

Original Research

To investigate the relationship between thyroid function and the severity of hypertension during pregnancy

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Abstract

Background: Hypertension is a prevalent medical issue that affects around 10% of pregnant women. It may lead to a significant number of hospitalizations and fatalities for both the mother and the fetus

Aim: To investigate the relationship between thyroid function and the severity of hypertension during pregnancy.

Materials and methods: For this investigation, a sample size of 80 participants was chosen using a random selection technique. The research cohort included 40 pregnant women with hypertension, aged between 18 -40 years. The control group included 40 normotensive pregnant women who were age-matched to the research group. Gestational age for each participant was determined based on their previous menstrual cycle. The research included patients who received a diagnosis of hypertension after 20 weeks of gestation, especially during the latter two-thirds of their pregnancy. The control participants were chosen from a group of pregnant women who were visiting the prenatal clinic and seemed to be in good health.

Results: The results indicate a statistically significant positive correlation between systolic blood pressure (SBP) and diastolic blood pressure (DBP) ($R=1.52a$, $P=0.01$), as well as between SBP and thyroid-stimulating hormone (TSH) ($R=0.88a$, $P=0.01$). Furthermore, notable inverse relationships were observed between TSH and FT3 ($R= -0.65b$, $P=0.01$), as well as between TSH and FT4 ($R= -0.43b$, $P=0.01$). Nevertheless, the analysis revealed that there was no statistically significant positive relationship ($P>0.05$) observed between the mean values of systolic blood pressure (SBP) and free triiodothyronine (FT3) ($R=0.07$), SBP and free thyroxine (FT4) ($R=0.08$), diastolic blood pressure (DBP) and FT3 ($R=0.09$), DBP and FT4 ($R=0.05$), as well as FT3 and FT4 ($R=0.02$).

Conclusion: The current investigation revealed a significant association between thyroid hypofunction and pregnancy induced hypertension. Additional research is necessary to examine the correlation between thyroid function and preeclampsia because of constraints such as a limited number of participants, variations in location, varying ethnic origins, and different food habits among the individuals included in the study.

Keywords: Thyroid function, Hypertension, Pregnancy, DBP, TSH

Introduction

Hypertension is a prevalent medical issue that affects around 10% of pregnant women. It may lead to a significant number of hospitalizations and fatalities for both the mother and the fetus.^{1,2} Hypertensive disorders in pregnancy encompass several types of illnesses, such as chronic and gestational hypertension, as well as eclampsia.¹ The National High Blood Pressure Education Program Working Group on High Blood Pressure in Pregnancy has classified hypertension in pregnancy into four categories: chronic hypertension, preeclampsia-eclampsia, preeclampsia superimposed on

chronic hypertension, and gestational hypertension.³ Although there is a significant impact on the health of mothers and newborns, there is a lack of substantial data about the risk of thyroid dysfunction. Hypertension, often known as high blood pressure, is a medical disorder characterized by abnormally elevated pressure exerted by the blood on the walls of the arteries. This increased pressure may potentially cause harm to organs and result in serious illnesses. Hypertension, characterized by a blood pressure equal to or greater than 140/90 mmHg, is widely acknowledged as one of the most prevalent chronic conditions.⁴ Pregnancy-induced hypertension has been shown to have many physiological impacts and might increase the mother's susceptibility to difficulties before to, during, or after childbirth. It may impact the formation of the placenta, leading to insufficient delivery of nutrients and oxygen to the fetus.⁵ The incidence of hypertension problems during pregnancy varies from 10 to 21% among pregnant women. The reported prevalence rates were 21.6% in south-eastern Nigeria, 10% in Ibadan, 11.6% in Benin City, and 17% in Sokoto.⁶⁻⁹ Thyroid dysfunctions, including hyperthyroidism and hypothyroidism, occurring during pregnancy may lead to the development of hypertension and other negative health consequences for both the baby and the mother. The negative health consequences include a higher likelihood of miscarriage, pregnancy-induced hypertension, premature delivery, placental abruption, low birth weight, and fetal death.¹⁰ In addition, hypothyroidism may operate as a separate risk factor for preeclampsia and fetal development limitation. Nevertheless, the precise mechanisms by which thyroid dysfunction contributes to hypertensive problems during pregnancy remain incompletely elucidated.¹⁰

Aims and Objectives: To investigate the relationship between thyroid function and the severity of hypertension during pregnancy.

Materials and Methods

The prospective cohort research was conducted on a sample size of 80 participants was chosen using a random selection technique. The research cohort included 40 pregnant women with hypertension, aged between 18-40 years. The control group included 40 normotensive pregnant women who were age-matched to the research group. Gestational age for each participant was determined based on their previous menstrual cycle. The study was conducted at Department of Obstetrics and Gynaecology, Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar, India. The study duration was August 2023 to February 2024. The Institutional Ethics Committee gave the study its approval. All enrolled patients provided written informed consent. Data such as name, age, etc. was recorded.

Inclusion Criteria

- Patients to give written informed consent
- Patients who received a diagnosis of hypertension after 20 weeks of gestation, especially during the latter two-thirds of their pregnancy.
- The control participants were chosen from a group of pregnant women who were visiting the prenatal clinic and seemed to be in good health. These women were of the same age and in the same trimester as the group with hypertension.
- Available for follow up.

Exclusion Criteria

- Patients not give written informed consent
- Participants having a history of hypertension before the current pregnancy, persons with diabetes mellitus, and those with a pre-pregnancy weight more than 90 kg.
- In addition, the research eliminated those individuals having proteinuria of 0.3 gm or above.
- Those unable to attend follow-up.

Methodology

The researchers employed a random sampling technique in the process of collecting the samples. A volume of 3 milliliters of whole blood was obtained by employing a plain specimen container. The centrifuged serum was subsequently stored at a temperature range of 2-8°C until it was subjected to analysis. The demographic information of all participants in the study was collected through the utilization of a standardized questionnaire administered by trained interviewers. The blood pressure of each participant was assessed utilizing an Accoson mercury sphygmomanometer. The utilization of Korotkoff's sound phases I and V was employed in order to ascertain the systolic and diastolic blood pressures (SBPs and DBPs) correspondingly. Values exceeding 140 mmHg for systolic blood pressure (SBP) and 90 mmHg for diastolic blood pressure (DBP) were deemed to be outside the normal range.

Statistical analysis

The data was entered using Microsoft Windows Excel, and the statistical analysis was done using the Statistical Package for Social Sciences (SPSS). We used frequency (%) and mean ± standard deviation to summarise categorical data. To determine whether there is a statistically significant difference the Chi square test and 't' test was employed. A p-value of less than 0.05 indicates statistical significance for the study.

Results

The demographic and anthropometric parameters were analyzed to determine any differences between hypertensive pregnant women and normotensive subjects. The mean age of hypertensive pregnant women (29.65±2.13 years) was found to be statistically similar to that of normotensive subjects (28.63±2.84 years) (P=0.23). There were no statistically significant differences observed in the mean levels of height (1.78 ± 0.12 m), weight (70.22± 4.18 kg), body mass index (27.75±1.19 m/kg²), and gestational age (30.07±1.85 weeks) between hypertensive subjects and normotensive subjects (1.98 ± 0.02 m, 69.30 ± 2.31 kg, 26.67±1.19 m/kg², and 30.29±1.42 weeks, respectively) (P>0.05). In hypertensive individuals, the average values of systemic blood pressure (SBP) and diastolic blood pressure (DBP) were found to be significantly higher (P=0.01) compared to the control group. Specifically, the mean SBP was 161.55±3.56 mmHg in hypertensive subjects, while it was 117.44±2.73 mmHg in the control group. Similarly, the mean DBP was 95.32±2.96 mmHg in hypertensive subjects, whereas it was 71.32±2.61 mmHg in the control group.

The average TSH value was found to be significantly higher (P<0.05) among pregnant women with hypertension (5.84 ± 0.98 µIU/ml) in comparison to pregnant women without hypertension (3.09 ± 1.01 µIU/ml). The serum mean level of FT3 was found to be significantly lower (P<0.05) in the test subjects (4.30 ± 0.84 pg/ml) compared to the control subjects (5.56 ± 1.09 pg/ml). Nonetheless, the study findings revealed no statistically significant disparity (P=0.39) in the average FT4 levels between hypertensive pregnant individuals (3.77 ± 0.99 pg/dl) and normotensive pregnant individuals (3.60 ± 1.32 pg/dl).

Table 1: Basic profile of the study participants

Parameters	Study Group	Control group	T-test	P-Value
Mean age (years)	29.65±2.13	28.63±2.84	1.98	0.23
BMI (kg/m ²)	27.75±1.19	26.67±1.19	4.06	0.37
Gestational age (weeks)	30.07±1.85	30.29±1.42	3.76	0.21
SBP (mmHg)	161.55±3.56	117.44±2.73	14.94	0.01
DBP (mmHg)	95.32±2.96	71.32±2.61	12.43	0.01

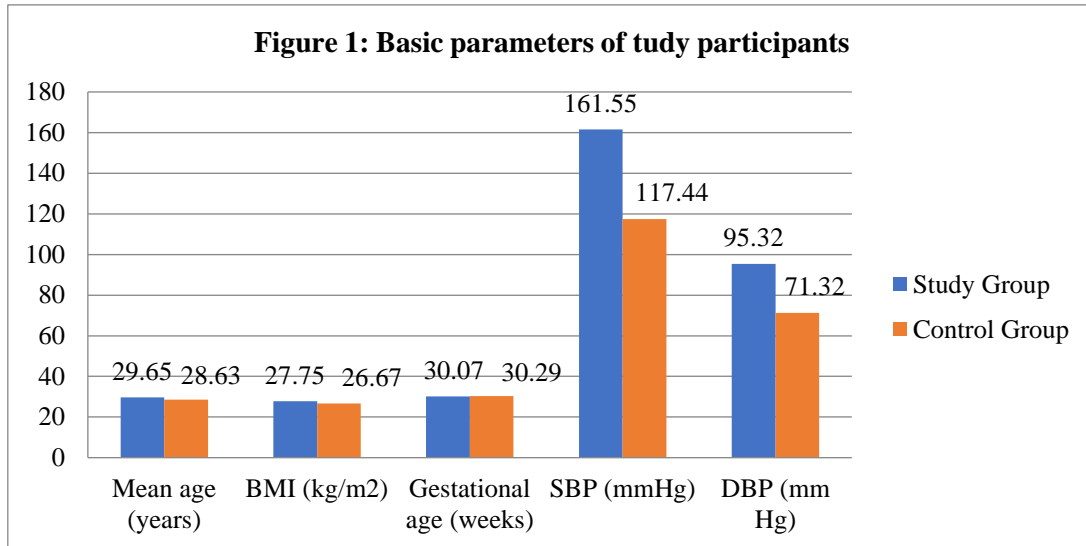


Table 2: TSH, FT3 and FT4 in hypertensive and normotensive pregnant women

Parameters	Study group	Control group	T-test	P-Value
TSH (μIU/ml)	5.84 ± 0.98	3.09 ± 1.01	6.54	0.01
FT3 (pg/ml)	4.30 ± 0.84	5.56 ± 1.09	-7.13	0.01
FT4 (ng/dl)	3.77 ± 0.99	3.60 ± 1.32	-0.07	0.39

Table 3: Severity of hypertension

Severity of hypertension	Number=40	Percentage
Gestational hypertension (GHTN)	4	10
Mild preeclampsia	26	65
Severe preeclampsia	10	25

Majority of women with pregnancy induced hypertension were having mild preeclampsia 65% followed by severe preeclampsia 25% and GHTN 10%.

Table 4: Correlation of thyroid status with severity of hypertension

Thyroid status	Study group			Total
	GHTN	Mild PE	Severe PE	
EU	3(75%)	19(73.08%)	4(40%)	26(65%)
SCH	1(25%)	6(23.08%)	5(50%)	12(30%)
CH	0(0%)	1(3.84%)	1(10%)	2(5%)
Total	4(100%)	26(100%)	10(100%)	40(100%)

The data presented in the aforementioned table indicates a positive correlation between the severity of hypothyroidism and the severity of hypertension. A notable disparity was observed in the incidence of clinical hypothyroidism cases and subclinical hypothyroidism cases among individuals with gestational hypertension and severe preeclampsia, respectively. The prevalence of clinical hypothyroidism was found to be 10% among individuals diagnosed with severe preeclampsia, whereas no cases of clinical hypothyroidism were observed among those with gestational hypertension. The prevalence of subclinical hypothyroidism was found to be 50% in cases of severe preeclampsia and 23.08% in cases of gestational hypertension [Table 4].

Table 5: Correlation between SBP, DBP, TSH, FT3 and FT4 among the hypertensive pregnant women

Parameters	SBP mmHg	DBP mmHg	TSH (μIU/ml)	FT3 (pg/ml)	FT4 (ng/dl)
SBP (mmHg)	--	1.52	0.88	0.07	0.08
DBP (mmHg)	1.52	--	1.21	0.09	0.05
TSH (μIU/ml)	0.88	1.21	--	-0.65	- 0.43
FT3 (pg/ml)	0.07	0.09	-0.65	--	0.02
FT4 (ng/dl)	0.08	0.05	-0.43b	0.02	--

The results indicate a statistically significant positive correlation between systolic blood pressure (SBP) and diastolic blood pressure (DBP) ($R=1.52a$, $P=0.01$), as well as between SBP and thyroid-stimulating hormone (TSH) ($R=0.88a$, $P=0.01$). Furthermore, notable inverse relationships were observed between TSH and FT3 ($R= -0.65b$, $P=0.01$), as well as between TSH and FT4 ($R= - 0.43b$, $P=0.01$). Nevertheless, the analysis revealed that there was no statistically significant positive relationship ($P>0.05$) observed between the mean values of systolic blood pressure (SBP) and free triiodothyronine (FT3) ($R=0.07$), SBP and free thyroxine (FT4) ($R=0.08$), diastolic blood pressure (DBP) and FT3 ($R=0.09$), DBP and FT4 ($R=0.05$), as well as FT3 and FT4 ($R=0.02$) [Table 5].

Discussion

Gestational hypertension, a transient condition, is the primary form of hypertension that occurs during pregnancy. Most academics have focused on pre-eclampsia because of its substantial consequences for the well-being of both the mother and the baby. Conversely, there is a scarcity of knowledge about the repercussions linked to a diagnosis of gestational hypertension (GH). Research suggests that thyroid-related endocrine diseases are widespread among women of reproductive age, making them one of the most frequent endocrine illnesses.¹¹ Klein et al.¹² found that 30% of pregnant women diagnosed with gestational hypertension (GH) also had pre-eclampsia and other hypertensive problems throughout their pregnancy. Therefore, it is reasonable to consider that thyroid dysfunction may be the underlying pathogenic state in growth hormone (GH) and other endothelial vascular problems. The objective of this research is to evaluate the thyroid function in pregnant women who have hypertensive diseases. The purpose is to get up-to-date knowledge on the root causes, processes, and effects of thyroid dysfunction on the development of gestational hypertension. A statistically significant difference ($P=0.01$) was seen in the average TSH level between pregnant women with hypertension and those without hypertension. The significant rise in thyroid-stimulating hormone (TSH) levels in pregnant women with hypertension is due to a thyroid disorder known as hypothyroidism. Hypothyroidism is mostly an autoimmune illness characterized by the activation of antigen presenting dendritic cells via self-proteins. However, once activated, the antigen presenting dendritic cells may stimulate the T-cells to produce cytokines that promote the development of hypertension via vascular remodeling, resulting in an elevation in peripheral vascular resistance.

This finding corroborates earlier studies done in Australia, India, and Kano, Nigeria, as well as in Australia.¹³⁻¹⁵ These studies consistently found significant increases in the average levels of thyroid-stimulating hormone (TSH) among pregnant women with hypertension in their specific locations. Nevertheless, it is important to acknowledge that this specific discovery contradicts the findings presented by Pasupathi et al,¹⁶ who observed no notable difference between Indian pregnant persons with hypertension and those without hypertension. The research revealed that the mean TSH level (5.84 ± 0.98) is within the appropriate reference range ($0.4-6.0 \mu\text{IU/ml}$) for the population being studied.

Conversely, pregnant women with hypertension had a notably decreased average blood concentration of FT3 compared to pregnant women without hypertension. Nevertheless, there was no discernible

difference in the mean blood concentration of FT4 when comparing individuals with hypertension and those without hypertension. FT4 and FT3 are abbreviations for the free circulating forms of the thyroid hormones Thyroxine (T4) and Triiodothyronine (T3) respectively. The thyroid hormones are produced by the thyroid follicular cells of the thyroid gland with the help of thyroperoxidase, an enzyme that assists in the attachment of iodine to tyrosine residues. T4 is classified as a pro-hormone and functions as a reservoir for the active and major thyroid hormone, T3.¹⁷

Additionally, the transformation of T3 is aided by iodothyronine deiodinase in the tissues.¹⁷ Therefore, the absence of notable differences in blood levels of FT4 between hypertensive and normotensive pregnant women may be ascribed to the regular enzymatic activity of thyroperoxidase in both groups. On the other hand, the observed reduction in FT3 levels in hypertension persons, as opposed to normotensive individuals, may be explained by the relative suppression of iodothyronine deiodinase in hypertensive pregnant women. T3 is a biologically active thyroid hormone that has the capacity to cause vasodilation in smooth muscle cells of blood vessels.¹⁸ Existing data suggests that hypertension is an autoimmune illness that impairs the production of vasodilators, such as endothelin, nitric oxide (NO), and T3. Therefore, the significant decrease in the level of FT3 in the blood may be caused by the inhibition of FT3 release, which is a result of thyroid dysfunction associated with increased narrowing of blood vessels in the body, a factor that is involved in the rise in blood pressure. This discovery aligns with the conclusions documented by previous researchers.¹⁹ The observed results differed from the values reported by Pasupathi et al.¹⁶, in their research on pregnant women in India. In addition, the study found a significant difference in the occurrence of subclinical hypothyroidism among the participants ($P < 0.05$). However, there were no significant differences observed in the occurrence of euthyroid, overt hypothyroidism, subclinical hyperthyroidism, and overt hyperthyroidism ($P > 0.05$).

65% of instances of pregnancy-induced hypertension in women were attributed to moderate preeclampsia. Severe preeclampsia was the second most common illness, impacting 25% of women, whereas gestational hypertension (GHTN) was present in 10% of cases. In a research done by Manjusha et al.²⁰, it was shown that the rates of gestational hypertension and preeclampsia were 19.2% and 78.8% respectively, indicating a similar incidence of both conditions. The results of our investigation revealed a direct association between the intensity of hypothyroidism and hypertension, suggesting that as the severity of hypertension escalated, the severity of hypothyroidism also rose. The occurrence of euthyroid patients was more common in pregnant hypertension (75%) than in severe preeclampsia (40%). An evident discrepancy was seen in the occurrence of clinical hypothyroidism among persons with gestational hypertension and those with severe preeclampsia. Among women with severe Preeclampsia, the occurrence of clinical hypothyroidism was 10%, whereas women with gestational hypertension did not exhibit any cases of clinical hypothyroidism. Similarly, there was a significant difference in the occurrence of subclinical hypothyroidism between persons with gestational hypertension (25%) and those with severe preeclampsia (50%). A research done by Khaliq et al.²¹ found a significant difference between severe and moderate instances of Preeclampsia in women. More precisely, the severe group showed a significant increase in serum Thyroid-Stimulating Hormone (TSH) levels in comparison to the moderate group. A research done by Osathanordh and colleagues²² found a significant decrease in thyroid hormone levels in patients with severe Preeclampsia compared to those with moderate Preeclampsia. A research done by Minire et al.²³ revealed that women with preeclampsia had complications including eclampsia, placental abruption, HELLP syndrome, renal failure, and disseminated intravascular coagulation (DIC). The documented rates for these problems were 3.3%, 6.9%, 4.2%, 12.3%, and 2.79% correspondingly. The research produced results that were mostly similar. A research done by Khanaam et al.²⁴ found a notable rise in the occurrence of hypothyroidism among persons diagnosed with preeclampsia. Das et

al.²⁵ found a statistically significant correlation between high levels of thyroid-stimulating hormone (TSH) and thyroid problems in women diagnosed with preeclampsia. Furthermore, a notable association was found between the level of thyroid-stimulating hormone (TSH) in the blood and both the systolic blood pressure (SBP) and diastolic blood pressure (DBP) in pregnant women with hypertension. There was no statistically significant link found between the levels of FT3 and FT4 in the blood serum and both the systolic blood pressure (SBP) and diastolic blood pressure (DBP) when these variables were analyzed together. As hypertension advances, the blood concentration of thyroid-stimulating hormone (TSH) increases accordingly. This finding indicates a connection between hypothyroidism and the development of hypertension during pregnancy. This is supported by the significant difference in the incidence of subclinical hypothyroidism between pregnant women with hypertension and those without. In a research done in India, Nanda et al.²⁶ discovered a similar result among pregnant women with hypertension.

Limitation of the study: The shortcoming of the study is small sample size and short duration of the study.

Conclusion

The current investigation revealed a significant association between thyroid hypofunction and pregnancy induced hypertension. Additional research is necessary to examine the correlation between thyroid function and preeclampsia because of constraints such as a limited number of participants, variations in location, varying ethnic origins, and different food habits among the individuals included in the study.

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