ORIGINAL RESEARCH

Study of depression, anxiety and bone mineral density in thyroid disorders

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ABSTRACT

Introduction: Thyroid hormone plays crucial roles in adult brain function, and it is widely acknowledged that hypothyroidism is linked with neuropsychiatric symptoms encompassing emotional, cognitive, and mood changes. Subclinical hypothyroidism (SCH) is characterized by elevated thyroid-stimulating hormone (TSH) levels within normal free triiodothyronine (FT3) and free thyroxine (FT4) ranges. Patients with primary hypothyroidism have demonstrated an elevated risk of fractures, although there is conflicting data regarding changes in bone mineral density (BMD) within this group.This study aimed to explore the relationship between anxiety, depression, BMD, and SCH. **Materials and Methods:** Anxiety, depression and BMD (DEXA scan) were evaluated in 145 SCH cases over a one-year period. Participants were sourced from patients undergoing thyroid function testsat BirsaMunda Government Medical College and Hospital on OPD and IPD patients by Departments of Medicine, Orthopedics and Psychiatry collectively. Inclusion criteria encompassed individuals aged 20-50 years with TSH levels between 5.5-10 mU/L and normal FT3 and FT4 levels. Exclusion criteria comprised individuals already on thyroxine supplementation, those with pre-existing psychological conditions, substance abuse, chronic diseases, or neurological disorders. **Results:** The study revealed mild anxiety and moderate depression among SCH cases. BMD was decreased but not significantly. Statistical analysis showed a significant correlation between anxiety and SCH and between depression and SCH. **Conclusion:** Among SCH cases, mild anxiety and moderate depression were observed, with BMD generally remaining intact. The study underscores a noteworthy association between anxiety/depression and SCH, independent of age, sex, and body mass index.

Keywords: Depression, Anxiety, Thyroid, Bone mineral density, Osteoporosis.

INTRODUCTION

Thyroid hormone plays a critical role in increasing oxygen consumption across most bodily cells, modulating both lipid and carbohydrate metabolism, which in turn affects body weight and cognitive functions. It is pivotal for the maturation of the brain, particularly necessary for the proper development of the central nervous system (CNS). The cerebral cortex, basal ganglia, and the cochlea are among the regions most impacted. Insufficient thyroid hormone levels during developmental phases can lead to cognitive delays, motor dysfunction, and hearing and speech impairments. During fetal development or immediately after birth, a lack of thyroid hormone can result in the brain retaining infantile properties, underdevelopment of cortical neurons, delayed myelination, and diminished blood supply to the brain. Such deficits are irreversible unless addressed early in life. In the fetal and neonatal stages, inadequate thyroid function can lead to cognitive

impairments and stunted growth, whereas in adults, the symptoms are generally milder and often improve with hormonal therapy. Affected individuals may experience slowed speech, lack of initiative, reduced intellectual capacity, memory lapses, lethargy, and pronounced drowsiness. In older adults, such symptoms could be mistakenly attributed to senile dementia. Psychiatric manifestations, particularly of the paranoid variety, are frequent, alongside occasional episodes of agitation and frequent headaches [1-4].Subclinical hypothyroidism (SCH), identified by a low to normal free T4 level and a mildly elevated serum thyroid-stimulating hormone (TSH) level, often falls within the range of 5 to 15 mU/L. This condition is alternatively known as mild hypothyroidism, preclinical hypothyroidism, biochemically defined hypothyroidism, or reduced thyroid reserve, and more recently, minimal symptomatic hypothyroidism. Studies indicate that a TSH level exceeding 10 mU/L raises the likelihood of developing overt hypothyroidism, accompanied by hypercholesterolemia and atherosclerosis, suggesting a TSH threshold of 10 mU/L for SCH. Thyroid hormones are crucial for brain function in adults, with hypothyroidism linked to neuropsychiatric issues. The impact of hypothyroidism on cognitive and mood disorders, including its mimicry of depression and dementia in severe cases, is well-documented, though the effects of mild hypothyroidism or SCH on these conditions and their response to treatment are subjects of ongoing debate [5-8].Anxiety, a natural response characterized by apprehension or unease, is a recognized psychiatric disorder alongside mood disorders, which encompass sustained emotional states that affect one's overall psychological condition, with depression and mania as primary examples. SCH is a prevalent condition, affecting 3–7% of the general populace, with rates increasing with age—reaching up to 17% among the elderly, particularly women [9-11]. Thyrotoxicosis has been identified as a cause of osteoporosis, with misuse of thyroxine for reducing thyroid nodules leading to iatrogenic thyrotoxicosis. Additionally, patients with primary hypothyroidism have demonstrated an elevated fracture risk, despite inconsistent findings regarding bone mineral density (BMD) changes in this demographic [12]. This investigation assessed anxiety, depression, and BMD in young to middle-aged adults (20–50 years) diagnosed with SCH.

MATERIALS AND METHODS

This study was conducted as a cross-sectional observational study atBirsaMunda Government Medical College and Hospital on OPD and IPD patients by Departments of Medicine, Orthopedics and Psychiatry collectively. The inclusion criteria encompassed individuals aged 20-50 years with TSH levels between 5.5-10 mU/L and normal FT4 and FT3 levels. Patients excluded from the study included those already on thyroxine supplementation, individuals with pre-existing psychological illnesses such as schizophrenia, bipolar disorder, and depression, those with chronic diseases like ischemic heart disease, diabetes mellitus, cerebrovascular diseases, and rheumatoid arthritis, as well as those with neurological diseases such as seizures, known substance abuse, prior thyroid gland surgery, and cases of SCH during pregnancy.145 cases were collected from the laboratory database. Data collection involved using a preformed and predesigned pro forma for the study through questionnaire methods. Specific scales were employed for assessing neuropsychiatric changes: the Hamilton Anxiety Rating Scale (HAM-A) for anxiety evaluation, the Hamilton Rating Scale for Depression (HAM-D) for depression assessment. The HAM-A scale is a clinician-rated scale with 14 items measuring both psychic anxieties and physical complaints related to anxiety, scored on a scale of 0 (not present) to 4 (severe), with a total score range of 0–56 indicating severity levels. The HAM-D scale consists of 17 items, assessing depressive symptoms severity and change in adults, with scores of 0–7 considered normal and a score of 20 or higher indicating moderate severity.

BMD was measured using DEXA Scan.

RESULTS

The study involved 145 subjects, of which 17 were male (11.72%) and 128 were female (88.28%). The age range of the study population was between 20 and 50 years, with a mean age of 42.67 and a standard deviation of 7.61. To facilitate analysis, the sample was categorized into three age groups: Group I (20–29 years) with 12 cases (8.28%), Group II (30–39 years) with 46 cases (31.72%), and Group III (40–50 years) with 87 cases (60%). The mean TSH value was 8.05 with a standard deviation of 1.3. The mean FT4 value was 1.64 with a standard deviation of 0.67, and the mean FT3 value was 2.18 with a standard deviation of 0.76.The anxiety levels were evaluated using the Hamilton Anxiety Rating Scale (HAM-A) with a minimum score of 7, a maximum score of 27, a mean score of 17.16, and a standard deviation of 4.67 (Table 1). The cases of subclinical hypothyroidism (SCH) were categorized into three groups based on anxiety severity: mild anxiety (93 cases, 64.14%), moderate anxiety (39 cases, 26.90%), and severe anxiety (13 cases, 8.97%). The HAM-A score showed a significant correlation with the level of thyroid-stimulating hormone (TSH) but not with the levels of free thyroxine (T4) and free triiodothyronine (T3). Additionally, there was no significant correlation between HAM-A scores and age or body mass index (BMI). However, the HAM-A scores were influenced by the TSH level, and a significant correlation was observed between TSH level and HAM-A score based on Pearson's correlation test.Regarding depression evaluation using the Hamilton Depression Rating Scale (HAM-D), the mean score was 9.45 with

a standard deviation of 3.31. Cases were divided into mild depression (52 cases, 35.86%) and moderate depression (93 cases, 64.14%). The HAM-D score was significantly correlated with TSH levels but not with age or FT3 levels. There was no statistically significant correlation between HAM-D scores and age or BMI. Similar to anxiety, depression levels were significantly affected by TSH levels.Overall, the prevalence of mild anxiety in the study population was 1.38% and was statistically significant, while the prevalence of moderate anxiety was 0.59% and not statistically significant. The prevalence of severe anxiety was 2.25% and statistically significant, and the prevalence of depression was 1.39% and statistically significant. The combined prevalence of anxiety and depression in the study population was 2.18%, as presented in Table 2.Table 3 shows Decrease BMD values in study patients compared to normative data. However, difference was not statistically significant.

Table 1: Correlation of HAM-A and HAM-D with various parameters

Parameter	HAM-A	HAM-D
TSH	0.001	0.026
T4	0.612	0.759
T3	0.87	0.922
Age	0.575	0.474
BMI	0.345	0.643

Table 2: Prevalence of anxiety, depression in study population

Parameters	P (prevalence)	Value	SE	P
Mild anxiety	0.0145	0.0017	8.73	<0.05
Moderate anxiety	0.0061	0.0003	1.812	0.064
Severe anxiety	0.0022	0.0002	10.5	<0.05
No depression (normal)	0.008	0.0012	6.53	2.1
Depression	0.0142	0.0016	8.78	<0.05

Table 3: Decrease BMD values in study patients

Patient group	Spine	Femoral neck	Ward triangle
Premenopausal (n=60)	-0.56 ± 0.25	-0.11 ± 0.22	-0.20 ± 0.28
Postmenopausal (n=68)	-1.02 ± 0.38	-0.41 ± 0.21	-1.02 ± 0.16
Males (n=17)	0.18 ± 0.55	0.17 ± 0.35	-0.30 ± 0.32

DISCUSSION

A study by Senthilkumaran et al. from the Department of Biochemistry, Chennai Medical College Hospital and Research Centre, Tamil Nadu, investigated the prevalence and distribution of subclinical hypothyroidism (SCH) in rural women, revealing an increase in SCH cases with advancing age, ranging from 15 to 67 years [13]. Jailkhani et al.'s study further supported this trend, reporting 17.8% prevalence among men (44 cases) and 81.2% among women (203 cases) [14]. Our study also predominantly included female participants, indicating a higher occurrence of SCH in females. This aligns with Franklyn's findings, who studied 1210 individuals aged over 60 years, recruited from primary care settings, and observed SCH rates of 11.6% in women and 2.9% in men [15]. Similarly, Deshmukh et al. from Mumbai reported an SCH prevalence of 11.3%, with a male-to-female ratio of 1:3.7, noting an increase in SCH with age [16].Anxiety levels were assessed using the Hamilton Anxiety Rating Scale (HAM-A), revealing a significant correlation with TSH levels. This correlation was consistent with findings from SaitGönen et al.'s study, conducted in collaboration with the Department of Psychiatry, which divided patients into subclinical hyperthyroidism, SCH, and euthyroid groups. Both subclinical hyper- and hypothyroidism groups exhibited higher anxiety scores than the euthyroid group, as determined by Beck's Anxiety Inventory [17]. Depression was evaluated using the Hamilton Depression Rating Scale (HAM-D/HDRS), showing a significant correlation with TSH levels, which was also supported by data from Almeida et al., indicating increased psychiatric disorder prevalence in SCH patients compared to the thyroid group [17].The study population exhibited a prevalence of mild anxiety at 1.38%, moderate anxiety at 0.59% (not statistically significant), and severe anxiety at 2.25% (statistically significant), with depression prevalence at 1.39% (statistically significant). The combined prevalence of anxiety and depression was 2.18% in the study population, consistent with findings by Mani K et al. [18]. BMD changes were not significant in the study subjects.

CONCLUSION

The study revealed that among individuals with SCH, anxiety levels were mild, while depression levels were moderate. Additionally, BMD was lower among the cases. The study identified a significant

correlation between anxiety and SCH, as well as between depression and SCH. Notably, anxiety, depression and decreased BMD did not exhibit significant correlations with age, sex, or body mass index (BMI) among SCH cases.

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