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Correlation of Thyroid Disorders with Body Mass Index in Patients Presenting to BINOR Hospital, Bannu, Khyber Pakhtunkhwa, Pakistan

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Abstract

Objective: To investigate the correlation between thyroid disorders and body mass index and to see whether the association is significant in the Pakistani population or otherwise.
Methodology: The cross-sectional was conducted in PAEC- BINOR Hospital, Bannu. Patients' ages varied from 18 to 70 years. T3 FT4 and TSH were performed from the patients by the RIA technique, and BMI was calculated as per WHO standard criteria. Underweight (18.5), normal weight BMI (18.5–24.9), overweight BMI (25.0–29.9), and obese BMI (30.0 or higher) are the BMI cutoff values. Patients were classified into three categories; Hypothyroid, Hyperthyroid and Euthyroid on the basis of Thyroid function tests.
Results: Out of 200 subjects included in the study, 149 were females and 51 were males. Out of 200 participants, 77 (38.5%) individuals were categorized on the basis of thyroid function test reports into the hyperthyroid group, 53 (26.5%) were categorized as the hypothyroid group and 70 (35%) were categorised as Euthyroid group. Chi-square test with each BMI category showed a significant association with thyroid disorders, p<0.005. The three categories of thyroid disorders were also separately correlated through Pearson's correlation in which the hypothyroid group showed a significant positive correlation (p=<0.001, the Hyperthyroid group showed a significant negative correlation with p=<0.001, and the euthyroid group showed an insignificant weak correlation with BMI. Thyroid hormones T3, FT4, and TSH were also correlated with BMI by applying the student T-test.
Conclusion: This study showed a significant correlation between thyroid disorders and body mass index, which indicates that obesity might be a risk factor for thyroid disorders. The hypothyroid group has a significant positive association with BMI, and the hyperthyroid group has a negative correlation with BMI. In fact, there is no significant association between the euthyroid group and BMI. Thyroid hormones also show a significant correlation with BMI. TSH is positively correlated with BMI, while T3 and FT4 are negatively correlated with BMI.
Key words: BMI, Thyroid disorder, Thyroid hormones.

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Introduction

Thyroid disorder, such as hypothyroidism and hyperthyroidism, has been linked to weight gain according to previous research. The association between thyroid hormones and body mass index is still not explored in Pakistan. This data after analysis will suggest whether obesity is a risk factor for thyroid dysfunction in our local population or otherwise.

A study done in Pakistan in 2006 based on the Asian-specific BMI criteria showed that the prevalence of overweight and obese individuals in the population is 25% and the prevalence of obesity alone is 10.3%.[1] Fat accumulation in adipose tissue induces the production of cytokines that in turn activate the hypothalamic-pituitary-thyroid (HPT) axis causing dysregulation of thyroid function.

Thyroid hormones are responsible for energy metabolism. Therefore, abnormalities in the level of thyroid hormones are associated with changes in body weight and composition. Minor changes in levels of thyroid hormone levels, even if within reference ranges, are proven to increase the tendency to gain

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weight.[2] Overt thyroid disease is manifested as changes in body metabolism and body weight, along with altered protein and fat lysis.[3,4] Typically, weight loss is seen clinically in hyperthyroidism and weight gain in cases of hypothyroidism.[5]

Materials and Methods

A cross-sectional comparative Study was conducted in the duration of 6 months from May 2020 to November 2020 at PAEC-BINOR cancer Hospital, Bannu. The sample size was 200 individuals that were attending OPD in the hospital. The sample size was calculated through the WHO sample size calculator, with a power of the test of 80% and a level of significance of 5%. Thyroid function tests were performed i.e., T3, T4, and TSH in the RIA laboratory of BINOR Hospital, District Bannu, Khyber Pakhtunkhwa, for each patient, and their BMI was measured according to WHO standard criteria. Cutoff values taken for BMI measurement were underweight (<18.5), normal (18.5-24.9), overweight (25.0-29.9), and obese (>30). Thyroid disorders were divided into three groups on the basis of TFT namely hypothyroid group, hyperthyroid group, and euthyroid group. Euthyroid included the patients that have a previous history of thyroid dysfunction and also those who were taking medication for thyroid disease but whose current TFT reports were in the normal range. Hypothyroid and hyperthyroid groups include individuals with newly diagnosed diseases as well as follow-up patients.

Patients of ages (18 – 70 years) with signs/ symptoms of thyroid disorders were included in the study, also Patients under treatment for thyroid disorders as well as newly diagnosed individuals were included in study.

Patients taking medications for co-morbidities related to obesity and lipid lowering drugs, Patients having heart disease, subclinical and thyroidectomy patients Pregnant or lactating females and those who were not willing, were excluded from the study.

Statistical analysis was performed by using SPSS version 26 and MS officer 2007. Descriptive statistics were analyzed as mean and standard deviation. Pearson correlation and chi-square test was applied in the study. $P \leq 0.05$ was taken as level of significance.

Results

Total 200 patients were enrolled in the study. Out of 200 patients, 149(74.5%) were female and 51(25.5%) were male. Frequency of thyroid disorders with each BMI categories showed that majority of hyperthyroid patients were in underweight category, and majority of hypothyroid individuals were in overweight and obese categories, however, majority of Euthyroid were in the normal BMI range. This interpretation is plotted in a bar graph shown in figure 1.

The Chi-square test showed the overall association between categorical variables of thyroid disorders and BMI which is illustrated in Table I. This correlation was further verified by applying Pearson's correlation to each thyroid disorders group separately, as shown in Table II. Furthermore, an association of thyroid hormones with BMI was also tested by applying the student's t-test as shown in table III. Mean and standard deviations were calculated for numerical data of thyroid hormones, for which graphs were plotted to show the variation among means of Thyroid hormones (i.e; T_3, FT_4, and TSH) with different BMI categories. The trend of increasing and decreasing BMI with hormonal variations are shown in figure 2, 3, and 4.

The mean T3 and FT4 showed a similar trend of variation with BMI categories. Figures 2 and 3 show that mean T3 and FT4 were highest in the underweight category and decreased as the BMI increased. However, the mean TSH shown in figure 4 have the opposite trend, Mean TSH increases with increase in BMI.

Table I: Chi-square test applied on thyroid disorders and BMI

	Value	Df	P-Value
Pearson Chi-Square	57.835[a]	6	0.005
Likelihood Ratio	58.304	6	0.000

Table II: Pearson's Correlation between Euthyroid, Hypothyroid, Hyperthyroid and BMI

	Value	Df	P-Value
Pearson Chi-Square	57.835[a]	6	0.005
Likelihood Ratio	58.304	6	0.000

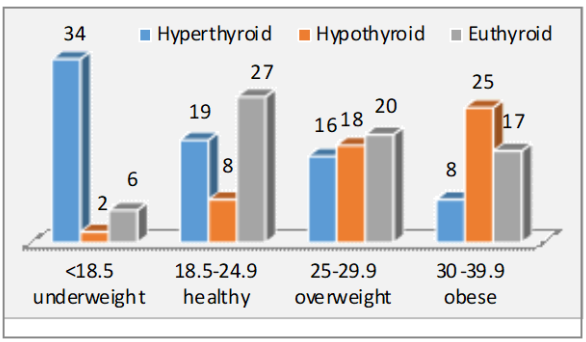

Figure 1. Frequency of thyroid disorders with each BMI category.

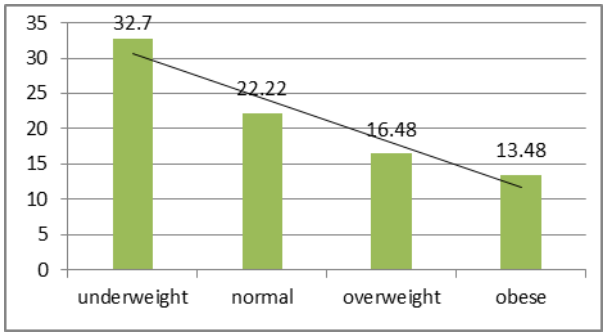

Figure 2. Variation of Mean FT4 (pM) with BMI.

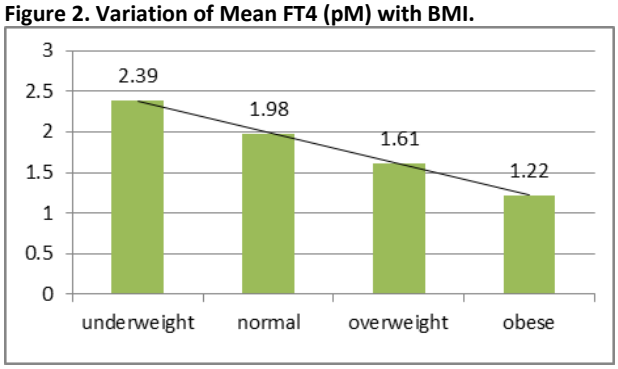

Figure 3. Variation of mean T3 (ng/ml) with BMI.

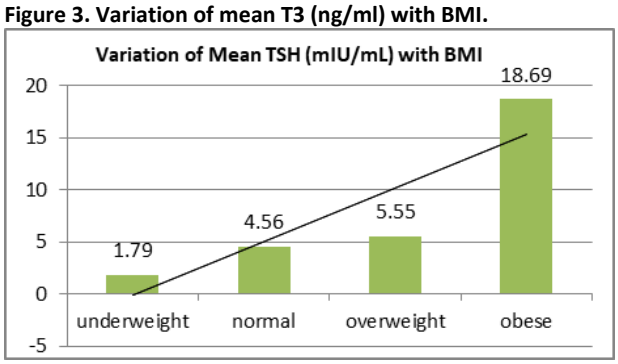

Figure 4. Variation of Mean TSH (mIU/mL) with BMI.

Discussion

Since obesity is considered to be a risk factor for multiple health issues, overweight and obese individuals are suggested to have higher incidence and morbidity regarding thyroid disorders. This study was conducted to ascertain if any correlation exists between thyroid disorders and body mass index.[6] Total participants included in this study were 200, out of which 149 (74.5%) were female and 51 were male. Thyroid disorders were seen predominantly in females similar to the studies by Meng et al7 and Archana et al.[8] Our study showed a significant overall correlation between thyroid disorders and BMI according to Chi-square tests with p=0.005. Our study showed that Pearson's correlation between BMI and the euthyroid group was insignificant and association was negligible. This is in similarity with the studies by Manji et al, and Figueroa et al, that showed no relation between BMI and thyroid function in euthyroid subjects.[9,10]

We found that, out of total hypothyroid subjects (n=53), 43 are overweight or obese. Thus, the majority of hypothyroid individuals had increased BMI. This is similar to another study conducted by Makwane et al where a higher frequency of hypothyroid subjects was found in obese group as compared to other groups.[11] Previous studies suggest that hypothyroidism is more frequently observed in obese individuals. Obesity is considered as a risk factor for hypothyroidism in particular.[12-15] However, other studies reported no definite association between an increased risk of hypothyroidism and obesity.[16,17] Our study gives a positive and significant correlation between BMI and the hypothyroid group. Different prevalence rates of hypothyroidism in obese individuals in these studies may be due to the differences in race, variation in body fat type, and conditions under which the studies were conducted.[11]

On the other hand, many previous studies consider thyroidal illness to be a reason for altered metabolic rate leading to gain or loss of body weight. Longitudinal studies done by Fox et al., show that weight gain is caused by increased TSH[18] and Wolters et al. in their study showed that weight loss is a result of reduced TSH.[19] In our study Pearson's correlation showed a negative correlation between BMI and hyperthyroid group. We also compared levels of T_3, FT4 and TSH separately with BMI. Among these, T_3 and FT_4 showed negative association with BMI. It is in contrast to the study by Makwane *et al.,* where they failed to find significant association between thyroid hormones and BMI in their study subjects.[11] Pergola *et al,* and Reinehr *et al* showed that raise in TSH and FT_3 can be seen in individuals with high BMI. They suggested no relation between FT_4 and obesity.[20,21] Alevizaki *et al,* and Roef *et al,* in their research studied relation of FT_3 and BMI and gave the results that in healthy euthyroid adults FT_3 has positive association with BMI.[22,23] This is contradictory to our study, which shows a significant negative correlation between T_3 and BMI.

Our study showed the significant positive correlation of TSH with BMI and negative correlation of BMI with both FT_4 and T_3. Knudsen N et al., have suggested a positive correlation between BMI with TSH, and a negative association between BMI and FT_4. According to their results, no correlation of BMI was seen with serum free T_3.[24] Similar results were given by Nyrnes et al, in the fifth Tromso study. They concluded that

Table III: Paired T-test for BMI Vs T_3, T_4 and TSH

Paired sample T-test		Correlation	Sig.
Pair 1	Body mass index & Free T_4	- 0.380	0.007
Pair 2	Body mass index & T_3	- 0.390	0.001
Pair 3	Body mass index & TSH	0.357	0.003

there is positive correlation between TSH within the normal range and BMI.[25] Michalaki et al. reported that obese individuals had higher levels of T_3, T_4, and TSH than control group individuals.[26] Makwane et al showed significantly higher TSH level in overweight and obese subjects than normal subjects and reported no difference in the total T_3 or total T_4 levels with BMI in his control and study groups.[11]

Similarly, Muscogiuri G et al., have concluded that higher TSH values are documented in overweight and obese subjects.[27] Another study of 87 morbidly obese female subjects found that they had higher TSH levels than those with moderate obesity. Thus, TSH had positive correlation with BMI. Individuals having higher BMI also had lower FT_4 values, while no relationship could be established between BMI and FT3.[28] Other studies by Buscemi et al., and Manji et al, differ from the these results and that show no significant relationship between BMI and TSH as well as BMI and FT4.[9,29] Bastemir et al, in their research showed positive correlation between the serum TSH levels in participants with high BMI and normal thyroid function. They also gave the conclusion that BMI and the class of obesity were positively correlated. [30]

Conclusion

The conclusion of this study is that there is a significant correlation between thyroid disorders and body mass index which indicates that obesity might be a risk factor for thyroid disorders. Hypothyroid group have a significant positive association with BMI and hyperthyroid have negative correlation with BMI. In fact there is no significant association between euthyroid group and BMI. Thyroid hormones also show significance correlation with BMI. TSH is positively correlated with BMI while T3 and FT4 are negatively correlated with BMI.

Limitations: Limitation of this study is that this study is conducted only in District Bannu Khyber Pakhtunkhuwa and the study sample is small. This study did not included thyroid disorders of subclinical cases i.e subclinical Hypothyroidism and Subclinical Hyperthyroidism and their association with BMI.

Recommendations: It is recommended that another study with large study sample should be conducted in different areas of Pakistan as well as in South Asia so that the variation among the BMI of populations in different areas and their correlation with thyroid disorder can be noted.

Specific Criteria for BMI of Pakistani population should be established for comparison.

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