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Research Article

CROSS-SECTIONAL STUDY OF BLOOD PRESSURE AND TSH VALUES IN A POPULATION WITH CASSAVA AS STAPLE FOOD

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ABSTRACT

Background: Tapioca is one of the staple foods of the people of Kerala. If it is not prepared properly during cooking the cyanide present in it will interfere with body functions. The cyanide is metabolized into thiocyanate by the liver. Thiocyanate has been shown to interact with the blood pressure and thyroid function.

Objectives: The objectives of the study are to observe the variation in physiology of the human body due to the effect of low dose cyanide in diet on the blood pressure and thyroid function.

Materials and methods: A descriptive cross-sectional study design was conducted in the department of General Medicine out-patient department of a tertiary care hospital of central Kerala. This research was conducted after obtaining ethical clearance from the institutional ethical committee. The blood pressure of each subject was recorded. The fasting TSH values of each subject were determined.

Results: There were no significant changes in the systolic blood pressure in hypothyroid group (p=0.288) and hyperthyroid group (p=0.915). There were no significant changes in diastolic blood pressure in hypothyroid group (p=0.270) and in hyperthyroid group (p=0.813). There was significant difference in TSH values in the hypothyroid group (p=0.001) and in the hyperthyroid group (p=0.001) compared to the matched controls.

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Conclusions: The above study did not show significant changes in the systolic and diastolic blood pressure compared to matched controls. These findings are unusual since thyroid dysfunction is known to cause increase in blood pressure as seen in various other studies. This means low dose cyanide in diet in a population with cassava as staple food might be protective from hypertension and is good for the cardiovascular system. There was significant increase in TSH values in the hypothyroid group. There was significant decrease in TSH values in hyperthyroid group. These findings are comparable with the values obtained in other studies.

KEYWORDS

Systolic blood pressure, Diastolic blood pressure, TSH, cassava .

INTRODUCTION

A staple food is a food that is eaten often and in large quantities that it forms the major part of the standard diet of the people of a region1. It supplies the large proportion of the energy needs and nutrients. Staple foods are usually inexpensive and readily available. Roots and tubers are important staples for over one billion people in the developing world. Cassava is a good source of carbohydrates and a better source of essential nutrients compared to potato. The cassava plants grown in different parts of the world produce different quality and quantity of the produce. Cassava is considered a poor man's food because it is cheaper that rice and wheat2. It is the staple food of the poor in many African nations and in India in the state of Kerala. During the World War II, there was again a severe shortage of rice and this established cassava as a popular food. Cassava is a good source of dietary fibers, vitamins, calcium, potassium, etc. This makes it healthier than potatoes3. Cruciferous vegetables are rich in the compound called indole glucosinolate. This compound is also metabolized into thiocyanate. The antithyroid effects of cruciferous vegetables are well established, but they are not taken as a staple food. The cassava starches are linamarin and lotaustralin. These are cyanogenic glucoside. The gut bacteria convert it into hydrogen cyanide. The hydrogen cyanide is detoxified and converted into thiocyanate by the liver enzyme, rhodanese or thiosulfate cyanide transsulfurase4. Thiocyanate is water soluble. The half-life of thiocyanate is approximately three days. Thiocyanate is a potent vasodilator5. It has been used to treat essential hypertension from the early 1920s. it is still used clinically for hypertensive crises. Thiocyanate reacts with the sulfhydryl groups of erythrocytes, albumin, etc. to produce nitric oxide (NO). NO binds to vascular smooth muscles and triggers intracellular cGMP-mediated activation of protein kinase G and subsequent inactivation of myosin light chain. This results in relaxation of the vascular smooth muscles. It causes peripheral vasodilation of both arteries and veins6. The thyroid gland secretes the thyroid hormones whose primary function is to maintain the optimum metabolism of tissues7. The thyroid function is regulated by the thyroid stimulating hormone (TSH) secreted by the anterior pituitary lobe. The primary and major hormone secreted by the thyroid gland is the thyroxine (T4). Triiodothyronine (T3) is secreted in lesser amounts8. The principal organs that take up iodine in the body are the thyroid (20%) and the kidneys (80%). The thyroid cells, thyrocytes contain a symporter that transport sodium and iodide ion called Na+/I- symporter (NIS). TSH increases the number of NIS only in the thyrocytes9. Thiocyanate (SCN-) is a strong inhibiter of iodide

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uptake by the thyrocytes. Thiocyanate is an inhibiter of the NIS10. The daily minimum requirement of iodine for normal thyroid function is about 150µg/day11. In the population of Kerala exposed to low dose cyanide the dietary iodine requirement is very much increased. Supplementation of table salt with iodine increases the dietary intake to about 500µg/day.

This study was conducted to determine the effects of cassava as staple food on thyroid function by comparing the blood pressure and TSH values between hypothyroid subjects, hyperthyroid subjects with matched controls in a tertiary care teaching hospital of central Kerala. Thyroid Stimulating Hormone (TSH) titer is the cheapest and the most reliable test for thyroid functions12. Reliable results are obtained in morning samples because TSH levels peak between midnight and 8 am. TSH assays are used to detect thyroid dysfunctions, monitor thyroid hormone replacement therapy, guide the management of subclinical thyroid disorder and assess suppressive therapy in thyroid cancer. Recent studies have shown marked increase in the number of thyroid disorders in the population of Kerala. There have been significant changes in the environment and smaller yield in cassava making it more toxic13.

METHOD

Ethical clearance was obtained from the institutional ethical committee of Government Medical College, Ernakulam, before the cross-sectional study was conducted. The period of study was two months from April 2016 to October 2016. This study included all apparently healthy subjects attending the Medicine out-patient department within the age group 18-60 years. This study excluded all subjects with history of drug intake which interfere with thyroid function or blood pressure, eg. lithium, amiodarone, glucocorticoids, dopamine, β-blockers, etc. A total of 209 subjects were studied after getting their informed consent. There were 66 males and 143 females. They were divided into three groups based on their thyroid function test results. Hypothyroid group, hyperthyroid group and matched controls. Blood was drawn after aseptic precautions were followed using a disposable syringe and needle14. The blood samples were sent to the Biochemistry laboratory of the same institution to estimate the TSH values. A third generation VITROS TSH3 assay is used. The VITROS TSH3 test utilizes a 'one step' immunometric sandwich assay design. The blood pressure was recorded by palpatory method and auscultatory method, in the sitting posture with the help of a manual mercury sphygmomanometer and stethoscope. The data obtained was entered into the excel sheet. The data obtained was entered into Microsoft Excel sheet. The data was analyzed with the help of Statistical Package for Social Sciences (SPSS) windows version 26. The results obtained were expressed as mean and standard deviation. The mean difference between the groups were analyzed using one way Analysis of Variation (ANOVA) P value, inter group P value and Kruskal Wallis P value. ANOVA, P value of < or = 0.05 is considered significant.

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Figure 1: Pie chart diagram of study group

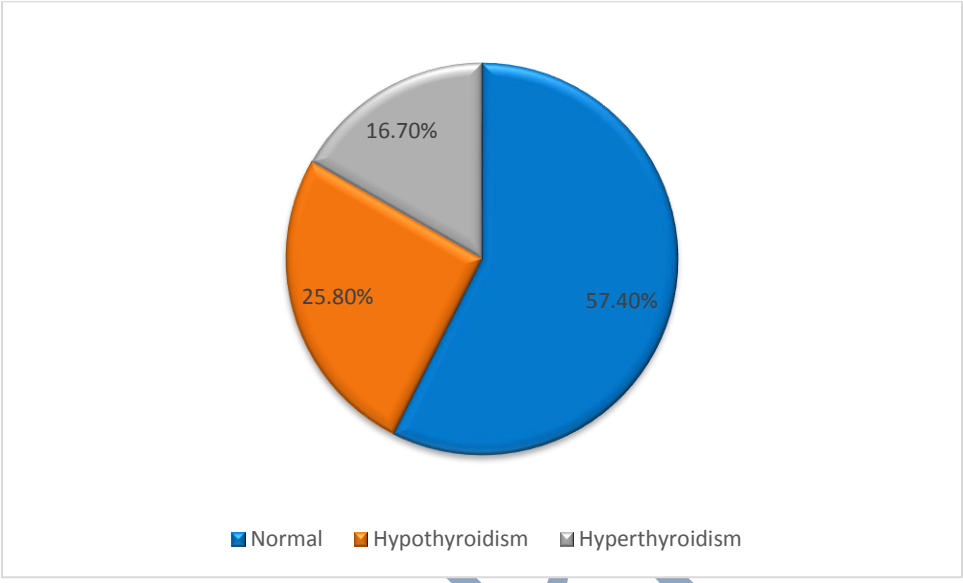

Figure 2: Bar chart of mean age across study group

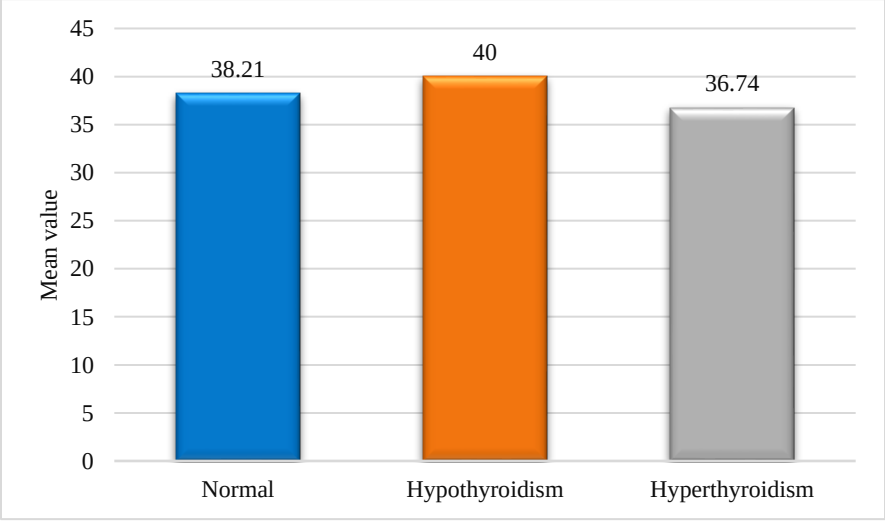

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Figure 3: Bar chart of mean gender across study group

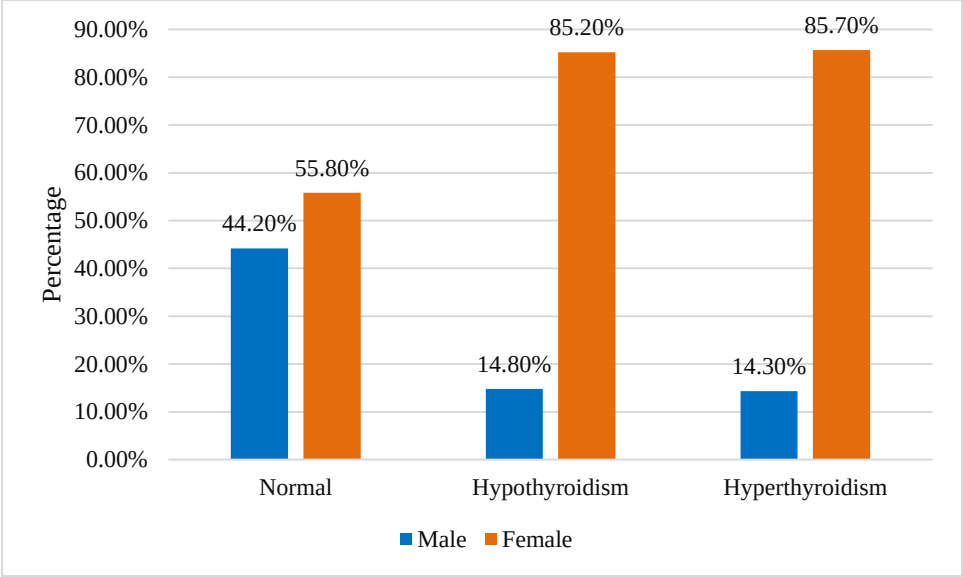

Table 1: Comparison of median TSH across study group

Group	N	TSH Median (IQR)	Inter group P value	Kruskal Wallis P value
Normal	120	1.94 (1.11, 2.83)	N & Hypo: <0.001 N & Hyper: <0.001	<0.001
Hypothyroidism	54	12.07 (8.54, 22.32)		
Hyperthyroidism	35	0.21 (0.07, 0.34)		

Table 2: Comparison of mean systolic blood pressure across study group

Group	N	SBP Mean ± SD	Inter group P value	One Way ANOVA P value
Normal	120	130.35 ± 19.32	N & Hypo: 0.288 N & Hyper: 0.915	0.558
Hypothyroidism	54	133.93 ± 20.63		
Hyperthyroidism	35	130.77 ± 23.89		
Total	209	131.34 ± 20.44		

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Table 3: Comparison of mean diastolic blood pressure across study group

Group	N	DBP Mean ± SD	Inter group P value	One Way ANOVA P value
Normal	120	81.37 ± 12.49	N & Hypo: 0.270 N & Hyper: 0.813	0.542
Hypothyroidism	54	83.67 ± 12.51		
Hyperthyroidism	35	81.94 ± 13.58		
Total	209	82.06 ± 12.66		

RESULTS

A total of 209 subjects were analyzed. There total male subjects were 62 and the total female subjects were 143. The total number of euthyroid subjects studied 120. Total number of hypothyroid subjects 54. The total number of hyperthyroid subjects studied 35. Hypothyroidism is more in older age group compared to hyperthyroidism. The prevalence of hypothyroidism and hyperthyroidism were significantly higher in females. The TSH values were significantly higher in the hypothyroid group. The TSH values were significantly lower in the hyperthyroid group. The mean age for normal subjects was 38. The mean age for hypothyroid subjects was 40. The mean age for hyperthyroid subjects was 36. The Systolic blood pressure comparison between the normal group and the hypothyroid group showed an Inter group P value of 0.288 and between the normal group and hyperthyroid group it showed an Inter group P value of 0.915. The one-way ANOVA P value was 0.558. All these values were not significant. The Diastolic blood pressure comparison between the normal and hypothyroid group showed an Inter group P value of 0.270 and between the normal and hyperthyroid group it showed an Inter group P value of 0.813. The one-way ANOVA P value was 0.542. All these were not significant. The TSH values comparison between the normal and the hypothyroid group showed an Inter group P value of <0.001, which is very significant. Between the hyperthyroid group the Inter group P value was <0.001, which is very significant. The Kruskal Wallis P value was found to be <0.001, this is also very significant.

DISCUSSION

Cruciferous vegetables are rich in the compound called indole glucosinolate15. This compound is also metabolized into thiocyanate. The antithyroid effects of cruciferous vegetables are well established, but they are not taken as a staple food. Cyanide toxicity manifests as metabolic acidosis, hypoxia, bradycardia, altered mental status, etc16. CNS symptoms are due to cerebral vasodilation causing increase in intracranial pressure.

Abnormal thyroid function can cause high blood pressure. Thyroid hormones have direct and indirect cellular effects on the cardiovascular system17. Changes in the thyroid function increases cardiovascular risk. Hypothyroidism weakens the heart muscle and makes it less efficient. Diastolic blood pressure is increased in hypothyroidism due to increased peripheral resistance. Hyperthyroidism increases the heart rate and cardiac output. Systolic

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blood pressure is increased in hyperthyroidism18. Both these actions result in increase in blood pressure, both systolic and diastolic pressure in various studies. Sodium or potassium thiocyanate is one of the earliest drugs introduced to treat patients with essential hypertension19. The usage has been stopped due to significant cardiac and neurologic toxicity. This might be the reason that there are no significant changes in blood pressure in this study population compared to studies of blood pressure and thyroid diseases20.

CONCLUSION

In the above study there is no significant increase in systolic or diastolic blood pressure in the hypothyroid group or hyperthyroid group compared to the matched controls. This is very different from other similar studies. These indicate that the thiocyanate formed from the low dose cyanide in a population with cassava as staple food prevents the increase in blood pressure due to thyroid dysfunction. Cassava is protective to the cardiovascular health. Traditional and old food habits are the best for health. The thiocyanate will interfere with the thyroid function only when there is associated iodine deficiency. Iodine supplements in diet are very useful in a population with cassava as staple food because it can reverse the effects of thiocyanate on thyroid.

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