

# Thyroid Hormone Levels in Apparently Euthyroid Subjects with Essential Hypertension in a Tertiary Hospital in Nigeria

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## ABSTRACT

**Background:** High blood pressure (BP) is a major health problem in Nigeria and the involvement of thyroid hormones in this condition has not been evaluated in this center.

**Objective:** The objective of this study was to evaluate the proportion of patients with an essential hypertension who had abnormal thyroid hormone levels and the type of thyroid disorders commonly observed in this group of patients.

**Materials and Methods:** A retrospective study of 94 patients (30 males, aged  $30.4 \pm 2$  years and 64 females, aged  $43.4 \pm 1.3$  years) with essential hypertension was carried out between January 2005 and December 2007. Demographic and other medical information were obtained from the health records. Analysis of laboratory results of triiodothyronine ( $T_3$ ), Thyroxine ( $T_4$ ), and thyroid stimulating hormone (TSH) were made.

**Results:** Of the 94 patients evaluated, 26 (27.7%) had abnormal thyroid hormone levels, with 23.4% having hyperthyroidism, 4.3% had sub-clinical hypothyroidism and none had overt hypothyroidism. Of the 26 subjects with abnormal thyroid hormone levels, 18 (69.2%) were females while 8 (30.8%) were males. Out of the 18 female subjects with abnormal thyroid hormone levels, 16 had hyperthyroid levels while 2 had sub-clinical hypothyroid levels. Out of the 8 male patients, 6 had hyperthyroid hormone levels while 2 had sub-clinical hypothyroid levels.

**Conclusion:** Thyroid hormone abnormalities are common in patients with essential hypertension. Hyperthyroidism was the most common thyroid disorder observed. Young patients presenting with essential hypertension should be screened for thyroid hormone abnormalities since they can best be managed by treating the underlying causes.

**Key words:** Blood pressure triiodothyronine, essential hypertension, thyroid stimulating hormone, thyroxine

## INTRODUCTION

High blood pressure (BP) has become a major health problem in Nigeria affecting about 15% of Nigerians.<sup>[1]</sup> One of the numerous functions of thyroid hormones in the mammal is the stimulation of adrenergic activity with an increased heart rate and myocardial contractility. Studies have shown that both hypo and hyperthyroid disorders may increase the risk of hypertension.<sup>[2-4]</sup> The clinical symptoms

of thyroid hormone dysfunction are numerous and varied even in more subtle sub-clinical thyroid disease with general symptoms that may escape diagnosis. Sub-clinical hypothyroidism has been associated with diastolic hypertension and reduced pulse pressure.<sup>[5,6]</sup>

Streeten *et al.*<sup>[7]</sup> reported that hyperthyroidism may be associated with peripheral vasodilatations and reduction of the diastolic BP and sometimes with systolic hypertension while hypothyroidism may be accompanied by diastolic hypertension. Elevated diastolic BP was reported to be common in subjects with hypothyroidism in a small group of patients with myxedema.<sup>[8,9]</sup> These authors observed a fall in diastolic BP when the hypothyroidism was corrected with thyroid hormone replacement therapy.<sup>[10]</sup> Others; however, failed to observe any association between BP and hypo- or hyperthyroidism.<sup>[11]</sup> Endo *et al.*<sup>[12]</sup>

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	<b>DOI:</b> 10.4103/0974-2727.115921

observed no evidence that hypothyroidism predisposed to BP in 80 hypothyroid patients and 73 euthyroid subjects. Again, one study reported lower thyroid function among subjects with BP who had no apparent thyroid dysfunction.<sup>[13]</sup> Apart from these inconsistent reports, no study from this center has been done to determine the frequency with which hypertension may be associated with thyroid dysfunction, the treatment of which may lead to normalization of BP. This study therefore seeks to examine the proportion of patients with an essential hypertension who had abnormal thyroid hormone levels and the type of thyroid disorders commonly observed in this group of patients.

## MATERIALS AND METHODS

This is a retrospective study of patients with essential hypertension referred to the Clinical Chemistry Laboratory of Aminu Kano Teaching Hospital, Kano between January 2005 and December 2007. Demographic and other medical information including BP control were obtained from the patients' health records. Analysis of laboratory results of triiodothyronine ( $T_3$ ), thyroxine ( $T_4$ ), and thyroid stimulating hormone (TSH) were made. Those who were known to have thyroid disease were excluded and only the first result of those who had multiple results was included also excluded were those with known secondary cause of their hypertension. Blood specimens were routinely collected in the morning in the fasting state. The thyroid hormones were determined using ELECSYS 1010 auto-analyzer which uses the principle of electrochemiluminescence immunoassay technique. Data were expressed as mean  $\pm$  SEM and Students' *t*-test for unpaired means was used for the statistical analysis. Values were considered as a statistically significant at  $P < 0.05$ .

## RESULTS

There were 94 patients in the study group and consisted of 30 males, with a mean age of  $30.4 \pm 2.0$  years and 64 females with a mean age of  $43.4 \pm 1.3$  years. Table 1 shows thyroid hormone levels of studied patients. Of the 94 patients evaluated, 26 (27.7%) had abnormal thyroid hormone levels, with 23.4% having hyperthyroidism, 4.3% had sub-clinical hypothyroidism and none had overt hypothyroidism. The means hormone levels in the studied population were  $T_3$  ( $2.95 \pm 0.36$  nmol/L),  $T_4$  ( $138.3 \pm 10.0$  nmol/L), and TSH ( $1.49 \pm 0.19$   $\mu$ IU/mL). Table 2 shows the characteristics of studied patients on the basis of thyroid hormone levels. Of the 26 subjects with

abnormal thyroid hormone levels, 18 (69.2%) were females while 8 (30.8%) were males. Out of the 18 female subjects with abnormal Thyroid hormone levels, 16 had hyperthyroid levels while 2 had sub-clinical hypothyroid levels (with only TSH outside the normal reference range). Out of the 8 male patients, 6 had hyperthyroid hormone levels while 2 had sub-clinical hypothyroid levels. All thyroid hormone parameters in the hyperthyroid group were significantly higher ( $P < 0.001$ ) when compared with those with euthyroid hormone levels. On the other hand,  $T_4$  was significantly increased, though within the reference range ( $P < 0.05$ ) and TSH was significantly increased ( $P < 0.001$ ) in the sub-clinical hypothyroid group compared to the euthyroid group. The mean  $T_3$  level in the sub-clinical hypothyroid group was however not significantly increased ( $P > 0.05$ ) when compared to the euthyroid group.

## DISCUSSION

The results from this study indicated that abnormal thyroid hormone levels are common in patients with essential hypertension in this center. This suggests the possibility of some 27.7% of patients with essential hypertension had previously unrecognized thyroid disorders, which could be treated either with thyroid replacement therapy or thyroid hormone lowering agents. The finding of 27.7% of the patients had abnormal thyroid hormone levels in this study is consistent with previous reports of association between increased BP and hyperthyroidism.<sup>[3,4]</sup> On the contrary, our finding is at variance with others who failed to show any association between the hypertension and the hyperthyroidism or sub-clinical hypothyroidism.<sup>[11]</sup> In the same vein, in a study of subjects with no apparent thyroid dysfunction, lower thyroid function was reported among patients with hypertension.<sup>[13]</sup> There was no single overt hypothyroidism observed among our study population.

**Table 1: Thyroid hormone levels in patients with essential hypertension**

Measured variables	Patients with essential hypertension	Reference range
No. of patients	94	-
Mean age (years)	$38.9 \pm 1.82$	-
Number of males	30	-
Number of females	64	-
Number of patients with thyroid disorders	26 (27.7%)	-
$T_3$ (nmol/L)	$2.95 \pm 0.36$	1.3-3.1
$T_4$ (nmol/L)	$138.3 \pm 10.0$	66-181
TSH ( $\mu$ IU/mL)	$1.49 \pm 0.19$	0.27-4.2
Systolic BP	$150 \pm 6.0$	70-120
Diastolic BP	$100 \pm 2.0$	60-80

$T_3$ : Triiodothyronine,  $T_4$ : Thyroxine, TSH: Thyroid stimulating hormone, BP: Blood pressure

**Table 2: Thyroid hormone levels in hypertensive patients with thyroid dysfunction**

Measured variables	Euthyroid hypertensive patients	Hyperthyroid hypertensive patients	P value	Sub-clinical hypothyroid hypertensive patients	P value
Number of patients	68	22	-	04	-
Number of males	22	06	-	02	-
Number of females	46	16	-	02	-
T <sub>3</sub> (nmol/L)	1.96±0.10	6.27±0.84	<0.001	2.21±0.21	>0.05
T <sub>4</sub> (nmol/L)	106.8±5.0	229.7±19.4	<0.001	156.6±11.4	<0.005
TSH (μIU/mL)	1.57±0.17	0.54±0.19	<0.001	5.37±0.29	<0.001

T<sub>3</sub>: Triiodothyronine, T<sub>4</sub>: Thyroxine, TSH: Thyroid stimulating hormone

The observed number of patients with hyperthyroidism (23.4%) among hypertensive subjects is lower than previously reported.<sup>[14]</sup> Hyperthyroidism is a metabolic disorder that is strongly associated with cardiovascular manifestations including hypertension and palpitation.<sup>[15]</sup> The hyperdynamic circulatory effect of hyperthyroidism is due to marked reduction in peripheral vascular resistance, increased total blood volume, and heart rate.<sup>[16-18]</sup> This may exacerbate pre-existing cardiac disease and may also cause new cardiovascular abnormalities. Prisant *et al.*<sup>[3]</sup> earlier reported that the prevalence of hypertension was greater among the hyperthyroid than euthyroid patients and that isolated systolic hypertension was the most common form of hypertension. Saito and Surata<sup>[4]</sup> observed that elevation of systolic BP is more common in younger age group. Age was reported to have a tremendous effect on BP in patients with hyperthyroidism. Whereas among euthyroid controls systolic BP increased with age, no age related increases were observed among hyperthyroid patients because of the relatively high systolic BP in young patients.<sup>[19]</sup> The mean age of our study population was 38.9 ± 1.82. It is suggested that clinicians should maintain a high degree of suspicion for thyroid hormones abnormality when patients present with hypertension especially when dealing with younger subjects. This is an important because of the potentiation of catecholamine action by an excess of thyroid hormone, which has been postulated to be accompanied by increased β-adrenergic receptors in heart tissues.<sup>[19]</sup>

The mechanism by which thyroid hormones affect systemic vascular system may not be completely resolved. It was reported that hemodynamic changes arise from the effect of T<sub>3</sub> on both the heart and systemic vasculature. T<sub>3</sub> is capable of causing rapid relaxation of vascular smooth muscle cells. Because the vascular smooth muscle of resistance arteriole pulmonary determines peripheral vascular tone, T<sub>3</sub> may directly regulate vascular resistance, which in turn causes alterations in BP.<sup>[20]</sup>

Sub-clinical hypothyroidism was observed in 4.3% of the study group. This is higher than 3.6% observed in a group of 688 hypertensive patients reported by Streeten *et al.*<sup>[7]</sup> Studies

have shown that sub-clinical hypothyroidism has been associated with elevated diastolic BP, which also resolved after T<sub>4</sub> treatment.<sup>[20]</sup> Whether patients with sub-clinical hypothyroidism require T<sub>4</sub> treatment remains controversial, but the risk of developing overt hypothyroidism especially in the presence of thyroid antibodies is high. Therefore, treatment of the condition may halt the progression to overt hypothyroidism. Sub-clinical hypothyroidism may leads to intrinsic myocardial changes, reflected by changes in contractility and relaxation, causing decreased cardiac contraction, cardiac output, heart rate, left ventricular compliance, and an increase in total peripheral resistance, which may be responsible for the observed hypertension. Other studies have however reported that cardiac structure and function remain normal in the sub-clinical hypothyroidism.<sup>[6]</sup>

## CONCLUSION

Our data suggest that thyroid hormone abnormalities are common in patients with essential hypertension. Hyperthyroidism was the most common thyroid disorder observed in this group of patients. Young patients presenting with essential hypertension should be screened for thyroid hormone abnormalities since they can best be managed by treating the underlying causes.

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**How to cite this article:** Emokpae AM, Abdu A, Osadolor HB. Thyroid hormone levels in apparently euthyroid subjects with essential hypertension in a tertiary hospital in Nigeria. *J Lab Physicians* 2013;5:26-9.  
**Source of Support:** Nil. **Conflict of Interest:** None declared.

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