assessed; however, they could be linked to either unavailability of the guidelines, functional equipment and reagents, well-functioning laboratory facilities, a high healthcare provider-patient ratio, or inadequate knowledge and skills among healthcare providers. Evidence shows that most low-resource settings do not have a well-functioning laboratory facility.

In this study, the availability of laboratory facilities was not assessed. However, the underperformance of liver and kidney function tests suggests inadequate functioning laboratory facilities. This creates challenges in distinguishing between pre-eclampsia with severe and without severe features, which may hinder proper and timely management, and consequently, pregnant women present emergently with eclamptic seizures (Machano & Joho, 2020).

On the other hand, all cases of mild pre-eclampsia and 96.8% of severe pre-eclampsia received antihypertensive medication as per the standard guideline. The conservative treatment of pre-eclampsia is essential for controlling blood pressure in order to minimize pregnancy-related complications, minimize prematurity, and promote maternal and infant survival. This finding is different from what is reported in Afghanistan and in six sub-Saharan African countries, in which 31%

of cases of mild pre-eclampsia and 5% of cases of severe pre-eclampsia did not receive antihypertensive medication, respectively (Ansari et al., 2019),(Rawlins et al., 2018).

Furthermore, this study's findings show a significant difference in the management of severe pre-eclampsia between higher and lower-level healthcare facilities. Most cases were managed correctly at higher healthcare facility levels than at lower levels. The difference could be due to the unequal distribution of resources between different levels. Healthcare facility levels are categorized based on the services provided, which determines the allocation of resources to a particular facility, including healthcare providers with advanced professional qualifications. It is therefore suggested that the government should strive to reduce the resource allocation disparity in the ANC departments between healthcare facility levels for a significant reduction of morbidity and mortality related to pre-eclampsia.

This study's strength was that it focused on the critical topic of pre-eclampsia magnitude and how it is managed at all levels of healthcare in Zanzibar, which is poorly documented. The use of a standardized questionnaire enabled us to study the most critical risk factors, and we were able to adjust for some potential confounders. Despite its strength, this study has few limitations worth mentioning. The sample size was relatively small, so we did not find a significant association with common risk factors established in the literature.

Furthermore, this study was conducted in healthcare facilities. Thus, our findings may not represent all pregnant women in the catchment area. The diagnosis of pre-eclampsia, on the other hand, relied on a combination of blood pressure elevation, protein in the urine, and clinical findings without using laboratory tests such as thrombocytopenia, liver, and renal function tests for severe features, which limited the classification of the identified pre-eclamptic cases. The pre-eclampsia management assessment was based only on admitted patients; thus, we missed information on the comprehensive management practice at different healthcare facility levels. However, our findings may be helpful for further studies in this area.

The information obtained from this study, particularly on how pre-eclampsia is managed at different healthcare facility levels, is critical for policymakers and health planners to rethink the quality of maternal care quality and strive to improve care by reducing disparities between healthcare facility levels and ensuring lab equipment and supplies for pre-eclampsia management are available at all healthcare facility levels.

## Conclusions

The prevalence of pre-eclampsia among pregnant women attending ANC in Zanzibar is high. The predictors for pre-eclampsia in this setting are having a family history of pre-eclampsia, a previous history of pre-eclampsia, and a history of medication use in the index pregnancy.

The standard guidelines for the management of pre-eclampsia are not adequately followed, and severe pre-eclampsia is mostly mismanaged at lower healthcare facility levels. The findings are relevant for identifying high-risk pregnancies, improving maternal healthcare delivery, and saving lives. As a result, a multifaceted approach is urgently needed in this setting to support frontline healthcare providers and healthcare facilities, especially of the lower levels, in providing quality care to pregnant women, promoting community engagement in ANC, and raising awareness about high-risk pregnancy and complication readiness.

## Ethics consideration

Ethical permission for this study was obtained from the University of Dodoma Research Ethics Committee (UDOM-REC) with reference number MA.84/261/02/218 and Zanzibar Health Research

Institute (ZAHRI) with a reference number ZAHREC/04/ST/JAN/2021/02. Written consent was given to pregnant women after explaining the purpose of the study and being told that their participation was voluntary and they would be able to withdraw at any time from the study. The authors declare that this is an original work and have no interest in disclosing it.

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**Author's contribution:**
SAR conceived the study, SAS and SAR designed the study, and SAR collected the data. SAS and SAR did the data analysis, and SAS and RBO wrote the final draft of the manuscript. All authors reviewed the manuscript and accepted it for publication

## References

ACOG. (2002). Practice bulletin #33: diagnosis and management of preeclampsia and eclampsia. *Obstetrics & Gynecology*, *99*(1), 159–167. https://doi.org/10.1016/s0029-7844(01)01747-1

Adeline, M. E., Laksana, M. A. C., & Atika, S. (2018). Characteristic of Referral Patients With Severe Preeclampsia In Surabaya. *Biomolecular and Health Science Journal*, *1*(1), 25. https://doi.org/10.20473/bhsj.v1i1.8219

Andarge, R. B., Anshebo, A. A., Halil, H. M., Kebede, B. A., & Ahmed, R. (2020). *Prevalence and Associated Factors of Pre-eclampsia among Pregnant Women at Antenatal Booking in the Halaba Kullito General Hospital , Southern Ethiopia . Journal of Women ' s Health Care*. 1–9. https://doi.org/10.35248/2167-0420.20.9.496.Copyright

Ansari, N., Manalai, P., Maruf, F., Currie, S., Stekelenburg, J., Roosmalen, J. Van, Kim, Y., & Tappis, H. (2019). *Quality of care in early detection and management of pre-eclampsia / eclampsia in health facilities in Afghanistan*. *0*, 1–12.

Baker, U., Peterson, S., Marchant, T., Mbaruku, G., Temu, S., Manzi, F., & Hanson, C. (2015). Identifying implementation bottlenecks for maternal and newborn health interventions in rural districts of the United Republic of Tanzania. *Bulletin of the World Health Organization*, *93*(6), 380–389. https://doi.org/10.2471/BLT.14.141879

Barua, A., Mundle, S., Bracken, H., Easterling, T., & Winikoff, B. (2011). Facility and personnel factors influencing magnesium sulfate use for eclampsia and pre-eclampsia in 3 Indian hospitals. *International Journal of Gynecology and Obstetrics*, *115*(3), 231–234. https://doi.org/10.1016/j.ijgo.2011.07.016

Belay, A. S., & Wudad, T. (2019). Prevalence and associated factors of pre-eclampsia among pregnant women attending anti-natal care at Mettu Karl referal hospital, Ethiopia: cross-sectional study. *Clinical Hypertension*, *25*(1), 1–8. https://doi.org/10.1186/S40885-019-0120-1/TABLES/4

Benner, M., Lopez-Rincon, A., Thijssen, S., Garssen, J., Ferwerda, G., Joosten, I., van der Molen, R. G., & Hogenkamp, A. (2021). Antibiotic Intervention Affects Maternal Immunity During Gestation in Mice. *Frontiers in Immunology*, *12*, 685742. https://doi.org/10.3389/FIMMU.2021.685742/FULL

Bernard, N., Forest, J. C., Tarabulsy, G. M., Bujold, E., Bouvier, D., & Giguère, Y. (2019). Use of antidepressants and anxiolytics in early pregnancy and the risk of preeclampsia and gestational hypertension: A prospective study. *BMC Pregnancy and Childbirth*, *19*(1), 1–9. https://doi.org/10.1186/S12884-019-2285-8/TABLES/5

Cochran, W. G. (1977). Double sampling. *Cochran WG. Sampling Techniques. 3rd Ed. New York: John Wiley & Sons, Inc*, 327–358.

Dildy, G. A., Belfort, M. A., & Smulian, J. C. (2007). Preeclampsia recurrence and prevention. *Seminars in Perinatology*, *31*(3), 135–141. https://doi.org/10.1053/J.SEMPERI.2007.03.005

Dutta Mou, A., Barman, Z., Hasan, M., Miah, R., Momtahena Hafsa, J., Das Trisha, A., & Ali, N. (123 C.E.). Prevalence of preeclampsia and the associated risk factors among pregnant women in Bangladesh. *Scientific Reports |*, *11*, 21339. https://doi.org/10.1038/s41598-021-00839-w

Fingar, K. R., Mabry-Hernandez, I., Ngo-Metzger, Q., Wolff, T., Steiner, C. A., & Elixhauser, A. (2006). Delivery Hospitalizations Involving Preeclampsia and Eclampsia, 2005–2014: Statistical Brief #222. *Healthcare Cost and Utilization Project (HCUP) Statistical Briefs*, 1–26.

Frank, I. O., Michael, J. M., Jenny, R., & Joseph, O. (2020). Prevalence and risk factors for pre-eclampsia/eclampsia in Northern Tanzania. *Journal of Public Health and Epidemiology*, *12*(2), 78–85. https://doi.org/10.5897/jphe2019.1143

goverment of Zanzibar. (2019). *management protocols for emergency obstetric and newborn care*.

Graves, S. W., Seely, E. W., & Williams, G. H. (1993). Genes, phenotypes and hypertensive pregnancies. *Nature Genetics*, *4*(1), 7–8. https://doi.org/10.1038/ng0593-7

Grum, T., Seifu, A., Abay, M., Angesom, T., & Tsegay, L. (2017). 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*, *17*(1), 1–7. https://doi.org/10.1186/s12884-017-1507-1

Herklots, T., Van Acht, L., Meguid, T., Franx, A., & Jacod, B. (2017). Severe maternal morbidity in Zanzibar's referral hospital: Measuring the impact of in-hospital care. *PLoS ONE*, *12*(8), e0181470. https://doi.org/10.1371/journal.pone.0181470

Iachan, R. (1982). Systematic Sampling: A Critical Review. *International Statistical Review / Revue Internationale de Statistique*, *50*(3), 293. https://doi.org/10.2307/1402499

Joho, A., Kibusi, S., & Ernest, A. (2020). *Knowledge on Prevention and Management of Preeclampsia and Eclampsia among Nurses in Primary Health Settings: Baseline Findings from an Inter- ventional Study in Dodoma Region, Tan... July*. https://doi.org/10.24248/eahrj.v4i1.619

Kashanian, M., & Baradaran, H. R. (2011). *Risk Factors for Pre-Eclampsia: A Study in Tehran, Iran*. *November*.

Klln, B., Nilsson, E., & Otterblad Olausson, P. (2011). Delivery outcome after maternal use of drugs for migraine: a register study in Sweden. *Drug Safety*, *34*(8), 691–703. https://doi.org/10.2165/11590370-000000000-00000

Kuklina, E. V., Ayala, C., & Callaghan, W. M. (2009). Hypertensive disorders and severe obstetric morbidity in the United States. *Obstetrics and Gynecology*, *113*(6), 1299–1306.

https://doi.org/10.1097/AOG.0B013E3181A45B25

Lavallee, L. (2015). Clinical presentation, assessment and management of pre-eclampsia. *Nursing Standard (Royal College of Nursing (Great Britain) : 1987)*, *29*(45), 51–59. https://doi.org/10.7748/NS.29.45.51.E9952

Machano, M. M., & Joho, A. A. (2020). *Prevalence and risk factors associated with severe pre-eclampsia among postpartum women in Zanzibar : a cross-sectional study*. 1–10.

Maembe, L. E., & Pembe, A. B. (2015). Managing pre-eclampsia and eclampsia in Dar es Salaam public health facilities: A focus on equipment, supplies, drugs and knowledge of healthcare workers. *Tanzania Medical Journal*, *27*(1), 43–54.

Mahande, M. J., Daltveit, A. K., Mmbaga, B. T., Masenga, G., & Obure, J. (2013). Recurrence of Preeclampsia in Northern Tanzania: A Registry-Based Cohort Study. *PLoS ONE*, *8*(11), 79116. https://doi.org/10.1371/journal.pone.0079116

Makuwani, D. A. M., Sospeter, D. P. F., Subi, D. L., Nyamhagatta, D. M. A., Kapologwe, D. N., Ismael, M. H., Mkongwa, D. N., Ulisubisya, D. M. M., & Bakari Kambi, P. M. (2020). Baseline Data on Trend of Maternal Mortality in Tanzania using Administrative Data and its Policy Implication. 2018 Report. *Global Journal of Medical Research*, *20*(6), 5–12. https://doi.org/10.34257/gjmrkvol20is6pg5

Minassian, C., Thomas, S. L., Williams, D. J., Campbell, O., & Smeeth, L. (2013). Acute Maternal Infection and Risk of Pre-Eclampsia: A Population-Based Case-Control Study. *PLoS ONE*, *8*(9). https://doi.org/10.1371/JOURNAL.PONE.0073047

MoHASWZ. (2018). *Ministry of Health & Social Welfare , Zanzibar Health Management Information System Unit Health Information Bulletin 2008*.

MoHCDGEC. (2016). Tanzania Demorgraphic and Health Survey Indicator Survey (TDHS-MIS) 2015-2016. *Dar Es Salaam, Tanzania, and Rockville, Maryland, USA: MoHCDGEC, MoH, NBS, OCGS, and ICF*, *1*(1), 1–630.

Mostello, D., Kallogjeri, D., Tungsiripat, R., & Leet, T. (2008). Recurrence of preeclampsia: effects of gestational age at delivery of the first pregnancy, body mass index, paternity, and interval between births. *American Journal of Obstetrics and Gynecology*, *199*(1), 55.e1-55.e7. https://doi.org/10.1016/J.AJOG.2007.11.058

Nilsson, E., Ros, H. S., Cnattingius, S., & Lichtenstein, P. (2004). The importance of genetic and environmental effects for pre-eclampsia and gestational hypertension: a family study. *BJOG : An International Journal of Obstetrics and Gynaecology*, *111*(3), 200–206. https://doi.org/10.1111/J.1471-0528.2004.00042X.X

Oguntunde, O., Charyeva, Z., Cannon, M., Sambisa, W., Orobaton, N., Kabo, I. A., Shoretire, K., Danladi, S. E., Lawal, N., & Sadauki, H. (2015). Factors influencing the use of magnesium sulphate in pre-eclampsia/eclampsia management in health facilities in Northern Nigeria: A mixed methods study. *BMC Pregnancy and Childbirth*, *15*(1), 1–8. https://doi.org/10.1186/s12884-015-0554-8

Otieno, A. N. (2012). *Factors Contibuting To Adverse Outcomes Of Pre-Eclampsia Among Pregnant Women Attending Antenatal Clinics In Kibera Slums, Nairobi*.

Pandey, R., & Verma, M. R. (2008). Samples allocation in different strata for impact evaluation of developmental programme. *Rev. Mat. Estat*, *26*(4), 103–112.

Raghuraman, N., March, M. I., Hacker, M. R., Merport, A., Wenger, J., Narcisse, R., Louis, J.,

Scott, J., & Rana, S. (2014). Pregnancy Hypertension : An International Journal of Women ' s Cardiovascular Health Adverse maternal and fetal outcomes and deaths related to preeclampsia and eclampsia in Haiti. *Pregnancy Hypertension: An International Journal of Women's Cardiovascular Health*, *4*(4), 279–286. https://doi.org/10.1016/j.preghy.2014.09.002

Rawlins, B., Plotkin, M., Rakotovao, J. P., Getachew, A., Vaz, M., Ricca, J., Lynam, P., Kagema, F., & Gomez, P. (2018). *Screening and management of pre- eclampsia and eclampsia in antenatal and labor and delivery services : findings from cross-sectional observation studies in six sub-Saharan African countries*. 1–11.

Redman, C. W., & Sargent, I. L. (2005). Latest advances in understanding preeclampsia. *Science (New York, N.Y.)*, *308*(5728), 1592–1594. https://doi.org/10.1126/SCIENCE.1111726

Sahlman, H., Koponen, M., El-Nezami, H., Vähäkangas, K., & Keski-Nisula, L. (2019). Maternal use of drugs and preeclampsia. *British Journal of Clinical Pharmacology*, *85*(12), 2848–2855. https://doi.org/10.1111/bcp.14117

Sarsam, D. S., Shamden, M., Al Wazan, R., & Sarsam, S. D. (2008). Expectant versus aggressive management in severe preeclampsia remote from term. *Singapore Medical Journal*, *49*(9), 698–703.

Say, L., Chou, D., Gemmill, A., Tunçalp, Ö., Moller, A. B., Daniels, J., Gülmezoglu, A. M., Temmerman, M., & Alkema, L. (2014). Global causes of maternal death: A WHO systematic analysis. *The Lancet Global Health*, *2*(6), 323–333. https://doi.org/10.1016/S2214-109X(14)70227-X

Seif, S. A., & Rashid, S. A. (2022). Knowledge and skills of pre-eclampsia management among healthcare providers working in antenatal clinics in Zanzibar. *BMC Health Services Research*, *22*(1), 1512. https://doi.org/10.1186/S12913-022-08892-5/TABLES/4

Serrano, N. C., Quintero-Lesmes, D. C., Dudbridge, F., Leon, L. J., Hingorani, A. D., Williams, D. J., & Casas, J. P. (2020). Family history of pre-eclampsia and cardiovascular disease as risk factors for pre-eclampsia: the GenPE case-control study. *Hypertension in Pregnancy*, *39*(1), 56–63. https://doi.org/10.1080/10641955.2019.1704003

Tanzania Minisrty of Health. (2013). The United Republic Of Tanzania Standard Treatment Guidelines And Essential Medicines List. [ONLINE]. Available at: <https://www.severemalaria.org/sites/mmv-smo/files/content/attachments/2017-03-10/Tanzania_STG_052013.pdf>

Tanzania Minisrty of Health. (2017). Standard Treatment Guidelines & National Essential Medicines List Tanzania Mainland. [ONLINE]. Available at: < https://hssrc.tamisemi.go.tz/storage/app/uploads/public/5ab/e9b/b21/5abe9bb2162671303

Tooke, L., Riemer, L., Matjila, M., & Harrison, M. (2016). Antiretrovirals causing severe pre-eclampsia. *Pregnancy Hypertension*, *6*(4), 266–268. https://doi.org/10.1016/J.PREGHY.2016.04.006

Tufton, N., & Patel, R. R. (2011). Prevalence of hypertensive disorders in a prenatal clinic in Zanzibar. *International Journal of Gynecology and Obstetrics*, *112*(1), 69–70. https://doi.org/10.1016/j.ijgo.2010.09.005

Uguz, F. (2017). Is There Any Association Between Use of Antidepressants and Preeclampsia

or Gestational Hypertension?: A Systematic Review of Current Studies. *Journal of Clinical Psychopharmacology*, *37*(1), 72–77. https://doi.org/10.1097/JCP.0000000000000618

Umesawa, M., & Kobashi, G. (2017). Epidemiology of hypertensive disorders in pregnancy: prevalence, risk factors, predictors and prognosis. *Hypertension Research : Official Journal of the Japanese Society of Hypertension*, *40*(3), 213–220. https://doi.org/10.1038/HR.2016.126

Wandabwa, J., Doyle, P., Kiondo, P., Campbell, O., Maconichie, N., & Welishe, G. (2010). Risk factors for severe pre-eclampsia and eclampsia in Mulago Hospital, Kampala, Uganda. *East African Medical Journal*, *87*(10), 415–424. https://doi.org/10.4314/eamj.v87i10

WHO. (2009). *Monitoring Emergency Obsetric a Handbook*.

WHO. (2011). *Prevention and treatment of pre-eclampsia and eclampsia*.

WHO. (2017). *Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division*.

Williams, P. J., & Broughton Pipkin, F. (2011). The genetics of pre-eclampsia and other hypertensive disorders of pregnancy. *Best Practice and Research: Clinical Obstetrics and Gynaecology*, *25*(4), 405–417. https://doi.org/10.1016/j.bpobgyn.2011.02.007