http://jmscr.igmpublication.org/home/
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v7i9.67

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Schizophrenia and depression are mental disorders with wide range of psychiatric manifestations

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Abstract
Objectives: *The present study was performed to the assess the levels of thyroid profile and mineral profile in patients of schizophrenia & depression.*
Material & Methods: *50 patients diagnosed for schizophrenia & 50 with depression visited the Out-patient Department (OPD) of Department of Psychiatric at Mahatma Gandhi Medical College & Hospital, Jaipur were enrolled for the study based on the predefined inclusion and exclusion criteria.*
Observations: *TSH levels (P=0.019) were significantly higher in the schizophrenia group whereas T_3 (P=0.004) &T_4 (P=0.001) values were significantly lower, serum Ca levels were lower (P= 0.000). serum Po_4 levels were significantly higher. (P=0.000) decrease serum Mg levels in schizophrenia group as compared to control group (P=0.003).*
TSH levels were high in patient's depression. (P=0.076) and less Serum T_3 (P=0.000) and T_4 (P=0.000) was observed in depression group. serum Ca and Mg levels were significantly lower in depression group (P=0.000) (P=0.020) respectively. the serum Po_4 levels were significantly higher. (P=0.004)
Conclusion: *we concluded that in psychiatric disorder, thyroid hormones levels tend to be lower. This suggested hypo activity of thyroid gland. The study also reported decreased level of Ca & Mg and increased serum Po_4 levels. Derangement of the above minerals can lead to several complications. Thyroid hormones are responsible for regulation of the basal metabolic rate. Patients with psychiatric manifestations should be recommended screening for thyroid & mineral profile*
Keywords: *Schizophrenia, depression, hormonal , profile and mineral profile.*

Introduction

Schizophrenia is a chronic and severe disorder that affects how a person thinks, feels, and acts. [1]Depression is a psychological problem characterized by low mood, cognitive impairments such as decreased attention and memory, decreased behavioural functioning and physiological symptoms such as changes to sleep pattern and appetite, fatigue and aches and pains.[2]

Hyperthyroxinemia has been reported in variety of acute psychiatric disorders e.g. schizophrenia, functional psychosis, major affective disorders, . personality disorders. [3]

The prevalence of schizophrenia in patient with thyroid dysfunction is more.[4-6] There are reports

available on the association of autoimmune thyroid disorders with non-affective psychosis. [7-9]

Thyroid hormones have been shown to regulate the levels of dopamine receptors and the activity of tyrosine hydroxylase.[10] In a human study of acutely ill schizophrenic patients, the interrelation between serum levels of dopamine, prolactin, TSH, and T_4 was observed and the serum levels of dopamine were found to be elevated in schizophrenic patients, while levels of the other parameters were decreased. [11]

Primary thyroid disorders including both hypothyroidism and hyperthyroidism may be accompanied by various neuropsychiatric manifestations ranging from mild depression and anxiety to overt psychosis. depression, and weight gain. Autoimmune thyroiditis is the commonest cause of hypothyroidism. [12]

Thyroid disorders, including both hypothyroidism and hyperthyroidism, may be accompanied by various neuropsychiatric manifestations, ranging from depression. [13]

Overt thyroid disease is rare in depression, found to be hypothyroid, while subclinical hypothyroidism occurs in 4% to 40% of these patients.[14-15] In the context of nutrition, a mineral is a chemical element required as an essential nutrient by organisms to perform various functions necessary for life. [16]

Excessive amount of Ca or deficiencies of Ca can be linked to various problems, including depression. Ca plays an important role in neuronal activity because neuronal activity influences cognitive and behavioural variables, the discoveries of the different neuronal effects of Ca are of great significance to the sciences of mind and behaviour. 17]

Phosphorus (Po_4) is the second most abundant essential mineral in the human body after Ca. It not only plays a role in numerous biologic processes, including energy metabolism and bone mineralization, but also provides the structural framework for (DNA) and (RNA. Dysregulation in PTH hormone and the resulting production of abnormalities in Ca and phosphorus may produce depression or delirium.[18]

Magnesium (Mg) deficiency is manifested itself by signs of neuromuscular dysfunction, hyper irritability and psychotic behaviour. Hypomagnesemia is associated with state of neurotype excitability while hypermagnesemia has sedative or depressant effect measured. [19-20]

Thyroid hormone are said to regulate the neuro transmitter receptors. Ca, Po_4 & Mg also play significant role in signal transduction, as cofactor & in the formation of ATP etc.

The present study was, therefore, planned to explore their role in thyroid profile and mineral profile in patients with schizophreniza with the following objectives that to estimate the serum T_3, T_4 and TSH levels in patient with schizophrenia and depression to analyse minerals (calcium, phosphorus and magnesium) in patient with schizophrenia and depression and to compare the thyroid function and mineral profile in patient with schizophrenia and depression with normal healthy control.

Materials and Methods

The study was conducted in Department of Biochemistry in association with the Department of Psychiatry, Mahatma Gandhi Medical College & Hospital, Jaipur. Patients diagnosed for psychiatric disorders (Schizophrenia & Depression) visiting the Out-Patient Department (OPD) of Department of Psychiatry fulfilling the inclusion and exclusion criteria were enrolled for the study. Age and sex matched healthy subjects (n=50) constituted the control group. The study was conducted after seeking approval from the Institutional **Ethics Committee (IEC)** .Written and informed consent was obtained from all participants before enrollment into the study Patients age up to 65 years, irrespective of their genders and Psychiatric disorders classified according to Diagnostic and Statistical Manual for Mental Disorder (DSM V) and International Classification of Diseases (ICD 10) criteria. Patients with history of cerebrovascular disease

and Patients with Renal dysfunction were exclude .50 patients suffering from schizophrenia &50 Depression patients were enrolled as the subject And 50 age and sex matched healthy individual constituted the control group. Blood samples for all subjects (patient and control group) were collected using standard aseptic technique and analysed for following investigations: Serum TSH,T_3. T_4. are estimated using ECi. And Calcium, Magnesium and Phosphorus are estimated using Vitros 4600

Statistical Analysis

Results obtained for various parameter were presented as mean ± SD among the three group i.e. schizophrenia patients (n=50); depression patients (n=50) and control group (n=50). The results of patients were compared with those of control group by applying student's t-test.A P value of ≤ 0.05 was considered as significant for all statistical test.

Results and Discussion

Psychiatric patients diagnosed for depression (n=50) and schizophrenia (n=50) visiting the Out-Patient Department of Psychiatry were enrolled for the study. 50 age and sex matched healthy individuals contributed the control group. No significant variation was observed among the mean age of control group and schizophrenia group. The mean age of control group was 38.16±11.20 years and schizophrenia group is 34.70±12.96 years. 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). The mean level of T_3 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).

Similar observation was recorded in case of Total T_4 levels also. The mean level of T_4 control group is 8.64 ±1.71µg/dl and schizophrenia group is7.66 ±1.24 µg/dl. The variation was statistically significant (p-value is 0.001).

A study done by **Akiibinu MO et. al., 2012** [21], showed that the plasma levels of T_3 and T_4 were increased significantly while the mean levels of TSH was significantly lower in schizophrenics when compared with the controls. [21]

According to **Yazici K et. al., 2002**[22] higher basal TSH levels may be associated with a poorer treatment response in schizophrenia [22], while according to **Baumgartner A et. al., 2000**[23]**,** T_4 levels showed a positive correlation with the severity of illness and the degree of clinical response to neuroleptic treatment. [23] In another study done by **Sim K et. al., 2002,** significantly higher levels of free T_3 and free T_4 in schizophrenia patients were found. [12] **Yazici et al 2002**[22]**,** observed higher levels of total T_3 and free T_3 in schizophrenics when compared with the controls.[22] **Baumgartner A, 2002**, showed abnormal T_4 levels in patients of acute schizophrenia. [23]

The above finding were contrary to those of the present study.

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).

Similar findings were seen in the study done by **Ripova D et. al., 1997 & Das I et. al., 1995.** They observed lower serum Ca concentration while higher Ca/Mg ratio in schizophrenic patients. [24-25]

The mean Po_4 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 Po_4 was significantly higher in the schizophrenia group (P-value 0.00).

Similar findings were shown in the study done by **Chen X et al.,2018,** where higher levels of Po_4 were found in schizophrenic patients. [26]

The reason for high level of Po_4 have been shown in preliminary study done by **Deicken RF, 1995.** It provides the support for abnormal high-energy Po_4 metabolism in the basal ganglia of schizophrenic patients. [27]

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).

The present study is Similar to the study done by **Nechifor M et. al., 2004.** The study showed lower Mg levels in the erythrocytes of schizophrenic patients. [28]

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

Depression

Depression is a state of low mood and aversion to activity that can affect a person's thoughts, behaviour, feelings, and sense of well-being. [29]

On evaluation the mean age of control group is 38.16±11.20 years and that of depression group it was 35.70±10.97 years, the results were found to be comparable.

The mean TSH levels in control group was 2.51±1.03µIU/ml and in depression group it was 3.10±2.09µIU/ml. P=0.076NS.

On evaluation the mean T_3 of control group is 1.33±0.25 ng/ml and that of depression group it is 1.12±0.14 ng/ml. Statistical analysis showed significantly lower levels (P=0.000).

Similar observations was recorded in case of Total T_4 levels also. The mean T_4 level of control group is 8.64±1.71µg/dl and that of depression group it is 7.46±01.10 µg/dl. The evaluation showed significantly lower results with the P-value 0.004

Thyroid hormone metabolism abnormalities have been shown in the study done by **Bauer et al., 2008** which shows that the patients with mood disorders were evidenced who were having disturbances or abnormalities in thyroid hormones. [30]

Chueire V B et. al., 2007 reported that depression was observed more frequently among individuals with subclinical (49.7%) hypothyroidism than among individuals with overt hypothyroidism (16.8%) (P=0.001) and subclinical hypothyroidism increased the risk for a patient to present depression more than four times (OR = 4.9).[31]

The mean serum Ca level of control group is 9.39±0.88 mg/dl and that of subject group is 8.53±0.90 mg/dl. The results were significant with the P-value 0.000.

Hypothyroidism, a known cause of depression, is associated with low Mg level with circulating T_4 level being directly correlated with serum Mg level. [34]

Levine J et. al., 1999, showed that the Ca and Mg are involved in many processes related to depression. Evaluations of serum and plasma Ca and Mg levels in depressive disorders do not show consistent results.[35]

There are few reports where there was no difference in the serum concentration of Mg ion or calcium /magnesium ratios (1:2) and that Mg was higher and low Ca in serum of depressive patients. [36]

On evaluation of the mean Po_4 of control group and depression group, the mean Po_4 of control group is 4.09±1.00 mg/dl and depression group is 4.71±1.10 mg/dl. The results were therefore significantly higher in depression patients (P=0.004).

The mean Mg levels of control group is 2.70±0.96 mg/dl and that of depression group it is 1.86±0.39 mg/dl, the results were significant with the P-value 0.020.

Cernak et. al., 2000 showed that chronic stress decrease both free and total plasma ionized Mg and simultaneously increases oxidative stress in humans.

The ratio of female's patients in the depression group was higher i.e. 64% as compared to males 36%.

Results of the present study demonstrate that in psychiatric disorders namely depression and schizophrenia, concentration of thyroid hormones and mineral profile are deranged.

Patients of depression and schizophrenia were observed to have a higher serum TSH level. The study recommends further research on the influence of thyroid dysfunction on psychiatric

disorders. Further, serum FT_3 & FT_4 levels should also be evaluated. Though the mean TSH levels in the psychiatric patients were within normal limits, increased TSH & decrease T_3 & T_4 levels cannot be neglected. The study therefore suggests inclusion of thyroid profile estimation in patients with psychiatric manifestations.

Deranged mineral metabolism can be associated with several secondary biochemical imbalances and hence monitoring of serum Ca & Po_4 levels are strongly recommended for patients identified with depression & schizophrenia. Since calcium deficiency may disturb the entire bone mineral metabolism, timely management & supplementation is advisable. Moreover, increased phosphorus levels can be linked to renal dysfunction. Therefore, appropriate management of serum phosphorus is also necessary. Mg is an important element which is required as a cofactor for functioning of several important enzymes. A decrease Mg level can influence the rate of other important pathways. Further research is there for recommended in patients of psychiatry disorder with respect to the metabolism of above studied mineral.

The findings of present study suggest that females are more prone to have psychiatric disorders. Therefore, female patients with thyroid disturbances & impaired mineral profile should be monitored for any behavioural disturbances. and also concluded that in psychiatric disorder, thyroid hormones levels tend to be lower. This suggested hypo activity of thyroid gland. The study also reported decreased level of Ca & Mg and increased serum Po_4 levels. Derangement of the above minerals can lead to several complications. Thyroid hormones are responsible for regulation of the basal metabolic rate. Patients with psychiatric manifestations should be recommended screening for thyroid & mineral profile. Further research on the influence of above studied parameters on the mental behaviour of subject is strongly recommended.

Table No 1 Gender wise distribution of the groups

Group	Male		Female		Age (mean ±SD)
Control (n=50)	31	62%	19	38%	38.16±11.20
Schizophrenia (n=50)	24	48%	26	52%	34.70±12.96
Depression (n=50)	18	36%	32	64%	35.70±10.97

Table No 2 Comparison of hormonal and mineral profile among the groups (control and Schizophrenia)

	Control (n=50)	Schizophrenia (n=50)	t-value	P-value
TSH (µIU/Ml)	2.51±1.03	3.22±1.83	2.341	0.019S
T_3 (ng/ml)	1.33±0.25	1.20±0.18	2.984	0.004S
TSH (µIU/Ml)	2.51±1.03	3.22±1.83	2.341	0.019S
TSH (µIU/Ml)	2.51±1.03	3.22±1.83	2.341	0.019S
T_4 (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 No 3 Comparison of hormonal and mineral profile among the groups (control and depression)

Group	Control (n=50)	Depression (n=50)	t-value	P-value
Age (years)	38.16±11.20	35.70±10.97	1.16	NS
TSH (µIU/ML)	2.51±1.03	3.10±2.09	-1.791	0.076
T_3 (ng/ml)	1.33±0.25	1.12±0.14	5.182	<0.001S
T_4 (µg/dl)	8.64±1.71	7.46±1.10	4.104	<0.001S
Ca^{++} (mg%)	9.39±0.88	8.53±0.90	4.831	<0.001S
Phosphorus (mg%)	4.09±1.00	4.71±1.10	-2.949	0.004
Mg^{++} (mEq/L)	2.70±0.96	1.86±0.39	5.732	0.02

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