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Original Research Article

A study of the thyroid profile and mineral in people with schizophrenia

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Introduction- One of the most severe and persistent psychiatric diseases that lasts for at least six months is schizophrenia. There are major mental and physical comorbidities, a high prevalence, a chronic course, and extremely large individual and social costs (lost productivity and increased medical expenses). "The mental disability known as "psychosis," which is a prevalent occurrence in schizophrenia, is characterised by hallucinations, sensory perception problems, or delusions. The disorder is brought on by biopsychosocial factors, such as perinatal, genetic, neuroanatomical, neurochemical, and other biological problems.
Material and Methods-This was a hospital based case-control study consisting of Fifty diagnosed patients with schizophrenia upto age group of 65 years attending psychiatry department were included as cases and Fifty healthy age and gender matched healthy controls participated as controls in the study. A written and informed consent to all the participants of both the groups was taken after explaining the purpose and details of the study. Using ECi, serum TSH, T3, and T4 are estimated. Utilizing Vitros 4600, calcium, magnesium, and phosphorus are also calculated.

Results: In the schizophrenia group, TSH levels were significantly higher (P=0.019), although T3 and T4 values were significantly lower (P=0.004 and P=0.001, respectively), and serum Ca levels were lower (P=0.000). Serum Po4 concentrations were noticeably higher. serum Mg levels in the schizophrenia group were lower (P=0.000) than in the control group (P=0.003).

Conclusions: We came to the conclusion that thyroid hormone levels are typically lower in psychiatric disorders. This implied that the thyroid gland was underactive. The study also found elevated serum Po4 levels and lower Ca and Mg levels. The aforementioned minerals can become out of balance in a number of ways. The regulation of the resting metabolic rate

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is carried out by thyroid hormones. Thyroid and mineral profile screening should be advised for patients with mental symptoms.

Keywords: Schizophrenia, psychosis, neurochemical, Thyroid profile, Mineral Profile

1. INTRODUCTION

One of the most severe and persistent psychiatric diseases that lasts for at least six months is schizophrenia. There are major mental and physical comorbidities, a high prevalence, a chronic course, and extremely large individual and social costs (lost productivity and increased medical expenses).[1] Schizophrenia is one of the top 10 causes of disability worldwide, with a lifetime prevalence of between 0.5 and 1.5 percent in the general population. According to reports, the annual incidence lies between 0.5 and 5 per 10,000 people. Schizophrenia typically first manifests between the ages of 20 and 45. After a first bout of schizophrenia, 30–60% of people reportedly experience partial or full recovery. About 20–40% of schizophrenia patients attempt suicide at least once in their lifetime, and about 10–15% of them actually succeed.[2] In line with WHO Over a two-year period, Chandigarh Center monitored two populations with established geographic boundaries. For rural and urban areas, the yearly incidence rates were 4.4 and 3.8 per 10,000, respectively.[3] In addition to believing that others are reading their minds, in control of their ideas, or conspiring to harm them, people with schizophrenia may hear voices or see things that aren't there. They occasionally discuss bizarre or uncommon topics, which can make it challenging to maintain a conversation. They may also stay still for extended periods of time without moving or speaking.[4] "The mental disability known as "psychosis," which is a prevalent occurrence in schizophrenia, is characterised by hallucinations, sensory perception problems, or delusions. The disorder is brought on by biopsychosocial factors, such as perinatal, genetic, neuroanatomical, neurochemical, and other biological problems.[2]

• **Genetic factors**: 10% of first-degree relatives of people with schizophrenia are at risk for developing schizophrenia. There is a 40% chance that a child may develop schizophrenia if both parents do. For dizygotic twins, concordance for schizophrenia is approximately 10%, while for monozygotic twins, it is 40%–50%. The notion linking the immune system to schizophrenia is supported by the existence of enriched connections among genes expressed in tissues associated to immunity as well as genes expressed in the brain among the 128 independent relationships related to the 108 loci.[5]

• **Perinatal:** 38–46% of schizophrenia cases in children of mothers with prenatal pyelonephritis and a positive family history of psychotic illnesses were caused by the combined effects of the 2 risk factors. Offspring of women who experienced influenza during their second trimester had greater rates of schizophrenia.[6]

• **Biochemical:** Many of the neurotransmitters connected to this illness are mostly reactions to recreational substances. The common neurotransmitters involved in the etiology of schizophrenia are dopamine, serotonin, norepinephrine, gamma amino butyric acid (GABA), and glutamate.[7]

To fully regain normal functioning, a person with "chronic" schizophrenia or a repeating pattern of the condition must normally undergo long-term therapy, which usually involves medication.

The thyroid gland is the largest endocrine gland in humans. Thyroxine (T4) and triiodothyronine (T3), which are hormones that accelerate metabolism, are produced when

ISSN: 0975-3583,0976-2833 VOL13, ISSUE8, 2022

the thyroid gland is stimulated by thyroid stimulating hormone (TSH). Psychiatric diseases frequently have abnormal thyroid hormone levels. There have been reports of hyperthyroxinemia in several acute psychiatric diseases, including schizophrenia, functional psychosis, major depressive disorders, and personality disorders.[8] Numerous investigations have shown that patients with schizophrenia have a significant frequency of thyroid abnormalities.[9,10,11] While the levels of the other parameters fell in schizophrenia patients, the serum levels of dopamine were found to be increased in these patients. It was expected that the increased dopaminergic activity would alter the pituitary's ability to secrete hormones, and that the decreased beta-adrenergic activity would follow from the lower serum TSH levels. This is also interesting since deiodinase activity and, by extension, the thyroid status of the brain, are maintained by catecholamines at the 1 and 2 adrenergic receptors.[12]

A mineral is a chemical element that an organism needs as an important nutrient in order to carry out a variety of life-sustaining processes.[13,14]

Since calcium (Ca) is a crucial molecule involved in the release of neurotransmitters, it is one of the most significant minerals and it's lack results in serious problems. Ca has a significant impact on neuronal activity. Numerous pieces of evidence point to these neurons' role in mood and emotions.[15]

The second-most prevalent necessary mineral in the human body is phosphorus (Po4). It not only contributes to a variety of biological functions, such as energy metabolism and bone mineralization, but it also gives DNA and ribonucleic acid (RNA) their structural underpinnings (RNA). It is created through a variety of metabolic processes, including beta oxidation and glycolysis. Ca and Po4 serum concentrations are modulated by PTH. a hormone that is dysregulated and the psychiatric illnesses that come from it.[16]

Psychiatric diseases are also discovered to have magnesium (Mg) disruption as their primary cause. According to the research, magnesium is frequently linked to both the fluidity of neuronal membranes and brain biochemistry. In Mg shortage, several neuromuscular and mental symptoms have been noted. Hyperirritability, neuromuscular dysfunction, and psychotic behavior are symptoms of magnesium insufficiency.[17,18]

There hasn't been much research done on the function of thyroid hormones and minerals in schizophrenic patients. It is said that thyroid hormone controls the neurotransmitter receptors. As cofactors and in the synthesis of ATP and other compounds, Ca, Po4, and Mg play important roles in signal transduction as well. Therefore, it was intended for the current study to investigate their function in the thyroid and mineral profiles of individuals with schizophrenia.

2. MATERIAL AND METHODS

This study was conducted in SGT Medical College Hospital and Research Institute in the conjunction with the department of psychiatry and the biochemistry department. The study included Schizophrenia patients who met the inclusion and exclusion criteria while seeking treatment at the Department of Psychiatry's Out-Patient Department (OPD). The control group included 50 healthy individuals who were age and sex matched. The institutional ethics committee's consent was sought before starting the study (IEC). Before enlisting in the study, all subjects provided written and informed permission. regardless of their genders, patients up to the age of 65 Diagnostic and Statistical Manual for Mental Diseases (DSM V) and International Classification of Diseases (ICD 10) criteria are used to classify psychiatric disorders. Patients with renal failure and those with a history of cerebrovascular disease were excluded. 50 people with schizophrenia were enlisted as study participants. The control group

ISSN: 0975-3583,0976-2833 VOL13, ISSUE8, 2022

consisted of 50 healthy individuals who were age and sex matched. Using a conventional aseptic approach, blood samples were taken from each participant (patient and control group) and analyzed for the following investigations: Using ECi, serum TSH, T3, and T4 are estimated. Utilizing Vitros 4600, calcium, magnesium, and phosphorus are also calculated.

Statistical Analysis

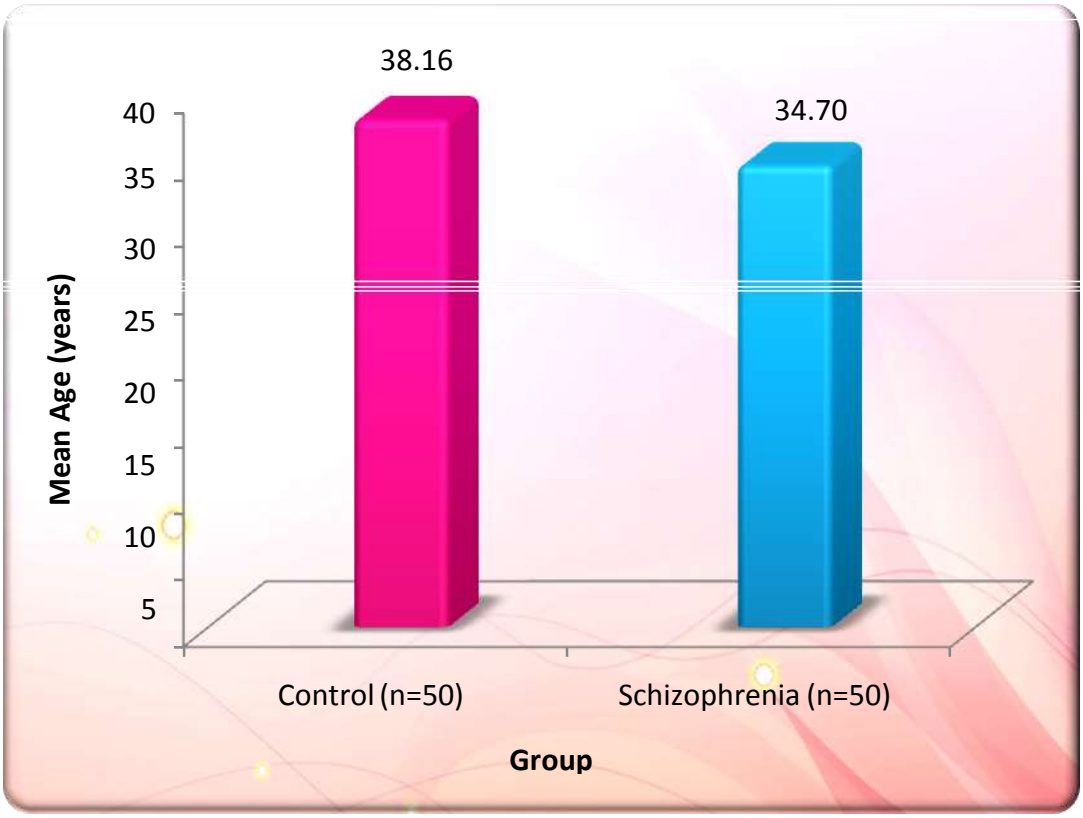
Results were provided as mean SD for the three groups, which included control group (n=50) and schizophrenia patients (n=50). By using the student t-test, the outcomes of the patients were compared to those of the control group. All statistical tests were considered significant if the P value was ≤ 0.05

3. RESULTS

The healthy controls and schizophrenia patients mean ages were 38.16 ±11.20 and 34.70 ±12.96 respectively (table-1),(Fig1)

Group	Age(years)	t-value	P-value
Control (n=50)	38.16±11.20	1.428	NS
Schizophrenia (n=50)	34.70±12.96		

Table 1.1: Distribution of Age in Control and Schizophrenia Grou



ISSN: 0975-3583,0976-2833 VOL13, ISSUE8, 2022

Figure 1: Distribution of Age in control and Schizophrenia Groups

Thyroid Profile of the study population

On evaluation the mean value of TSH in control group was 2.51 ± 1.03µIU/ml and schizophrenia group was 3.22 ±1.83 µIU/ml, the results were statistically significantly indicating a higher TSH level in schizophrenia (P= 0.019). Table 2, Fig 2 represents the distribution of TSH between control group and schizophrenia group.

Group	TSH (µIU/Ml)	t-value	P-value
Control (n=50)	2.51±1.03	2.341	0.019
Schizophrenia (n=50)	3.22±1.83		

P-value as obtained on applying 't-test'

Table 2: Distribution of TSH level in Control and Schizophrenia Groups

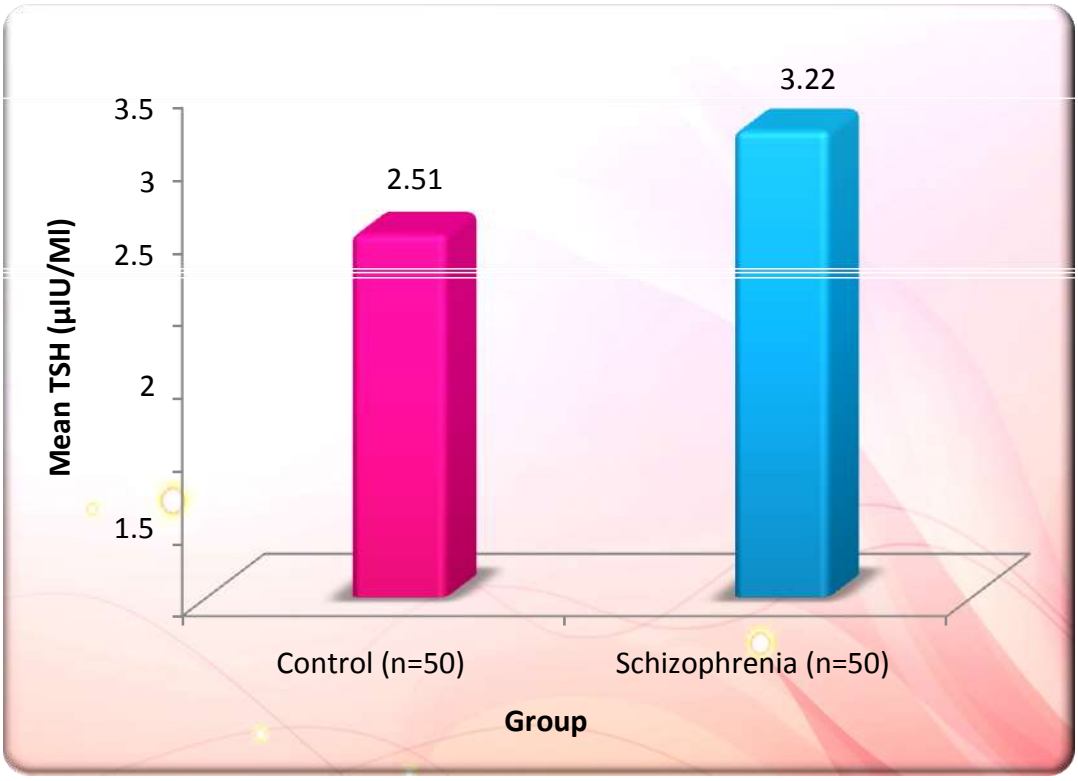


Figure 2: Distribution of TSH level in control and Schizophrenia Groups

The mean level of T3 of control group is 1.33±0.25ng/ml and schizophrenia group is 1.20±0.18ng/ml. The results of the investigations were significantly lower in the schizophrenia group (p-value <0.004). Table 3, Fig 3 represents the distribution of T3 levels between control group and schizophrenia group.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE8, 2022

Group	T_3 (ng/ml)	t-value	P-value
Control (n=50)	1.33±0.25	2.984	0.004
Schizophrenia (n=50)	1.20±0.18		

P-value as obtained on applying 't-test'

Table 3: Distribution of T_3 in Control and Schizophrenia Groups

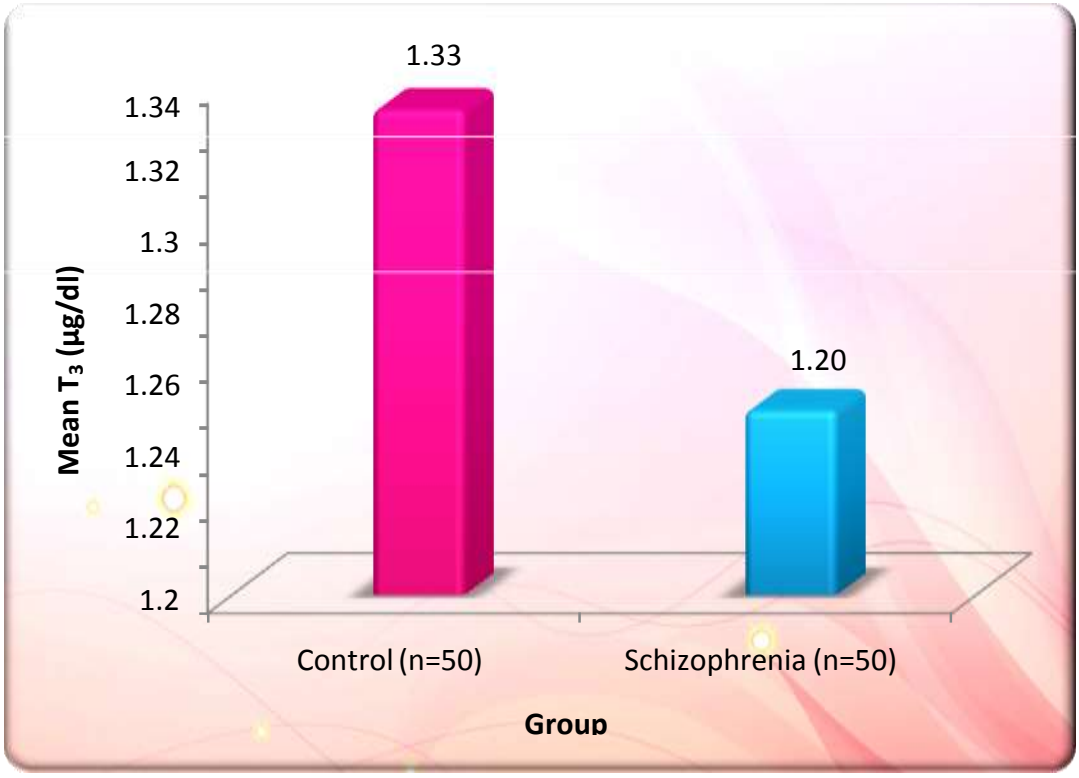


Figure 3: Distribution of T_3 in Control and Schizophrenia Groups

Similar observation was recorded in case of Total T4 levels also. The mean level of T4 control group is 8.64 ±1.71µg/dl and schizophrenia group is 7.66 ±1.24 µg/dl. The variation was statistically significant (p-value is 0.001). Table 4, Fig 4 represents the distribution of T4 levels between control group and schizophrenia group.

Group	T_4 (µg/dl)	t-value	P-value
Control (n=50)	8.64±1.71		

ISSN: 0975-3583,0976-2833 VOL13, ISSUE8, 2022

Schizophrenia (n=50)	7.66±1.24	3.281	0.001

P-value as obtained on applying 't-test'

Table 4: Distribution of T_4 in Control and Schizophrenia Groups

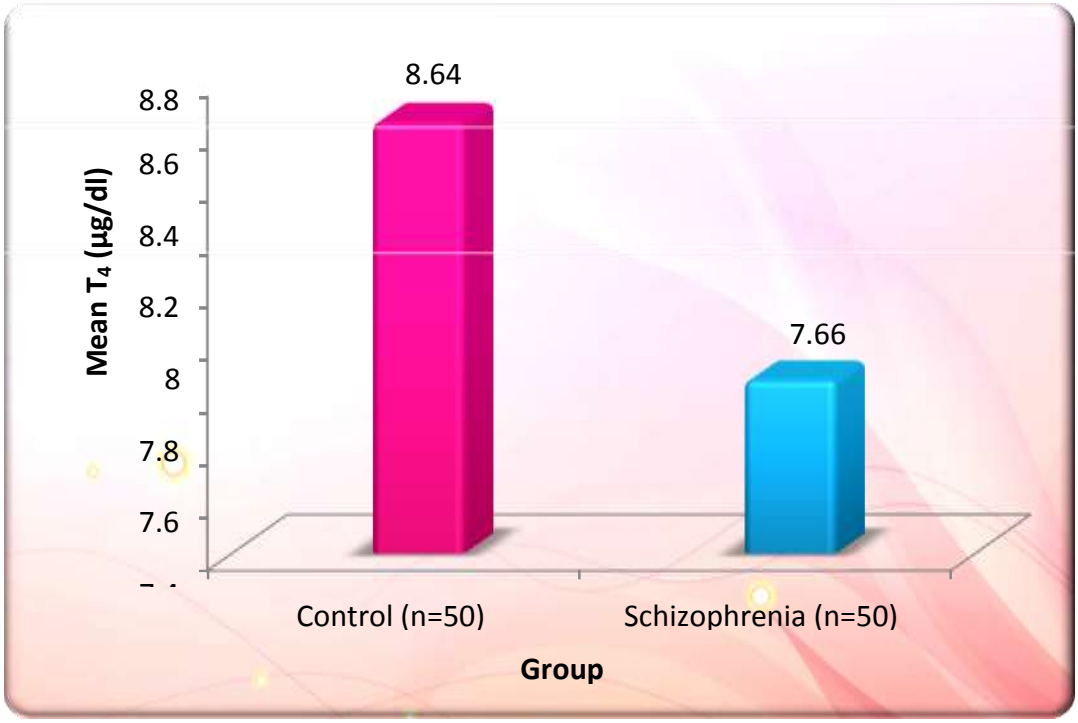


Figure 4: Distribution of T_4 in Control and Schizophrenia Groups

Mineral Profile of the study population

Calcium

According to Table 5, Fig 5 which is showing distribution of Serum Ca levels in control group and schizophrenia group, the mean Ca level in control group is 9.39 ±0.88 mg/dl and schizophrenia group is 8.47±1.13 mg/dl. The investigations showed statistically significant results (P-value 0.000).

Group	Ca^{++}(mg%)	t-value	P-value
Control (n=50)	9.39±0.88	4.542	0.00
Schizophrenia (n=50)	8.47±1.13		

P-value as obtained on applying 't-test'

Table 5: Distribution of Calcium in Control and Schizophrenia Groups

ISSN: 0975-3583,0976-2833 VOL13, ISSUE8, 2022

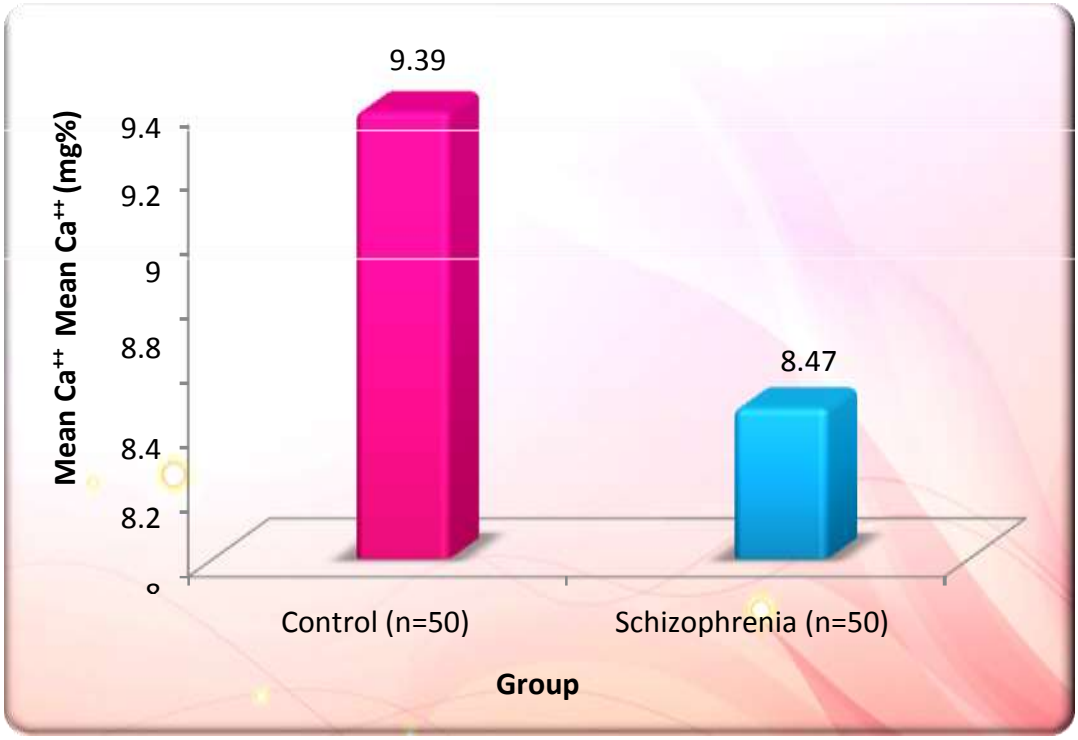


Figure 5: Distribution of Calcium in Control and Schizophrenia Groups

According to Table 6, Fig 6 which is showing distribution of Serum Po4 levels in control group and schizophrenia group, the mean Po4 level in control group is 4.09±1.00 mg/dl and subject group is 4.55±0.94 mg/dl. On statistical analysis, serum Po4 was significantly higher in the schizophrenia group (P-value 0.00).

Group	Phosphorus (mg%)	t-value	P-value
Control (n=50)	4.09±1.00	-2.37	0.00
Schizophrenia (n=50)	4.55±0.94		

P-value as obtained on applying 't-test'

Table 6: Distribution of Phosphorus in Control and Schizophrenia Groups

ISSN: 0975-3583,0976-2833 VOL13, ISSUE8, 2022

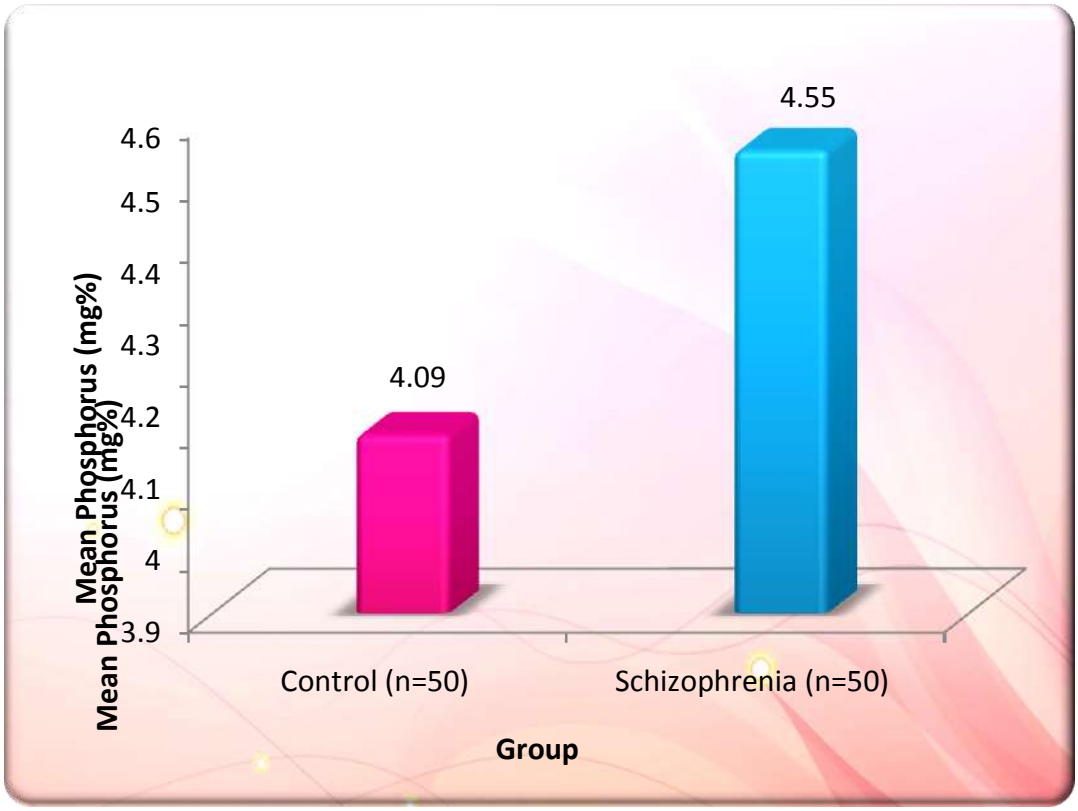


Figure 6: Distribution of Phosphorus in Control and Schizophrenia Groups

Table 7, Fig 7 showed the distribution of serum Mg levels between control group and schizophrenia group. On evaluation the mean Mg level in control group is 2.70±0.96mg/dl and that of schizophrenia group it is 2.22±0.57mg/dl. The mean Mg levels were statistically significant (P-value 0.003).

Group	Mg^{++} (mEq/L)	t-value	P-value
Control (n=50)	2.70±0.96	3.040	0.003
Schizophrenia (n=50)	2.22±0.57		

P-value as obtained on applying 't-test'

Table 7: Distribution of Magnesium in Control and Schizophrenia Groups

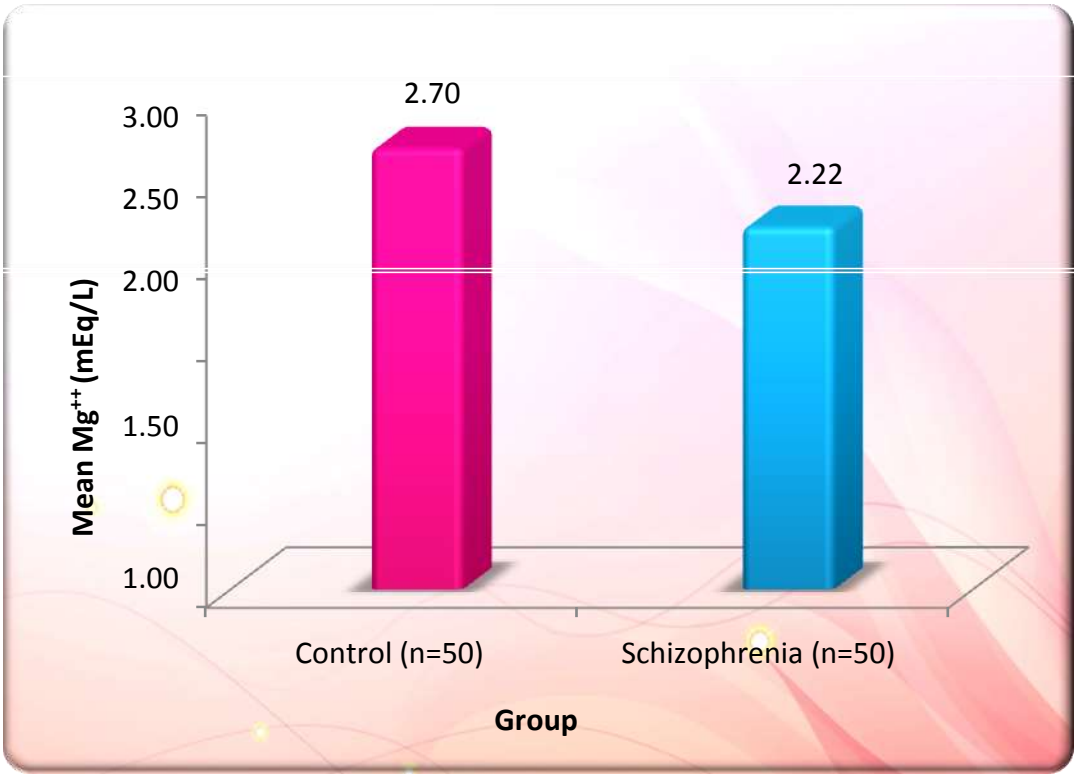


Figure7: Distribution of Magnesium in Control and Schizophrenia Groups

Table 8, Fig 8 demonstrates the sex distribution in control group v/s schizophrenia group. 52% of the patient were females and 48% males. The ratio was almost same.

Group	Male		Female	
Control (n=50)	31	62%	19	38%
Schizophrenia (n=50)	24	48%	26	52%

P-value as obtained on applying 't-test'

Table 8: Male and Female Ratio Distribution of cases in Control and Schizophrenia Group

ISSN: 0975-3583,0976-2833 VOL13, ISSUE8, 2022

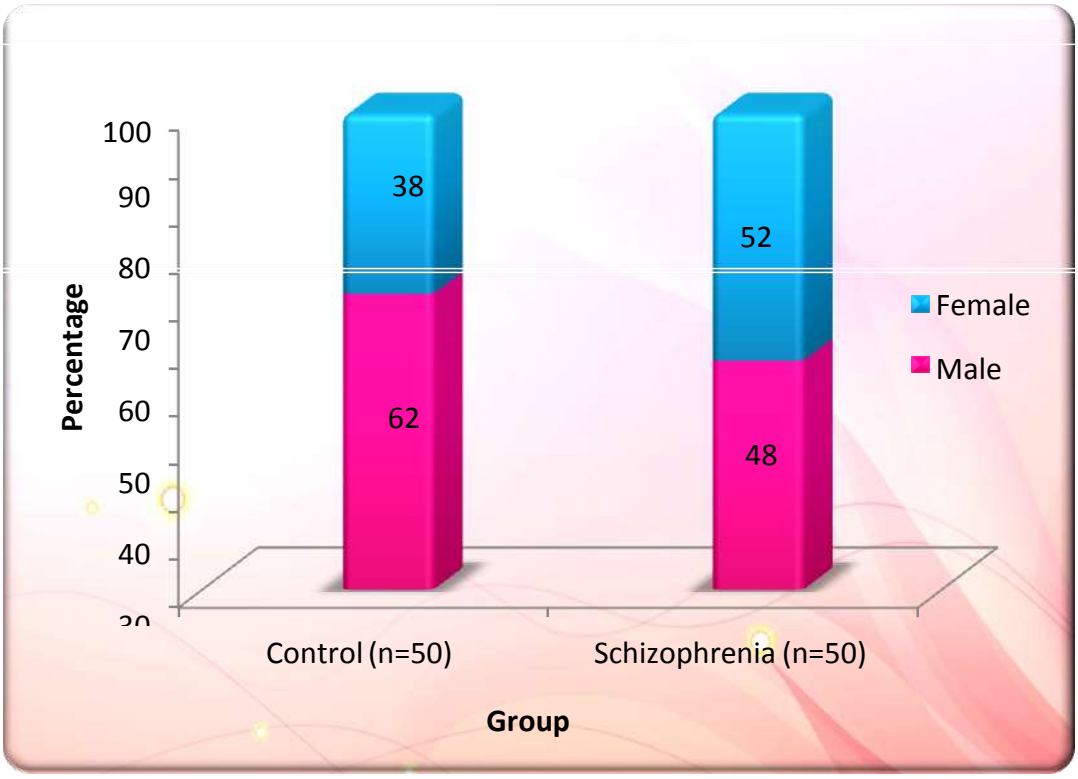


Figure 8: Male and Female Ratio Distribution of cases in Control and Schizophrenia Group

Table 9 shows the comparision of thyroid profile and mineral profile in patients with schizophrenia with normal healthy controls.

	Control (n=50)	Schizophernia (n=50)	t- value	p- value
TSH (µIU/Ml)	2.51±1.03	3.22±1.83	2.341	0.019S
T3 (ng/ml)	1.33±0.25	1.20±0.18	2.984	0.004S
T4 (µg/dl)	8.64±1.71	7.66±1.24	3.281	0.001S
Ca++(mg%)	9.39±0.88	8.47±1.13	4.542	<0.001S
Phosphorus (mg%)	4.09±1.00	4.55±0.94	2.37	<0.001S
Mg++ (mEq/L)	2.70±0.96	2.22±0.57	3.04	0.003

Table 9: Comparison of hormonal and mineral profile among the groups (control and Schizophrenia)

4. DISCUSSION

Neurological symptoms, abnormal brain structure and function, and minor physical flaws are all characteristics of schizophrenia.[19] Therefore, both working memory and long-term memory activities are affected negatively by the brain abnormalities.[20] The use of cannabis, dietary inadequacies, obstetric complications, immunological activation, infection, and maternal stress are some of the suggested causes of schizophrenia[3] The current study comprises of 50 schizophernia cases (26 female and 24 males) and age and gender matched healthy controls. Controls and cases were 38.16 ±11.20 and 34.70 ±12.9 years old. Serum TSH level were significantly increased (p= 0.019) while the level of serum T3 and T4 lower (p-value <0.004) and (p-value is 0.001). According to a study by Akiibinu MO et al. (2012), schizophrenics had significantly higher plasma levels of T3 and T4 compared to controls,

ISSN: 0975-3583,0976-2833 VOL13, ISSUE8, 2022

while their mean TSH levels were significantly lower.[21] Higher baseline TSH levels may be linked to a worse treatment response in schizophrenia, claim Yazici K et al. in 2002. [22], While T4 levels demonstrated a favourable association with the degree of clinical response to neuroleptic treatment and the severity of the illness, according to Baumgartner A et al., 2000.[23] In a second study by Sim K et al., 2002, it was discovered that schizophrenia patients had significantly greater levels of free T3 and free T4.[10] Yazici et al. found that schizophrenics had greater levels of total T3 and free T3 compared to controls in 2002.[22] Calcium level observed to be significantly lower in schizophrenia patients as compared to control group (p-value 0.000). Similar results were observed in the studies conducted by Das I et al., 1995; and Ripova D et al., 1997. They noticed that schizophrenia individuals had greater Ca/Mg ratios but lower serum Ca concentrations.[(24,25)]Serum Po_4 was significantly higher in the schizophrenia group as compare to controls. Higher levels of Po4 were discovered in schizophrenia patients in the study conducted by Chen X et al., 2018, which revealed similar results.[(26)] In a preliminary investigation conducted by Deicken RF, 1995, the cause of the elevated level of Po4 was demonstrated. It supports the aberrant high-energy Po4 metabolism in the basal ganglia of patients with schizophrenia.[27] The 2004 study of Nechifor M. et al. is analogous to the current study. According to the study, patients with schizophrenia had lower Mg concentrations in their erythrocytes.[28] Alexander PE et al. said in a prior study that the pathophysiology of schizophrenia has been connected to variations in Ca and Mg levels.[29] The current study's findings show that the levels of thyroid hormones and the mineral profile are abnormal in the psychiatric disease schizophrenia. Serum TSH levels were shown to be greater in schizophrenia patients. The study suggests more investigation into how thyroid malfunction affects psychiatric diseases. Although the mean TSH levels in mental patients were within normal ranges, it is important to take into consideration elevated TSH and declining T3 and T4 levels. The study advises that thyroid profile estimation be given to patients with psychiatric symptoms. Monitoring of blood Ca & Po4 levels is strongly advised for individuals with schizophrenia since deranged mineral metabolism can be linked to a number of secondary biochemical abnormalities. Since a calcium deficit may affect the entire metabolism of bone minerals, prompt care and supplements are advised. Furthermore, impaired renal function may be associated with elevated phosphorus levels. As a result, proper serum phosphorus management is also essential. Mg is a crucial element that functions as a cofactor for a number of crucial enzymes. A lower Mg content can affect how quickly other significant pathways move. In order to better understand how the above-mentioned mineral is metabolised in people with psychiatric disorders, more research is advised. The results of this study indicate that women are more likely than men to experience psychiatric problems. As a result, any behavioural issues in female patients with thyroid disorders and poor mineral profiles should be closely watched.

Limitations

The study was hampered by the small number of samples and short time period since a larger sample size was needed.

5. CONCLUSION

The goal of the study was to compare the thyroid and mineral profiles of schizophrenia patients to those of healthy controls.

The results of this study show that thyroid hormone levels are typically lower in psychiatric disorders. This implied that the thyroid gland was underactive.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE8, 2022

The study also found elevated serum Po4 levels and lower Ca and Mg levels. The aforementioned minerals can become out of balance in a number of ways.
The regulation of the resting metabolic rate is carried out by thyroid hormones.
Patients who have psychiatric symptoms should have their thyroid and mineral profiles tested.
It is highly advised to conduct more research on how the subject's mental behavior is affected by the aforementioned investigated parameters.

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