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Trends and Predictors of Pre-Eclampsia between 1990 and 2020 in Ghana: A Systematic Review

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Abstract

Pre-eclampsia is a specific form of hypertension in pregnancy that raises significant public health concerns globally. Mothers may sometimes appear healthy, yet later develop pre-eclampsia, leading to adverse consequences, including death. This situation has underscored the necessity for ongoing research to improve maternal birth outcomes and prevent disabilities and fatalities. This systematic review assessed trends and predictors of pre-eclampsia in Ghana over the last three decades. This review covered publications from January 1990 to December 2020, using three bibliographic databases. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement was used to screen and select the papers included in the review. The tool for Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) was used to enhance the quality of the evaluated papers. The majority (13 out of 21) of studies on the prevalence and predictors of pre-eclampsia were conducted between 2011 and 2020. The review found an average incidence rate of 9.1% for pre-eclampsia and identified approximately twenty-six predictors among pregnant women. These predictors included demographic and maternal factors, dietary and environmental influences, as well as maternal and perinatal care services. There is an increasing trend of pre-eclampsia among women in Ghana. Although the predictors of pre-eclampsia are relatively similar to those in other parts of the world, healthcare providers should ensure timely screening, treatment, and management to reduce adverse outcomes, including maternal mortality during pregnancy.

Keywords: *Ghana, Maternal, Predictors, Pre-eclampsia, Pregnancy.*

Introduction

Pre-eclampsia is a specific form of hypertension that occurs during pregnancy, presenting a significant global public health concern. It has been a major contributor to maternal deaths and adverse birth outcomes in both high- and low-resource settings [1]. Typically, pre-eclampsia develops after the first trimester, around 20 weeks of gestation, during labour, or within two days post-delivery, and is often accompanied by proteinuria [2, 3]. The condition is characterized by the persistent and progressive elevation of blood pressure, and if left untreated, can lead to eclampsia, a significant cause of adverse maternal and neonatal outcomes [2].

Despite extensive research, the precise biological mechanisms behind pre-eclampsia remain unclear [1]. Clinical evidence suggests that it results from a series of physiological reactions triggered by poor perfusion of the

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uterus and placenta [2]. This leads to oxidative stress, causing the release of anti-angiogenic proteins and inflammatory mediators into the maternal bloodstream, ultimately raising blood pressure [4, 5]. Pre-eclampsia is a leading cause of maternal and perinatal complications, including death [1]. Globally, hypertensive disorders during pregnancy affect 5-8% of women [6], contributing to 10-15% of maternal deaths and 25% of infant and neonatal mortality [7-9]. In Africa and Asia, hypertension-related disorders account for an estimated 10-16% of maternal deaths [2, 10].

In low-resource settings, the morbidities associated with pre-eclampsia are often underreported, as maternal outcomes are typically recorded only in terms of mortality [11]. This underreporting poses significant challenges for public health efforts and health system strengthening. In Ghana, the maternal mortality rate is estimated at 343 per 100,000 live births, with pregnancy-related deaths accounting for 14% of all-cause mortality among women [12]. Pre-eclampsia alone contributes to 19.4% of maternal deaths, ranking among the top three causes of maternal mortality in the country [13, 14].

Antenatal care (ANC) services have evolved over the years, aiming to provide focused care to pregnant women. Currently, women are advised to attend at least eight ANC visits before delivery [15]. These frequent visits enable healthcare providers to detect and manage pregnancy-related conditions, including hypertension, promptly to prevent complications and deaths [15]. However, various health-sector challenges, such as limited institutional capacity, inadequate in-service training, and insufficient resources, have hindered the effective implementation of ANC interventions, especially at peripheral health facilities [16]. Additionally, poor health-seeking behaviours, including delayed attendance at ANC clinics, have exacerbated the problem in Ghana [16].

Moreover, known predictors of pre-eclampsia do not always align with its causes in maternal mortality and morbidity. Some women who are otherwise healthy develop hypertension during pregnancy and experience adverse outcomes, including death. This underscores the need for ongoing research to understand better and address the predictors of pre-eclampsia to improve maternal outcomes and reduce mortality. Given its continued impact on maternal health, this systematic review aims to assess the rates and predictors of pre-eclampsia in Ghana from 1990 to 2020.

Research Questions

1) What has been the trend of pre-eclampsia in Ghana from 1990 to 2020? and 2) What have been the predictors of pre-eclampsia over the same period?

Materials and Methods

Search Strategy

This systematic review covered publications from January 1990 to December 2020 and used the following bibliographic databases: https://www.scholar.google.com, http://www.scopus.com, and https://pubmed.ncbi.nlm.nih.gov/.

Search Terms

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement was utilised in this review [17]. Search terms used to identify relevant literature included: “pre-eclampsia”, “eclampsia”, “pregnancy-induced hypertension”, “predictors of pre-eclampsia”, and “pregnant women in Ghana” (Table 1). Publications included in this systematic review comprised journal articles and institutional reports published in English.

Table 1. Search Terms used for Relevant Articles

Subjects	**Exposure**	**Outcomes**
("women"; "adolescents"; "mothers")	("pregnancy")	("pre-eclampsia"; "eclampsia"; "predictors of pre-eclampsia"; "determinants of pre-eclampsia"; "determinants of eclampsia")
AND		
("Ghana"; "Africa"; "West Africa")		

Screening of Articles

The researchers conducted an independent evaluation of the titles and/or abstracts of all articles retrieved from the search. A third researcher resolved all discrepancies that arose during the initial screening and the final evaluation of the articles. The researchers only included articles and reports that met the eligibility criteria, namely those that reported on pre-eclampsia or eclampsia and/or the factors associated with pre-eclampsia in Ghana, conducted and/or published within the last three decades.

Selection Criteria for the Review

The twenty-one publications included in this systematic review had to meet the following criteria: 1) they reported on pre-eclampsia, eclampsia, or pregnancy-induced hypertension among pregnant women in Ghana; 2) they examined the associated predictors or determinants among this population; 3) they included official reports from state institutions and their associated partners in the health sector; and 4) they were published in English. Both quantitative and qualitative studies were included in the review.

Study Quality Assessment

The first measure taken to ensure data quality involved utilising the built-in filtering features of the databases. To facilitate the publication process, the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) tool was used [18]. Two independent reviewers screened and evaluated all 1,040 publications extracted from the three databases based on the eligibility criteria.

Data Synthesis

The findings of the articles were evaluated in accordance with the established criteria of the study, which included the author's name, year of publication, country, study population, research design, and sample size. The proportion of the sample group identified as having pre-eclampsia, along with the associated predictors, was documented for the primary outcome variable of the study. The results of the reviewed papers, along with synthesised information, are presented in tabular format.

Results

Search Results

A total of one thousand and forty (1,040) papers were identified in the initial search conducted through Google Scholar (567), PubMed (94), and Scorpius (379). One hundred and two (102) duplicates in the combined dataset were removed before screening papers based on their titles and abstracts. The methodology for screening and final selection of papers is depicted in Figure 1. Although three (3) papers were published post-2020, the data for these studies were collected before 2020 and were therefore included in the current review. The remaining two papers did not specify the timeframe for data collection; however, they provided the most recent data regarding the relationship between dietary intake and pre-eclampsia, warranting their inclusion in the review. These papers did not address the prevalence of pre-eclampsia and

therefore did not affect the average estimate in the review. The reviewed papers were categorised into three main groups: the first, second, and third decades of the review. The majority of the papers (13/21) concerning pre-eclampsia were published between 2011 and 2020.

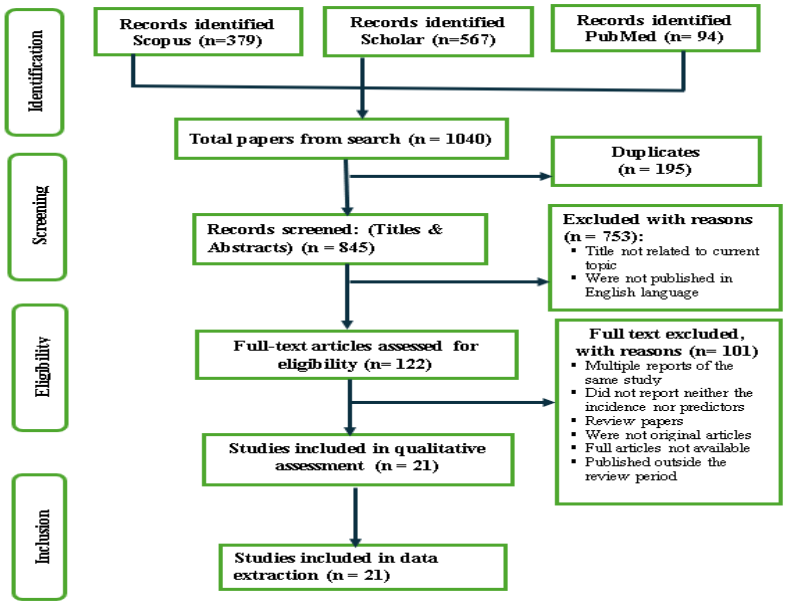

Figure 1. PRISMA Flow Diagram for Screening Articles; Adopted and Modified from Page et al, (2021)

Study Design

The reviewed papers encompassed a variety of observational study designs, including cross-sectional (n=8), case-control (n=6), and cohort (n=6) studies. A total of twelve (12) papers were conducted in the Southern Belt of Ghana, eight (8) in the Middle Belt, and one (1) in the Northern Belt during the specified review period. The sample sizes reported in these studies ranged from 100 to 10,307 pregnant women within clinical settings. Notably, the majority of the studies (n=13) were carried out at Korle-Bu Teaching Hospital (n=7) and Komfo Anokye Teaching Hospital (n=6).

Prevalence of Pre-eclampsia

Eleven (11) of the twenty-one (21) papers reported the incidence of pre-eclampsia over the past three decades. Among these 21 papers, one (1) study was conducted between 1990 and 2000, two (2) studies between 2001 and 2010, and eighteen (18) studies were reported in the most recent decade (Table 2). Geographically, the majority of the studies were conducted in the Southern Belt (12), followed by the Middle Belt (8). Korle-Bu and Komfo Anokye Teaching Hospitals were the predominant healthcare facilities for pre-eclampsia research in Ghana. The majority (8) of the papers included in this review were cross-sectional studies, followed by case-control studies (6) and cohort studies (5). On average, the reported prevalences of pre-eclampsia were 1.3%, 5.6%, and 11% for the periods 1990 to 2000, 2001 to 2010, and 2011 to 2020, respectively. The Southern Belt exhibited an average incidence of pre-eclampsia of 6.2%, the Middle Belt had 14%, and the Northern Belt reported 7% during this period. The overall average percentage of pre-eclampsia across the 22 papers over the three decades was 9.1%. The trend in pre-eclampsia prevalence is illustrated in Figure 2. Collectively, the studies encompassed a total of 24,037 participants, with 1,215 individuals diagnosed with pre-eclampsia, resulting in an estimated overall incidence of 5.1% during the studied period.

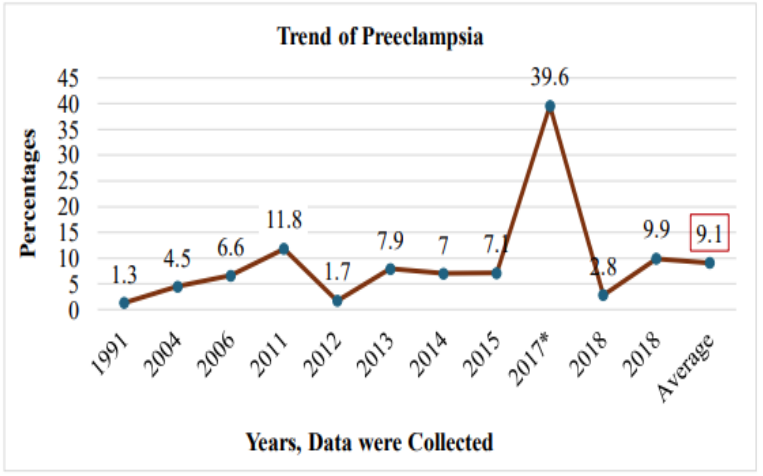

Figure 2. Trend of Pre-eclampsia

*(*was extremely high because the sample population was a special group (pregnant women with medical emergencies).*

Predictors of Pre-eclampsia

The review identified only one paper published between 1990 and 2000 that addressed the predictors of pre-eclampsia in Ghana. Between 2000 and 2001, three papers were published; between 2010 and 2020, nine. The studies identified maternal and environmental factors, nutrition, and access to health services as significant predictors of pre-eclampsia. Maternal age consistently emerged as a predictor of pre-eclampsia among pregnant women across the three decades [19-21]. Mothers younger than 20 years of age were reported to be at a higher risk of developing pre-eclampsia during pregnancy [19, 21, 22]. Similarly, mothers older than 35 years of age were also observed to be at an increased risk of pre-eclampsia [20-22]. The season of pregnancy was found to significantly predict the risk of pre-eclampsia [19, 21, 23]. This association was noted between the 1990–2000 and 2001–2010 decades, with mothers who were pregnant during the rainy season being at a higher risk of developing pre-eclampsia compared to those who were pregnant in the dry season [24].

Mothers with multiple pregnancies were consistently found to be at significant risk of developing pre-eclampsia across the three decades reviewed. In the 2011–2020 decade, multiple deliveries (parity) were reported by Adu-Bonsaffoh et al. [20] as a predictor of pre-eclampsia, while twin pregnancies were noted in the most recent decade to predict pre-eclampsia [22]. Other maternal factors that predicted pre-eclampsia included nulliparity [25], family history [24], depression or tension [26], and anxiety. Two out of twenty-one papers indicated that a change in sexual partner prior to pregnancy predicted pre-eclampsia in the two most recent decades [24, 27]. Several nutrition-related factors were also reported to predict pre-eclampsia, including obesity or higher Body Mass Index (BMI) scores [22, 24, 28-30], low serum concentrations of calcium and magnesium [30], high intakes of protein, high dietary intakes of folic acid and manganese, low intakes of vitamin B12, folate, and calcium, and excessive intakes of vitamin C [31]. Higher serum triglyceride levels were also associated with an increased risk of pre-eclampsia in recent decades [29]. Access to healthcare-related services was likewise reported as a predictor of pre-eclampsia; for instance, a lack of access to prenatal care was identified as a predictor between 1990 and 2000, although it was not examined in the last two decades [19]. Additionally, the use of contraceptives was reported to predict pre-eclampsia [23, 32].

Table 2. Prevalence and Predictors of Pre-eclampsia within the Three Decades

Authors	**Year of publication**	**Year of data collection**	**Study design**	**Study location**	**Geographic Belt**	**Sampling protocol**	**Sample size**	**Prevalence of PE**	**Predictors of PE**
Obed et al. [19]	1994	1991	Survey	KBTH- Greater Accra	Southern	Survey	10307	134 (1.3%)	Young maternal age, nulliparity, delivery in the rainy season, multiple pregnancy
Owiredu et al. [21]	2010	2006-2007	Cross sectional	KATH – Ashanti	Middle	Survey	8091	530 (6.6%)	Rainy season, younger and advanced maternal age
Obed & Aniteye, [27]	2007	2004	Longitudinal study	KBTH – Greater Accra	Southern	-	381	17 (4.5%)	Change of sexual partner
Owiredu *et al.,* [24]	2012	2006-2007	Case-control	KATH – Ashanti	Middle	-	100	-	Advanced maternal age, obesity, family history of hypertension
Oppong *et al., [33]*	2019	2006-2007	Case-control	KATH	Middle	-	150	-	Advanced maternal age, obesity, family history of hypertension
Owusu *et al.,* [34]	2013	2011	Cross sectional	KBTH- Greater Accra	Southern	Systematic review	220	26 (11.8%)	Snoring during pregnancy
Yeboah *et al.,* [30]	2017	-	Case-control	KATH- Ashanti	Middle	-	200	-	Low serum calcium and magnesium levels, high BMI
Abebrese *et al., [25]*	2017	2015	Cross sectional	Regional hospital – Brong Ahafo	Middle	Systematic random sampling	450	32 (7.1%)	-
Adu-Bonsaffoh *et al., [20]*	2017	2013	Cross sectional	KBTH – Greater Accra	Southern	Survey	1856	140 (7.9%)	Parity ≥2, gravidity ≥3, high maternal age >35yrs, high gestation age at ANC booking, low gestation at delivery
Anot *et al., [35]*	2019	2017-2018	Cohort study	KATH – Ashanti	Middle	-	493	197 (39.6%)	High suboptimal health status score

Awuah *et al., [36]*	2020	2018	Case-control	KATH- Ashanti	Middle	-	214	6 (2.8%)	-
Brown *et al.,* [37]	2015	2012-2014	Cohort study	Ridge hospital – Greater Accra	Southern	-	789	13 (1.7%)	-
Dalaba *et al.,* [38]	2015	2014	Cross sectional	District hospital KND -UER	Northern	Survey	60	4 (7%)	-
Beyuo *et al.,* [22]	2022	2018-2020	-	KBTH – Greater Accra	Southern	-	1176	116 (9.9%)	Maternal age <20yrs, twin gestation, underweight
Amegah *et al., [39]*	2021	2020	Cross sectional	CCTH/UH-Central	Southern	Simple random	799	-	Decreasing intake of vitamin D, exposure to household air pollution
Amoakoh-Coleman *et al., [28]*	2017	2011	Cohort study	KBTH – Greater Accra	Southern	Survey	600	-	Overweight Obesity at first trimester
Asare et al., [32]	2021	2019	Case-control	Comboni Mission H.- Volta	Middle	-	60	-	Contraceptive use (DMPA)
Avoka *et al., [31]*	2022a	-	Cohort study	Hospitals (7)-Eastern region	Southern	Simple random	475	-	Inadequate intake of vitamin B12, C, Calcium, & folate high intake of protein in pregnancy high intake of Manganese & folic acid
Avoka *et al.,* [26]	2022	-	Cohort study	Hospitals (7)-Eastern region	Southern	Simple random	475	-	Poor psychological and emotional health (tension, anxiety, & depression)
Ephraim *et al., [29]*	2014	2013	Case-control	Central regional & University hospitals – Central	Southern	Consecutive sampling	110	-	High BMI scores High triglyceride level
Obiri *et al., [40]*	2020	2015	Cross sectional	KBTH- Greater Accra	Southern	-	134	-	Placental pathology, placental malaria, primigravida

Discussion

Prevalence of Pre-eclampsia

We observed a consistent increase in the prevalence of pre-eclampsia over the past three decades. Specifically, the prevalence of pre-eclampsia in the last decade (2011-2020) was approximately 10%, representing an increase of 5 percentage points compared to the prevalence recorded between 1990 and 2000, as well as between 2001 and 2010. The notably high prevalence in 2017 can be attributed to the inclusion of a special study group consisting of pregnant women with medical complications. Overall, the elevated prevalence of pre-eclampsia in the recent decade (2011-2020) may be ascribed to broader healthcare coverage, and enhanced health-seeking behaviour among pregnant women compared to earlier decades [41-43]. Currently, a greater number of pregnant women have improved access to primary healthcare services, including antenatal care (ANC) at the community level, relative to those who lived between 1990 and 2000. The implementation of community-based health planning and services (CHPS), along with enhancements in health infrastructure, may have resulted in more women being screened and diagnosed with pre-eclampsia than in the preceding two decades. Additionally, the increased prevalence may be attributable to advancements in the diagnosis of pre-eclampsia, facilitated by the availability of more clinical equipment and skilled personnel in recent years [44]. The lower prevalence observed in 2011-2020 could also be linked to a relatively smaller number of studies on pre-eclampsia rates compared to more recent times. While data on pre-eclampsia have been somewhat accessible, they have generally been limited to the causes of maternal mortality and morbidity [45, 46], rather than the prevalence of the condition among pregnant women. The average prevalence of pre-eclampsia in the current study aligns with the 8.2% reported in all developing countries by Zhang et al. [44]. The findings of this study are comparatively higher than rates reported in Madagascar, Ethiopia, Nigeria, and other regions of Africa [47-49], as well as in Europe [50] and the USA [51]. The prevalence rate reported in this study falls within the range observed for Ghana (4.4% to 11.8%) and Ecuador (3.5% to 9.6%) and is closely related to the ranges reported for Iran (3.3% to 7.8%), Finland (3.6% to 8.1%), and Brazil (1.5% to 8.2%) [44]. The prevalence rate of pre-eclampsia identified in this study is double the global rate [52] and positions Ghana among the countries with the highest rates of pre-eclampsia, consistent with the findings of Zhang et al. [44].

Predictors of Pre-eclampsia

One of the most significant public health concerns is the insufficiency of effective treatment for pre-eclampsia. Consequently, both clinicians and public health practitioners prioritise the primary and secondary prevention of pre-eclampsia by implementing appropriate screening measures for pregnant women to enhance health and nutritional outcomes for both mother and infant [44]. This screening process involves the identification of potential risk factors and the provision of support to mothers in order to mitigate their impact on pregnancy outcomes.

Demographic and maternal factors

Lower maternal age consistently increases the risk of mothers developing pre-eclampsia across the three decades. Mothers younger than 20 years have been reported to be at a higher risk of developing pre-eclampsia [19, 21, 22]. This finding is not limited to pregnant women in Ghana but extends across different ethnicities [51]. One possible explanation for this phenomenon is that younger mothers often face challenges related to limited opportunities, economic resources, and maternal experience, as most women within this age group are nulliparous [25]. The new experience of pregnancy for these mothers may overwhelm

them, compounded by the anticipated economic burden of childcare and other responsibilities, potentially rendering the duration of the pregnancy a strenuous undertaking. This could lead to elevated blood pressures, as reported by Avoka et al. [26]. Additionally, advanced maternal age has been found to predict pre-eclampsia in recent decades, consistent with findings from Europe [53], America [54], China [55], Saudi Arabia [56], and France [57]. Multiple pregnancy emerged as a consistent risk factor for pre-eclampsia in the review spanning several decades. Mothers with more than three pregnancies, as well as those with twin pregnancies, exhibited a heightened risk of pre-eclampsia in Ghana [19, 20, 22]. This finding was corroborated among pregnant women in developed countries, including the USA [58], Sweden [59], and China [60]. Furthermore, a parity greater than two was identified in the review as a factor that increases the risk of pre-eclampsia for mothers [20]. However, this relationship between higher parity and pre-eclampsia is contradicted by several well-documented studies [61, 62]. Maternal history also emerged as a predictor of pre-eclampsia in the review, aligning with findings from another research [44, 63]. According to Zhang et al. [44], the risk associated with maternal history escalates with the number of pregnancies: 15% in the second pregnancy and approximately double that in subsequent pregnancies for pre-eclampsia. Additional studies have found a similar correlation between familial history and the prevalence of pre-eclampsia among pregnant women [50, 63].

Dietary and Environmental Factors

Overweight and/or obesity was the most frequently identified nutritional factor in the review that increased the risk of pre-eclampsia among pregnant women [22, 28-30]. The increased prevalence of overweight and obesity among Ghanaian women may, therefore, account for the rising rate of pre-eclampsia observed over the past three decades, with more than half of pregnant women with a parity of two or more in Ghana being classified as overweight or obese [64]. The relationship between obesity and pre-eclampsia is consistent with findings from other studies [50, 63]. Insufficient intake of specific dietary nutrients (including protein, vitamin C, B12, calcium, and folate) as well as low serum concentrations of dietary minerals (specifically calcium and magnesium) have been reported to increase the risk of pre-eclampsia in women [31, 39]. The low serum levels of calcium and magnesium in pre-eclamptic women corroborate findings among Pakistani women and have been reported to negatively affect arterial pressure, thus predisposing women to pre-eclampsia [65]. Nevertheless, a randomised trial found no significant effect size associated with calcium supplementation on the onset of pre-eclampsia [66]. Similarly, Zhang et al., [44] support the notion that inadequate nutrient intake could present a considerable risk for developing pre-eclampsia. Conversely, heightened intake of manganese and folic acid, along with elevated serum concentrations of triglycerides, are associated with an increased risk of pre-eclampsia among women [29, 31]. Elevated serum lipids, such as triglycerides and cholesterol (lipoproteins), lead to vasoconstriction, thereby predisposing pregnant women to pre-eclampsia. This finding is consistent with a study conducted in Pakistan that compared lipid profiles of normative and pre-eclamptic women [67]. The prevalence of pre-eclampsia varied by season, peaking during the rainy season [19, 21]. The fluctuation in the prevalence of pre-eclampsia correlated with changing climate and weather temperature is widely reported; however, the findings are often confounded by racial factors [44]. Two studies included in the review indicated that pre-eclampsia among Ghanaian women peaked during the rainy season, lasting from June to September. This phenomenon may relate to the impact of cold weather, as housing conditions

in many developing contexts, including Ghana, inadequately provide warmth and comfort. Such conditions may exacerbate maternal stress, anxiety, and discomfort during pregnancy, consequently leading to elevated blood pressure. Colder temperatures in Europe and South Africa have been reported to increase the risk of pre-eclampsia by over 13% [44, 68], which aligns with the current findings. Interestingly, while the risk of pre-eclampsia for Black women increases during summer months, White women experience a decreased risk [21, 44]. A high prevalence of pre-eclampsia has also been documented within the same timeframe in Nigeria, which is consistent with the current review [49]. However, the season in Nigeria is characterised by the dry season, whereas the corresponding period in Ghana encompasses both the major and minor rainy seasons (June to December). Nonetheless, the mean prevalence of pre-eclampsia per month in Ghana was consistent with findings in Nigeria [49] and China [69]. While summer months in China and the USA are characterised by warm or hot weather, the same period in Africa is marked by rain and cooler temperatures; nevertheless, this has been reported to contribute to a high prevalence of pre-eclampsia globally. Another environmental factor identified in the review was air pollution, which aligns with findings from Zhang et al., [44]. Exposure to air contaminants, including particulate matter, nitrogen dioxide, and noise during pregnancy, is reported to induce oxidative stress and inflammation, which affect vascular function and cytotrophoblasts, ultimately resulting in pre-eclampsia [70-73]. Amegah et al., [39] reported that the detrimental effects of air pollutants could potentially be mitigated through adequate intake of vitamin D.

Maternal and Perinatal Care

Inadequate prenatal care has been identified as a predictor of pre-eclampsia in both the 1990s and the 2010s. As noted, adequate and early screening of pregnant women facilitates appropriate interventions that can enhance maternal and perinatal outcomes [44]. Delayed antenatal care (ANC) registration adversely affects the quality of maternal and perinatal care provided to pregnant women, potentially increasing their risk of pre-eclampsia. Early antenatal care allows for timely screening and management of other associated conditions, such as poor psychological and emotional health, placental pathology, and malaria, all of which have been reported to predict pre-eclampsia [29, 31] independently. This may also elucidate the heightened risk of pre-eclampsia among pregnant women with suboptimal health status [35]. Additionally, sexual behaviour, changes in partner, and contraceptive use have been identified as risk factors for pre-eclampsia; however, the evidence in the literature outside of Ghana remains inconclusive [74, 75]. Nonetheless, it is recommended that women avoid contraceptives containing oestrogen, as they may contribute to elevated blood pressure [76].

Conclusion

There is a noticeable upward trend in the prevalence of pre-eclampsia among women in Ghana. The findings indicate that the average prevalence of pre-eclampsia from 2011 to 2020 is among the highest globally. Although the predictors of pre-eclampsia are relatively consistent across different regions, clinicians must implement timely screening and intervention strategies to mitigate or potentially eliminate adverse pregnancy outcomes.

Acknowledgment

Not applicable.

Conflict of interest

Authors declare that there is no conflict of interest with the production and publication of this finding.

References

[1]. Walle, T. A., & Azagew, A. W., 2019, Hypertensive disorder of pregnancy prevalence and associated factors among pregnant women attending ante natal care at Gondar town health Institutions, North West Ethiopia 2017. *J Pregnancy hypertension*, *16*, 79-84. https://www.sciencedirect.com/science/article/pii/S2210778918306871.

[2]. 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 childbirth*, *17*(1), 1-7.

[3]. Dolea, C., & AbouZahr, C., 2003, *Global burden of hypertensive disorders of pregnancy in the year 2000*.

[4]. Ramma, W., Buhimschi, I. A., Zhao, G., Dulay, A. T., Nayeri, U. A., Buhimschi, C. S., & Ahmed, A., 2012, The elevation in circulating anti-angiogenic factors is independent of markers of neutrophil activation in preeclampsia. *Journal of Angiogenesis*, *15*(3), 333-340.

[5]. Guseh, S. H., Feinberg, B. B., Dawood, H. Y., Yamamoto, H. S., Fichorova, R. N., & Burwick, R. M., 2015, Urinary excretion of C5b-9 is associated with the anti-angiogenic state in severe preeclampsia. *American Journal of Reproductive Immunology*, *73*(5), 437-444.

[6]. Fadare, R., Akpor, O., & Oziegbe, O., 2016, Knowledge and attitude of pregnant women towards management of pregnancy-induced hypertension in Southwest Nigeria. *J Journal of Advances in MedicalPharmaceutical Sciences*, 1-10. https://www.journaljamps.com/index.php/JAMPS/article/view/17106.

[7]. Mensah, F., Bentil, E., Adjepong, M., & Dolo, O., 2011, Causes of maternal mortality in Ghana-*A case study at the Koforidua Regional Hospital. In*

[8]. Andarge, R., Anshebo, A., Halil, H., Kebede, B., & 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.

[9]. Uzan, J., Carbonnel, M., Piconne, O., Asmar, R., & Ayoubi, J.-M., 2011, Pre-eclampsia: pathophysiology, diagnosis, and management. *Vascular health risk management*, *7*, 467.

[10]. Awuah, S. P., Okai, I., Ntim, E. A., & Bedu-Addo, K., 2020, Prevalence, placenta development, and perinatal outcomes of women with hypertensive disorders of pregnancy at Komfo Anokye Teaching Hospital. *Plos one*, *15*(10), e0233817.

[11]. Amorim, M. M., Souza, A. S. R., & Katz, L., 2017, Planned caesarean section versus planned vaginal birth for severe pre-eclampsia. *Cochrane Database of Systematic Reviews*(10).

[12]. GMHS, 2017, Ghana Maternal Health Survey. *Ghana Statistical Service*. https://www.dhsprogram.com/pubs/pdf/SR251/SR251.pdf

[13]. Der, E., Moyer, C., Gyasi, R., Akosa, A., Tettey, Y., Akakpo, P., Blankson, A., & Anim, J., 2013, Pregnancy related causes of deaths in Ghana: a 5-year retrospective study. *Ghana medical journal*, *47*(4), 158.

[14]. Lee, Q. Y., Odoi, A. T., Opare-Addo, H., & Dassah, E. T., 2012, Maternal mortality in Ghana: a hospital-based review. *J Acta obstetricia et gynecologica Scandinavica*, *91*(1), 87-92.

[15]. Asundep, N. N., Jolly, P. E., Carson, A., Turpin, C. A., Zhang, K., & Tameru, B., 2014, Antenatal care attendance, a surrogate for pregnancy outcome? The case of Kumasi, Ghana. *Maternal child health journal*, *18*(5), 1085-1094.

[16]. Apanga, P. A., & Awoonor-Williams, J. K., 2018, Maternal death in rural Ghana: a case study in

the upper East Region of Ghana. *J Frontiers in public health*, *6*, 101.

[17]. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., & Brennan, S. E., 2021, The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Bmj*, *372*.

[18]. Von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., Vandenbroucke, J. P., & Initiative, S., 2014, The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. *International journal of surgery*, *12*(12), 1495-1499.

[19]. Obed, S., Wilson, J., & Elkins, T., 1994, Eclampsia: 134 consecutive cases. *International Journal of Gynecology & Obstetrics*, *45*(2), 97-103.

[20]. Adu-Bonsaffoh, K., Ntumy, M. Y., Obed, S. A., & Seffah, J. D., 2017, Prevalence of hypertensive disorders in pregnancy at Korle-Bu Teaching Hospital in Ghana. *J Gynecol Neonatal Biol*, *3*(1), 8-13.

[21]. Owiredu, W. K. B. A., Ahenkorah, L., Amidu, N., Turpin, C. A., & Laing, E. F., 2010, Seasonal variation in the occurrence of pregnancy-induced hypertension-A Ghanaian study. *Journal of the Ghana Science Association*, *12*(1), 48-67.

[22]. Beyuo, T. K., Lawrence, E. R., Kobernik, E. K., & Oppong, S. A., 2022, Clinical presentation and predictors of eclampsia among women with hypertensive disorders of pregnancy in Ghana. *Pregnancy Hypertension*, *30*, 171-176.

[23]. Owiredu, W., Ahenkorah, L., Turpin, C., Amidu, N., & Laing, E., 2012, Putative risk factors of pregnancy-induced hypertension among Ghanaian pregnant women. *Journal of Medical and Biomedical Sciences*, *1*(3), 62-76.

[24]. Owiredu, W., Ahenkorah, L., Turpin, C., Amidu, N., & Laing, E., 2012, Putative risk factors of pregnancy-induced hypertension among Ghanaian pregnant women. . *Journal of Medical and Biomedical Sciences*, *1*(3), 62-76. .

[25]. Abebrese, J. K. A., Gyasi, S., & Afriyie, V., 2017, Maternal mortality, proteinuria and pregnancy induced hypertension: case study of a regional hospital in Brong Ahafo Region, Ghana. *Texila Int J Public Health*, *5*(4), 1-14.

[26]. Avoka, J. A., Ankomah, A., Ohemeng, A., Seidu, I., Wombeogo, M., & Dun-dery, F., 2022, Effects of Pregnancy-Induced Psychological and Emotional Factors on the Occurrence of *Preeclampsia/Eclampsia (PE-E) and Haemorrhage.*

[27]. Obed, S., & Aniteye, P., 2007, Pregnancy following eclampsia: a longitudinal study at Korle-BU teaching hospital. *Ghana medical journal*, *41*(3).

[28]. Amoakoh-Coleman, M., Ogum-Alangea, D., Modey-Amoah, E., Ntumy, M. Y., Adanu, R. M., & Oppong, S. A., 2017, Blood pressure patterns and body mass index status in pregnancy: An assessment among women reporting for antenatal care at the Korle-Bu Teaching hospital, Ghana. *Plos one*, *12*(12), e0188671.

[29]. Ephraim, R. K., Doe, P., Amoah, S., & Antoh, E., 2014, Lipid profile and high maternal body mass index is associated with preeclampsia: a case-control study of the Cape Coast Metropolis. *Annals of medical and health sciences research*, *4*(5), 746-750.

[30]. Yeboah, F., Seini, M., Turpin, C., Fondjo, L., Debrah, O., Annan, B., Tagoe, E., & Bawah, A., 2017, Maternal serum Calcium and Magnesium levels in women presenting with preeclampsia: Case-Control study in Greater Accra and Ashanti Regions of Ghana. *International Journal of Medical and Health Sciences*, *6*(4), 195-200.

[31]. Avoka, J. A., Ankomah, A., Ohemeng, A., Seidu, I., Wombeogo, M., & Apungu, F. K., 2022a, Assessing the Relationship between Individual Level Dietary Intake and the Occurrence of Preeclampsia/Eclampsia and Haemorrhage among Pregnant Women in Eastern Region of Ghana: *A Prospective Cohort Study*. https://doi.org/10.21522/TIJPH.2013.10.01.Art009

[32]. Asare, L., Asare, G. A., Owiredu, W. K., Obikorang, C., Appiah, E., Tashie, W., & Seidu, L., 2021, The use of hormonal contraceptives and preeclampsia among Ghanaian pregnant women. *Open Journal of Obstetrics and Gynecology*, *11*(04), 419.

[33]. Oppong, S. A., Bakari, A., Bell, A. J., Bockarie, Y., Adu, J. A., Turpin, C. A., Obed, S. A., Adanu, R. M., & Moyer, C. A., 2019, Incidence, causes and correlates of maternal near-miss morbidity: a multi-centre cross-sectional study. *BJOG: An International Journal of Obstetrics & Gynaecology*, *126*(6), 755-762.

[34]. Owusu, J. T., Anderson, F. J., Coleman, J., Oppong, S., Seffah, J. D., Aikins, A., & O'Brien, L. M., 2013, Association of maternal sleep practices with pre-eclampsia, low birth weight, and stillbirth among Ghanaian women. *International Journal of Gynecology & Obstetrics*, *121*(3), 261-265.

[35]. Anto, E. O., Roberts, P., Coall, D., Turpin, C. A., Adua, E., Wang, Y., & Wang, W., 2019, Integration of suboptimal health status evaluation as a criterion for prediction of preeclampsia is strongly recommended for healthcare management in pregnancy: a prospective cohort study in a Ghanaian population. *EPMA Journal*, *10*, 211-226.

[36]. Awuah, S. P., Okai, I., Ntim, E. A., & Bedu-Addo, K., 2020, Prevalence, placenta development, and perinatal outcomes of women with hypertensive disorders of pregnancy at Komfo Anokye Teaching Hospital. *Plos one*, *15*(10), e0233817.

[37]. Browne, J., Vissers, K., Antwi, E., Srofenyoh, E., Van der Linden, E., Agyepong, I., Grobbee, D., & Klipstein-Grobusch, K., 2015, Perinatal outcomes after hypertensive disorders in pregnancy in a low resource setting. *Tropical medicine & international health*, *20*(12), 1778-1786.

[38]. Dalaba, M. A., Akweongo, P., Aborigo, R. A., Saronga, H. P., Williams, J., Aninanya, G. A., Sauerborn, R., & Loukanova, S., 2015, Cost to households in treating maternal complications in northern Ghana: a cross sectional study. *MC Health Serv Res*, *34*(15). https://doi.org/https://doi.org/10.1186/s12913-014-0659-1

[39]. Amegah, A. K., Sewor, C., Obeng, A. A., Coker, E. S., & Eliason, S., 2022, Vitamin D intake modifies the association of household air pollution exposure with maternal disorders of pregnancy. *Indoor air*, *32*(1), e12963.

[40]. Obiri, D., Erskine, I. J., Oduro, D., Kusi, K. A., Amponsah, J., Gyan, B. A., Adu-Bonsaffoh, K., & Ofori, M. F., 2020, Histopathological lesions and exposure to Plasmodium falciparum infections in the placenta increases the risk of preeclampsia among pregnant women. *Scientific Reports*, *10*(1), 8280.

[41]. Agyei-Baffour, P., Oppong, R., & Boateng, D., 2013, Knowledge, perceptions and expectations of capitation payment system in a health insurance setting: a repeated survey of clients and health providers in Kumasi, Ghana. *BMC public health*, *13*(1), 1-9.

[42]. Edu, B. C., Agan, T. U., Monjok, E., & Makowiecka, K., 2017, Effect of free maternal health care program on health-seeking behaviour of women during pregnancy, Intra-partum and Postpartum Periods in Cross River State of Nigeria: A Mixed Method Study. *Open access Macedonian journal of medical sciences*, *5*(3), 370.

[43]. Haruna, U., Dandeebo, G., & Galaa, S. Z., 2019, Improving access and utilization of maternal healthcare services through focused antenatal care in rural Ghana: a qualitative study. *Advances in Public Health*, *2019*.

[44]. Zhang, N., Tan, J., Yang, H., & Khalil, R. A., 2020, Comparative risks and predictors of preeclamptic pregnancy in the Eastern, Western and developing world. *Biochemical pharmacology*, *182*, 114247.

[45]. Martey, J., Djan, J., Twum, S., Browne, E., & Opoku, S., 1994, Maternal mortality and related factors in Ejisu District, Ghana. *East African medical journal*, *71*(10), 656-660.

[46]. Senah, K., 2003, Maternal mortality in Ghana: the other side. *Institute of African Studies Research Review*, *19*(1), 47-55.

[47]. Ratsiatosika, A. T., Razafimanantsoa, E., Andriantoky, V. B., Ravoavison, N., Andrianampanalinarivo Hery, R., Boukerrou, M., Iacobelli, S., & Robillard, P.-Y., 2019, Incidence and natural history of preeclampsia/eclampsia at the university maternity of Antananarivo, Madagascar: high prevalence of the early-onset condition. *The Journal of Maternal-Fetal & Neonatal Medicine*, *32*(19), 3266-3271.

[48]. Vata, P. K., Chauhan, N. M., Nallathambi, A., & Hussein, F., 2015, Assessment of prevalence of

preeclampsia from Dilla region of Ethiopia. *BMC research notes*, *8*(1), 1-6.

[49]. Eugene, I. M., & Isaac, A. J., 2020, Seasonal variations in the incidence of preeclampsia-eclampsia in Bayelsa state in the Niger Delta Region of Nigeria. *Indian Journal of Obstetrics and Gynecology Research*, *7*(2), 149-154.

[50]. Lewandowska, M., 2021, The association of familial hypertension and risk of gestational hypertension and preeclampsia. *International Journal of Environmental Research and Public Health*, *18*(13), 7045.

[51]. Lisonkova, S., & Joseph, K., 2014, Incidence of Preeclampsia: Risk Factors and Outcomes Associated With Early-Onset Versus Late-Onset Disease. *Obstetric Anesthesia Digest*, *34*(4), 222.

[52]. Abalos, E., Cuesta, C., Grosso, A. L., Chou, D., & Say, L., 2013, Global and regional estimates of preeclampsia and eclampsia: a systematic review. *European journal of obstetrics & gynecology and reproductive biology*, *170*(1), 1-7.

[53]. Lamminpää, R., Vehviläinen-Julkunen, K., Gissler, M., & Heinonen, S., 2012, Preeclampsia complicated by advanced maternal age: a registry-based study on primiparous women in Finland 1997–2008. *BMC pregnancy and childbirth*, *12*, 1-5.

[54]. Sheen, J.-J., Huang, Y., Andrikopoulou, M., Wright, J. D., Goffman, D., D'Alton, M. E., & Friedman, A. M., 2020, Maternal age and preeclampsia outcomes during delivery hospitalizations. *American journal of perinatology*, *37*(01), 044-052.

[55]. Zhu, D., Chen, W., Pan, Y., Li, T., Cui, M., & Chen, B., 2021, The correlation between maternal age, parity, cardiac diastolic function and occurrence rate of pre-eclampsia. *Scientific Reports*, *11*(1), 8842.

[56]. Abu-Zaid, A., Alomari, M., Al-Hayani, M., Bazi, A., Almazmomy, A., Alsaegh, A., Alshawkani, H., & Radwan, A., 2020, Advanced maternal age and the frequency of pre-eclampsia-a single-center crosssectional study from Saudi Arabia. *J. Evolution Med. Dent. Sci*, *9*(37), 2726-2729.

[57]. Bouzaglou, A., Aubenas, I., Abbou, H., Rouanet, S., Carbonnel, M., Pirtea, P., & Ayoubi, J. M. B., 2020, Pregnancy at 40 years old and above: obstetrical, fetal, and neonatal outcomes. Is age an independent risk factor for those complications? *Frontiers in Medicine*, *7*, 208.

[58]. Wheeler, S. M., Myers, S. O., Swamy, G. K., & Myers, E. R., 2022, Estimated prevalence of risk factors for preeclampsia among individuals giving birth in the US in 2019. *JAMA Network Open*, *5*(1), e2142343-e2142343.

[59]. Hernández-Díaz, S., Toh, S., & Cnattingius, S., 2009, Risk of pre-eclampsia in first and subsequent pregnancies: prospective cohort study. *Bmj*, *338*.

[60]. Wang, Y., Wu, N., & Shen, H., 2021, A review of research progress of pregnancy with twins with preeclampsia. *Risk Management and Healthcare Policy*, 1999-2010.

[61]. Long, P., Abell, D., & Beischer, N., 1979, Parity and pre-eclampsia. *Australian and New Zealand Journal of Obstetrics and Gynaecology*, *19*(4), 203-206.

[62]. Maeda, Y., Kaneko, K., Ogawa, K., Sago, H., & Murashima, A., 2021, The effect of parity, history of preeclampsia, and pregnancy care on the incidence of subsequent preeclampsia in multiparous women with SLE. *Modern Rheumatology*, *31*(4), 843-848.

[63]. Tessema, K. F., Gebremeskel, F., Getahun, F., Chufamo, N., & Misker, D., 2021, Individual and obstetric risk factors of preeclampsia among singleton pregnancy in hospitals of Southern Ethiopia. *International Journal of Hypertension*, *2021*.

[64]. GMS, 2017, Ghana Micronutrient Survey-2017. [Internet]. University of Ghana, GroundWork, *University of Wisconsin-Madison, KEMRI-Wellcome Trust, UNICEF*. Accra, Ghana. Available from: https://groundworkhealth.org/wp-content/uploads/2018/06/UoG-GroundWork_2017-GHANA-MICRONUTRIENT-SURVEY_Final_180607.pdf.

[65]. Haleema, S., Imran, M., & Zafar, J., 2018, Correlation of Serum calcium and magnesium with preeclampsia. *Proceedings SZPGMI*, *32*(1), 66-71.

[66]. Hofmeyr, G. J., Betrán, A. P., Singata-Madliki, M., Cormick, G., Munjanja, S. P., Fawcus, S., Mose, S., Hall, D., Ciganda, A., & Seuc, A. H., 2019, Prepregnancy and early pregnancy calcium supplementation among women at high risk of pre-eclampsia: a multicentre, double-blind, randomised, placebo-controlled trial. *The Lancet*, *393*(10169), 330-339.

[67]. Jan, N. A., Mahmood, R., Wasi, N., Jan, N. A., Anjum, N., & Salahuddin, H., 2019, Evaluation and Comparison of Lipid Profile in Pregnancy and Preeclampsia. *Annals Of Abbasi Shaheed Hospital And Karachi Medical & Dental College*, *24*(4), 231-237.

[68]. Algert, C. S., Roberts, C. L., Shand, A. W., Morris, J. M., & Ford, J. B., 2010, Seasonal variation in pregnancy hypertension is correlated with sunlight intensity. 2010;203:215 e1–5. *American journal of obstetrics and gynecology*, *203*(215), 1-5.

[69]. Tam, W. H., Sahota, D. S., Lau, T. K., Li, C. Y., & Fung, T. Y., 2008, Seasonal variation in pre-eclamptic rate and its association with the ambient temperature and humidity in early pregnancy. *Gynecologic and obstetric investigation*, *66*(1), 22-26.

[70]. Auger, N., Duplaix, M., Bilodeau-Bertrand, M., Lo, E., & Smargiassi, A., 2018, Environmental noise pollution and risk of preeclampsia. *Environ Pollut*, *239*, 599-606.

[71]. Fowler, P. A., Bellingham, M., Sinclair, K. D., Evans, N. P., Pocar, P., & Fischer, B., 2012, Impact of endocrine-disrupting compounds (EDCs) on female reproductive health. . *Mol Cell Endocrinol*, *355*, 231-239.

[72]. Hu, H., Ha, S., Roth, J., Pedersen, M. K., Stayner, L., Slama, R., Sorensen, M., Figueras, F., & Nieuwenhuijsen, M. J., 2014, Ambient air pollution and pregnancy-induced hypertensive disorders: a systematic review and meta-analysis. . *Hypertension*, *64*, 494-500.

[73]. Pope, C. A., Bhatnagar, A., McCracken, J. P., Abplanalp, W., Conklin, D. J., & O'Toole, T., 2016, Exposure to Fine Particulate Air Pollution Is Associated with Endothelial Injury and Systemic Inflammation. *Circulation research*, *119*, 1204–1214.

[74]. Asres, A., Tilahun, A., Waji, S., Adella, G., & Addissie, A., 2020, Past hormonal contraceptive use and pre-eclampsia among pregnant women in Northwest Ethiopia: a case-control study. *Authorea Preprints*.

[75]. Klonoff-Cohen, H. S., Savitz, D. A., Cefalo, R. C., & McCANN, M. F., 1989, An epidemiologic study of contraception and preeclampsia. *Jama*, *262*(22), 3143-3147.

[76]. Farid, H., 2020, Birth control and high blood pressure: which methods are safe for you? [Internet]. *Harvard medical school, Harvard health publishing. [cited on Februray 21, 2023]. Retrieved from*: https://www.health.harvard.edu/blog/birth-control-and-high-blood-pressure-which-methods-are-safe-for-you-2020111321327