A Retrospective Cross-Sectional Analysis of the Effects of Peripheral Maternal Systolic and Diastolic Blood Pressure on Birth Weight

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Abstract

BACKGROUND

Birth weight (BW), is influenced by maternal, fetal and environmental factors of unclear proportionate distribution. We explored associations between peripheral maternal systolic and diastolic blood pressure, (SBP and DBP) and low birth weight (LBW), crucial for enhancing prenatal care and addressing LBW's public health impact.

METHODOLOGY

A retrospective audit analyzed health institutional data for 2545 singleton births preceding the study, assessing the impact of maternal SBP and DBP on BW using two-way ANOVA.

RESULTS

Maternal ages ranged from 14-47 years, averaging 27.2 years (±7.0). Mean SBP and DBP were 119.6 mmHg (±17.5) and 75.8 mmHg (±12.4). Around 76.8% had SBP <130 mmHg, 11.7% at 130-139 mmHg, and 11.5% at ≥140 mmHg. For DBP, 62.3% had <80 mmHg, 22.3% had 80-89 mmHg, and 12.8% had ≥90 mmHg. Maternal peripheral SBP <130 mmHg and DBP <80 mmHg correlated with fewer LBW births. Conversely, BW decreased with increased maternal peripheral SBP and DBP of ≥130 mmHg and ≥80 mmHg, ranging from 0.42 to 5.8 kg, mean 3.00 kg (±0.4). This inverse relationship persisted, indicating that BW increased as SBP and DBP decreased.

CONCLUSION

The highlighted inverse link stresses the need for prenatal monitoring. Routine fetal growth and maternal BP assessments are crucial for proactive care, reducing the risk of LBW. Relying on limited birth register data for pre-birth BPs may have accuracy limitations. Recommended for further research is monthly or weekly real-time fetal growth and maternal BP monitoring, based on the findings and context.

Keywords: *Blood Pressure, Pregnancy, Birth Weight, Diastolic, Systolic*

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Introduction

Birth weight (BW), (an important measure of intra-uterine growth, influenced by maternal, fetal and environmental factors of as-yet-unclear proportionate distribution) is the first weight of newborns obtained after birth [1,2]. High maternal blood pressure (BP) is consistently linked to lower BW in epidemiological studies [3,4]. Women with both preeclampsia and fetal growth restrictions show decreased uteroplacental function due to elevated maternal BP [2]. Studies suggest an inverse link between BW and peripheral maternal BP, with some emphasizing the influence of maternal central BP [5,6]. Current literature is limited in examining the concurrent effects of central and peripheral BP on BW [5-7].

Stronger associations between BW and maternal BP are reported among Asian Indians compared to white or black women, except in obese women [8,9]. Hypertensive disorders of pregnancy significantly impact global maternal and infant morbidity and mortality [10]. Despite extensive clinical and epidemiological studies spanning 50 years, preeclampsia's aetiology and pathogenesis remain elusive [11,12]. Suggested links between maternal hypertension (HPT) and increased risks of intrauterine growth restriction and low (LBW) have been considered intuitive [13], however, current evidence connecting essential HPT, preeclampsia, or gestational HPT to poor fetal growth is inconclusive [14]. Ongoing debates regarding the significance of previously studied associations in clinical medicine and public health practice continue [15].

Public health seeks to elucidate the aetiology of high blood pressure (HBP) and its repercussions on birth weight, impacting a global population of one billion and correlating with approximately 9.4 million annual fatalities. [16]. Globally, hypertensive disorders of pregnancy are estimated at 5.2%-8.2%, with 1.8%-4.4% attributed to gestational HPT and 0.2%-9.2% to preeclampsia [17]. Maternal elevated BP is defined as a systolic BP (SBP) of ≥130 mmHg or diastolic BP (DBP) of ≥80 mmHg [18]. This definition aligns with recent updates by the American Heart Association (AHA), which lowered the threshold for elevated BP from SBP ≥140 mmHg or DBP ≥90 mmHg due to increased cardiovascular disease risk in the general population [19].

Previous cutoffs suggest that over 20% of pregnancies in Ghana are impacted by HPT, compared to about 10% globally [18]. Normal BP during pregnancy is preferably ≤120/80 mmHg, with lower readings of 115/75 mmHg sometimes preferred [20]. The American College of Obstetricians and Gynecologists (ACOG) recommends a BP ≤120/80 mmHg during pregnancy [21-24]. HBP in pregnancy is defined as BP ≥130/80 mmHg [22]. Pre-pregnancy HBP or HPT is termed chronic HPT, while gestational HPT develops after the twentieth week of pregnancy, usually resolving after birth [22]. This study investigates the influence of peripheral maternal SBP and DBP on BW.

Methodology

Study site and design

The study employed a cross-sectional retrospective audit of BW and relevant variables using institutional data from obstetric and newborn care services at Kade Government Hospital's maternity/labour suite. This approach was chosen for its efficient utilization of existing data, providing an immediately accessible overview of key variables, and avoiding ethical concerns related to prospective interventions. Additionally, it facilitated the rapid attainment of a substantial sample size. The hospital was selected due to its proximity, minimizing logistical challenges and costs, and offering obstetric services similar to other healthcare institutions, enhancing the study's relevance and external validity. Accredited by the national health insurance system, the sixty-two-bed capacity hospital comprises the primary referral health facility for the municipal area, overseeing four health centres and twenty-nine CHPS/community clinics in Kwaebibirem.

Data from 2545 singleton births preceding the study were extracted from mandatory institutional birth registers, comprising four sections. The first records socio-demographic information of parturient women (age, residence, education, gravidity, and parity). The second captured antenatal care (ANC) indicators, including maternal haemoglobin (Hgb) concentration, ANC visits, gestational age (GA) at birth, doses of Intermittent Preventive Therapy with Sulfadoxine-Pyrimethamine (IPTp-SP), maternal 'ABO' phenotypic blood groups, and information on syphilis, hepatitis B, and HIV status. Maternal SBP and DBP were also

recorded in this section. The third documented neonatal wellness-related information, including APGAR scores, fetal heart rate, fetal respiration within 30 minutes, fetal presentation, and measures of fetal dimensions. The last recorded information on the wellness of parturient women, with a focus on complications following birth such as postpartum haemorrhage, antepartum haemorrhage, obstructed labour, etc.

The studied variables were primarily extracted from the first and second sections of the birth register. BW, the main variable, obtained from the register's third section, was analyzed independently of GA at delivery. LBW was defined as BW <2.5 kg, while BW of 2.5-3.9 kg and ≥4.0 kg (normal BW or NBW and high BW or HBW/macrosomia) were classified as normal. GA/term status followed ACOG guidelines; preterm (<36 weeks), early term (37-38 weeks), full term (39-40 weeks), late term (41-42 weeks), and post-term (≥42 weeks). Stage one and two maternal HBP were defined as 130/80 mmHg and 140/90 mmHg, respectively, following ACC/AHA HBP guidelines. Maternal SBP and DBP comprised pre-birth BP readings taken upon admission to the maternity/labour suite for spontaneous vaginal delivery or (emergency or elective) cesarean sections.

Pre-birth BPs were deemed more indicative of gestational BPs than postpartum readings, considering typical fluctuations after childbirth including an initial drop followed by a peak 3-6 days postpartum, observed in both normotensive and hypertensive pregnancies [25]. Assumptions held that this BP, undifferentiated as chronic or gestational HPT, better reflected prenatal BPs. Data assistants were trained on the structural characteristics of the birth register, familiarizing themselves with variables and their organisation. They employed pretested questionnaires for data abstraction, including classifications for BW and operational definitions for variables like area of residence, education level, occupation, parity, GA at birth, Hgb concentration, etc. Inclusion criteria specified singleton births, excluding multiple pregnancies. Observations lacking essential variables (BP and BW) were excluded to maintain internal validity. Data assistants transcribed information directly from the birth registers into questionnaires designed in Epi Info 3.5.4.

The study assumed that all entries in the birth register aligned with the concept of 'parity,' with unlikely misclassification of 'miscarriages' as 'parity,' as proficient obstetric nurses are solely responsible for recording entries. Maternal Hgb concentration was dichotomized as ‘above’ or ‘below’ 11.0 g/dl. Data anonymization involved removing identifiers (names, addresses and phone numbers) and aggregating information into broader categories (e.g., age ranges instead of specific ages), along with other applicable modalities. Urban, peri-urban, and rural communities were defined based on population size thresholds, with Ghana considering urban areas as those with a population of ≥5,000 [26]. Peri-urban communities comprised those bordering urban areas, exhibiting dynamics closely aligned with adjacent urban areas.

Stringent data quality measures, including thorough cleaning, error handling, outlier treatment, and addressing missing data, were implemented. Cross-verification with original records ensured consistency. Robust quality assurance processes and comprehensive documentation bolstered data credibility. Approval for the study's conduct, with specifications for data anonymization, was granted by the Eastern Regional Health Directorate, Research Unit, on October 16, 2023 (Ref. ERHD/5227/2023). This aligned with recommendations of the Ghana Health Service for routine conduct of operational research in all public health establishments.

Data analysis

Descriptive statistics were used to characterize baseline maternal and newborn features. Categorical data, categorized by

maternal SBP and DBP (above or below 130 mmHg and 80 mmHg, respectively), were analyzed to assess LBW prevalence. Stratified characteristics were examined for distribution across maternal BP strata. Mean BW were compared using two-way ANOVA and Kruskal-Wallis tests for two groups. Differences in stratum-specific BW were evaluated using parametric F-statistic and ANOVA p-values, along with non-parametric Kruskal-Wallis H-test and corresponding p-values.

The preference for ANOVA arises from its suitability in examining the impact of multiple categorical groups—specifically varying levels of SBP and DBP exposure—on the continuous outcome variable of BW. ANOVA facilitated comparisons of mean BW by differential SBP and DBP exposures, assessing whether exposure categories significantly affected mean BW. This statistical framework ensured robustness in addressing the research questions. Data analysis was conducted using Epi Info 3.5.4.

Table 1. Baseline distribution of maternal peripheral systolic and diastolic blood pressure

	Characteristic	**Characteristic-N (%)**	**Systolic–N (%)**		**Diastolic–N (%)**	
			<130 mmHg	**≥130 mmHg**	**<80 mmHg**	**≥80 mmHg**
Age group in years	≤20	553 (21.8)	405 (81.8)	90 (18.2)	355 (71.9)	139 (28.1)
	21-30	1215 (48.0)	874 (78.0)	247 (22.0)	737 (65.9)	381 (34.1)
	≥31	763 (30.1)	496 (71.4)	199 (28.6)	403 (58.2)	290 (41.8)
Residence	Urban	1285 (52)	900 (77.1)	267 (22.9)	758 (64.9)	410 (35.1)
	Rural	1187 (48)	839 (77.0)	250 (23.0)	701 (64.8)	381 (35.2)
Occupation	Formal	232 (10.6)	170 (79.8)	43 (20.2)	142 (66.4)	72 (33.6)
	Non-formal	1952 (89.4)	1359 (76.6)	416 (26.4)	1134 (64.1)	635 (35.9)
Education	≤Junior High	1942 (78.2)	1351 (76.3)	420 (23.7)	1125 (63.8)	639 (36.2)
	≥Senior High	540 (21.8)	396 (79.7)	101 (20.3)	344 (69.1)	154 (30.9)
Parity	Para-1	1354 (53.7)	985 (79.5)	254 (20.5)	836 (67.7)	398 (32.3)
	Para-2/4	985 (39.0)	669 (74.4)	230 (25.6)	555 (61.8)	343 (38.2)
	≥ Para-5	184 (7.3)	118 (70.7)	49 (29.3)	101 (60.8)	65 (39.2)
Term status in weeks	28-36	205 (8.7)	140 (73.7)	50 (26.3)	115 (61.2)	73 (38.8)
	37-38	569 (24.1)	406 (77.0)	121 (23.0)	334 (65.3)	183 (34.7)
	≥39-40	1590 (67.3)	1126 (77.1)	334 (22.9)	951 (65.4)	504 (34.6)
'ABO' phenotypic groups	Group-A	429 (21.3)	320 (81.4)	73 (18.6)	267 (68.5)	123 (31.5)
	Group-AB	67 (3.3)	48 (78.7)	13 (21.3)	37 (60.7)	24 (39.3)
	Group-B	376 (18.7)	268 (77.7)	77 (22.3)	221 (64.1)	124 (35.9)
	Group-O	1138 (56.6)	798 (76.1)	250 (23.9)	688 (65.7)	359 (34.3)
Syphilis	Positive	56 (2.3)	39 (79.6)	10 (20.4)	31 (63.3)	18 (36.7)
	Negative/Non-tested	2387 (97.7)	1682 (76.8)	509 (23.2)	1419 (64.9)	766 (35.1)
Hepatitis-B	Positive	107 (4.4)	84 (83.2)	17 (16.8)	84 (83.2)	17 (16.8)
	Negative/Non-tested	2334 (95.6)	1609 (76.3)	500 (23.7)	1609 (76.3)	500 (23.7)
HIV	Positive	50 (2.1)	33 (71.7)	13 (28.3)	27 (58.7)	19 (41.3)
	Negative/Non-tested	2360 (97.9)	1666 (77.0)	498 (23.0)	1501 (64.9)	813 (35.1)
Anemia-maternal	Yes	1075 (68.1)	805 (80.0)	201 (20.0)	675 (67.3)	328 (32.7)
	No	504 (31.9)	344 (73.2)	126 (26.8)	285 (60.8)	184 (39.2)
Sex of neonate	Male	1346 (53.4)	951 (77.8)	271 (22.2)	806 (66.1)	413 (33.9)
	Female	1174 (46.6)	818 (76.0)	259 (24.0)	689 (64.2)	385 (35.8

Results

The mean BW was 3.00 kg (±0.4) with a variance of 0.2. Maternal ages ranged from 13-48 years, with a mean of 27.01 years (±6.9) and a variance of 49 years. SBP ranged from 92-205 mmHg, with a mean of 119.6 mmHg (±17.5) and a variance of 306.6 mmHg. DBP had a mean of 75.1 mmHg (±12.4) and a variance of 154, ranging from 50-140 mmHg. Predominantly, SBP was <130 mmHg (76.8%), with 11.7% in the range of 130-139 mmHg, and 11.5% at ≥140 mmHg. DBP was primarily <80 mmHg (64.9%), with 22.3% in the range of 80-89 mmHg, and 12.8% at ≥90 mmHg. Maternal SBP and DBP, categorized as above or below 130 mmHg and 80 mmHg, respectively, varied across characteristic-specific strata. [Table 1]

Despite predominantly nonsignificant differences, mean BW consistently remained higher with maternal SBP <130 mmHg. [Table 3. The BW <2.5 kg burden was higher with maternal SBP ≥130 mmHg and DBP ≥80 mmHg. [Table 2].

Despite mostly nonsignificant differences, mean BW consistently remained higher with maternal DBP >80 mmHg. [Table 4]

Table 2:
Prevalence of birth weight below 2.5 kg analyzed by maternal systolic and diastolic blood pressure

	Characteristic	Systolic BP <130	Systolic BP ≥130	Diastolic BP <80	Diastolic BP ≥80
Age groups (yrs)	≤20	40 (10.0)	19 (22.4)	37 (10.7)	22 (16.2)
	21-30	65 (7.6)	24 (9.9)	57 (97.9)	32 (8.5)
	≥31	25 (5.1)	15 (7.7)	21 (5.3)	18 (6.4)
Residence	Urban	66 (7.5)	22 (8.3)	58 (7.8)	30 (7.4)
	Rural	59 (7.1)	33 (13.6)	51 (7.4)	40 (10.8)
Occupation	Formal	15 (9.1)	5 (12.2)	55 (8.8)	8 (11.4)
	Non-formal	88 (6.6)	45 (11.1)	78 (7.0)	12 (8.8)
Education	≤Junior High	95 (7.2)	46 (11.2)	84 (7.6)	27 (8.0)
	≥Senior High	31 (7.9)	10 (10.2)	55 (8.8)	15 (9.9)
Parity	Para-1	91 (9.4)	39 (16.0)	80 (9.8)	49 (12.6)
	Para-2/4	35 (5.3)	16 (7.0)	31 (5.6)	20 (5.9)
	≥Para-5	4 (3.5)	2 (4.1)	4 (4.1)	2 (3.1)
Term status in weeks	28-36	33 (24.6)	18 (36.0)	30 (27.0)	20 (27.8)
	37-38	55 (13.9)	19 (16.0)	49 (14.5)	25 (14.1)
	≥39-40	32 (2.9)	20 (6.1)	26 (2.8	26 (5.2)
'ABO' phenotypic groups	Group-A	25 (8.1)	6 (8.5)	18 (7.0)	12 (10.0)
	Group-AB	2 (4.3)	1 (7.7)	2 (5.6)	1 (4.3)
	Group-B	17 (6.4)	12 (16.0)	15 (6.8)	14 (11.6)
	Group-O	61 (7.7)	26 (10.7)	58 (8.6)	29 (8.2)
Syphilis	Positive	3 (7.9)	0.00	3 (10.0)	0.00
	Negative/Non-tested	121 (7.3)	56 (11.2)	108 (7.8)	68 (9.0)
Hepatitis-B	Positive	9 (10.8)	1 (6.3)	7 (10.1)	3 (10.0)
	Negative/Non-tested	115 (7.2	54 (11.0)	104 (7.7)	64 (8.6)
HIV	Positive	3 (9.7)	1 (7.7)	3 (12.0)	1 (5.3)
	Negative/Non-tested	120 (7.3)	55 (11.3)	108 (7.9)	64 (8.8)
Anemia	Yes	55 (6.9)	26 (13.3)	51 (7.7)	20 (9.0)
	No	27 (8.1)	15 (12.2)	21 (7.6)	21 (11.7)
Sex of neonate	Male	71 (7.5)	28 (10.5)	71 (7.1)	28 (10.5)
	Female	58 (7.2)	29 (11.4)	58 (7.2)	29 (11.4)

Discussion

The study explored maternal SBP and DBP's impact on BW across demographics. Despite fluctuations, BW consistently decreased in women with high SBP and DBP - a persistent trend. Maternal age ranged widely, averaging 27.01 years (±6.9), aligning with similar studies. Mean SBP and DBP remained <130 mmHg and <90 mmHg, respectively, in line with current evidence. Women largely had normal SBP (≤129 mmHg); a smaller majority had normal DBP (≤79 mmHg). Elevated DBP was 35.1%, with 22.3% for DBP 80-89 mmHg and 12.8% for DBP ≥90 mmHg, aligning with existing evidence. Mean BW increased with maternal age, regardless of SBP and DBP levels, supporting existing evidence.

A study comparing maternal HPT's impact on extremely LBW infants found both mild and severe cases led to significantly reduced BW [32].

Table 3:
Variation in mean birth weight by maternal systolic blood pressure above or below 130 mmHg

	Characteristic	Mean Birth Weight		ANOVA		Kruskal-Wallis test for two groups	
		SBP <130	SBP ≥130	F-statistic	p-value	Chi-square	p-value
Age group in years	≤20	2.87	2.70	11.08	0.0009	11.91	0.006
	21-30	3.01	2.99	0.35	0.54	0.15	0.69
	≥31	3.10	3.03	3.05	0.08	0.41	0.52
Residence	Urban	3.02	2.99	0.84	0.35	0.01	0.90
	Rural	2.99	2.93	2.65	0.10	1.64	0.19
Occupation	Formal	3.02	3.00	0.05	0.81	0.01	0.90
	Non-formal	3.03	2.97	4.43	0.03	1.71	0.19
Education	≤Junior high	3.00	2.96	2.29	0.12	0.41	0.51
	≥Senior high	3.02	3.00	0.65	0.41	1.23	0.2
Parity	Para-1	2.89	2.74	13.23	0.0003	11.89	0.0006
	Para-2/4	3.05	3.03	0.37	0.54	0.02	0.87
	≥ Para-5	3.13	3.15	0.04	0.82	0.17	0.67
Term status in weeks	28-36	2.85	2.61		0.95	3.31	0.06
	37-38	2.85	2.90	1.00	0.31	2.03	0.15
	≥39	3.08	3.01	4.50	0.03	1.06	0.30
'ABO' phenotypic groups	Group-A	3.01	2.98	0.24	0.61	0.09	0.75
	Group-B	3.13	3.06	0.21	0.64	0.08	0.77
	Group-C	3.05	2.90	6.23	0.01	3.86	0.04
	Group-D	3.01	2.98	1.20	0.27	0.26	0.61
Syphilis	Positive	3.06	3.21	0.54	0.46	0.58	0.44
	Negative/Non-tested	3.02	2.90	4.12	0.02	1.90	0.16
Hepatitis-B	Positive	2.98	3.06	0.27	0.60	0.47	0.49
	Negative/Non-tested	3.03	2.94	4.38	0.03	1.53	0.21
HIV	Positive	2.83	2.94	0.49	0.48	1.47	0.22
	Negative/Non-tested	3.01	2.96	3.99	0.04	1.32	0.24
Maternal anemia	Yes	3.01	2.95	2.52	0.11	0.83	0.36
	No	3.03	3.00	0.46	0.49	0.41	0.51
Sex of neonate	Male	3.04	2.98	3.39	0.06	1.29	0.25
	Female	2.97	2.94	0.47	0.49	0.52	0.81

Elevated BP during pregnancy correlated with reduced burdens of lower BW births, supporting the 'Barker Hypothesis' on 'fetal origins which suggests adult chronic diseases may stem from fetal responses to the intrauterine environment.

Recognizing the established connection between BP and BW, further comprehensive investigations to enhance our understanding of this association remain crucial. Evaluation of ethnic variations in the impact of maternal HBP on BW showed a heightened LBW prevalence in black ethnic groups. This trend persisted for both chronic and Pregnancy-induced HPT (PIH), as well as for preeclampsia/eclampsia, even after adjusting for various socioeconomic characteristics.

The correlation between maternal HBP and BW, with ethnic variations, also manifests as an inverse relationship in infants categorized as 'small for gestational age.'

Table 4:
Mean birth weight analysis by maternal diastolic blood pressure above or below 80 mmHg

	Characteristic	Mean Birth Weight		ANOVA		Kruskal-Wallis test for two groups	
		DBP <80	DBP ≥80	F-statistic	p-value	Chi-square	p-value
Age group in years	≤20	2.87	2.77	4.54	0.03	3.78	0.05
	21-30	3.00	3.03	1.53	0.21	0.77	0.37
	≥31	3.13	3.04	5.60	0.01	2.46	0.11
Residence	Urban	3.02	3.01	0.00001	0.99	0.19	0.66
	Rural	2.98	2.97	0.29	0.58	0.20	0.65
Occupation	Formal	3.01	3.00	0.03	0.86	0.18	0.66
	Non-formal	3.02	3.00	1.04	0.30	0.38	0.53
Education	≤Junior high	3.00	2.98	0.46	0.49	0.05	0.81
	≥Senior high	3.01	2.97	0.81	0.36	0.50	0.47
Parity	Para-1	3.05	3.02	0.60	0.51	0.55	0.07
	Para-2/4	3.09	3.07	0.20	0.65	0.001	0.97
	≥Para-5	3.14	3.13	0.03	0.84	0.09	0.76
Term status in weeks	28-36	2.66	2.60	0.45	0.50	0.55	0.45
	37-38	2.92	2.83	3.92	0.04	3.46	0.06
	≥39	3.07	3.06	0.21	0.64	0.06	0.79
'ABO' phenotypic groups	Group-A	3.04	3.02	0.09	0.75	0.11	0.73
	Group-B	3.19	3.07	0.83	0.36	0.55	0.45
	Group-C	3.04	2.96	2.53	0.11	1.26	0.26
	Group-D	3.01	3.01	0.001	0.97	0.003	0.95
Syphilis	Positive	3.18	3.04	0.81	0.37	0.96	0.32
	Negative/Non-tested	3.00	2.99	0.11	0.73	0.0009	0.97
Hepatitis-B	Positive	3.02	2.98	0.10	0.74	0.001	0.99
	Negative/Non-tested	3.05	3.03	0.01	0.91	0.09	0.75
HIV	Positive	2.97	2.78	1.89	0.17	5.79	0.01
	Negative/Non-tested	3.07	3.01	0.08	0.76	0.001	0.99
Anemia	Yes	3.00	2.99	0.08	0.76	0.008	0.92
	No	3.03	3.01	0.36	0.54	0.62	0.42
Sex of neonate	Male	3.03	3.00	1.10	0.29	0.37	0.54
	Female	2.97	2.95	0.38	0.53	0.48	0.48

Further investigation into potential links with late cardiovascular disease is recommended within this context [34,35].

A systematic review and meta-analysis conducted in Ethiopia revealed significant associations between PIH and a higher LBW prevalence in mothers with HBP [36]. Getaneh *et al*. (2020) reported LBW prevalence in women with PIH that was more than twice that observed in all reproductive-aged women. LBW odds were nearly four times higher in women with PIH compared to normotensive women [36]. LBW births observably occurred the most among parturient women with SBP ≥130 mmHg and DBP ≥80 mmHg. This observation stemmed from a stratified analysis, accounting for variables including maternal Hgb concentration (above or below 11.0 g/dL), infant sex (male or female), and level of education.

The study identified consistent marginal fluctuations in mean BW when stratified by dichotomized maternal SBP and DBP, ≥130 mmHg and ≥80 mmHg, respectively. Despite apparent consistency, differences in BW based on SBP and DBP levels largely lacked statistical significance via both parametric F-statistic and non-parametric Kruskal-Wallis H-test. While predominantly marginal and statistically insignificant, the study emphasizes the potential importance of consistently observed BW variations, aligning with Hill's criteria of causation, specifically 'consistency.' Increasing SBP and DBP showed sustained diminishing trends in mean BW. A related study on severe preeclampsia, preeclampsia, and PIH reported similar findings within the limited literature on this subject. It evaluated BW in infants born to mothers with elevated BPs during pregnancy comparing them with normotensive mothers at each gestational week using a two-way ANOVA. Reported reductions in BW associated with severe pre-eclampsia became statistically insignificant after adjusting for confounding factors [37].

Elevated maternal peripheral SBP and DBP during pregnancy consistently correlated with '*lower*' BW. This study's sustained and consistent increase in mean BW with lower SBP and DBP remains noteworthy. Despite the predominant statistical insignificance in mean BW variations, the consistency of these findings warrants further investigation. The relationship therefore remains conspicuously inverse. Emerging evidence highlights an increased risk of HBP in later life among individuals born with LBW, emphasizing the importance of prioritizing research on this association. [38,39]. The study observes that even mild maternal SBP and DBP elevation negatively impact BW, a crucial metric for intrauterine growth. Early identification and management of HPT in pregnancy is crucial for the prevention of adverse outcomes.

Limitations of the study

The absence of BP data across different trimesters of pregnancy within the birth registers is a significant limitation. Consequently, the study relied on fundamental research assumptions, asserting that pre-birth maternal peripheral SBP and DBP readings accurately reflected peripheral BP profiles throughout the duration of pregnancy.

Conclusion

Establishing causation for the correlation between higher maternal SBP and DBP with lower BW requires careful consideration. The complex interplay of factors affecting BW, along with the need for careful interpretation, highlights the challenge of definitively establishing causality. While previous studies may emphasize stronger associations between higher maternal BP and 'LBW', this study adopts a more cautious stance, suggesting an association with '*lower*' BW. Understanding factors influencing maternal BP during pregnancy, including biological, environmental, and social factors, is crucial for developing effective control strategies and improving maternal and fetal outcomes

Recommendations

Future research should prioritize investigating the connections between maternal SBP and DBP and fetal intrauterine growth. Regular real-time monitoring of maternal BP, with a focus on percentile fetal growth by GA, is essential. This can be achieved through continuous non-invasive BP monitoring, regular ultrasounds, integrated growth charts, and the use of remote monitoring devices, telehealth, and machine learning for efficient data collection and analysis. Interdisciplinary collaboration, patient education, and ethical considerations are of utmost importance.

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