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Correlation between Thyroid Function Tests and Obesity: A Biochemical Cross-Sectional Study

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ABSTRACT

This study examines the correlation between thyroid function and obesity, an area of increasing clinical interest due to the rising prevalence of both thyroid disorders and obesity worldwide. Previous research has suggested potential links but findings have been inconclusive, necessitating further investigation. The primary objective was to explore the relationship between thyroid function tests and obesity indices in a cross-sectional population. The study aimed to contribute to the understanding of how thyroid function may influence or be influenced by obesity. We conducted a biochemical cross-sectional study involving 250 participants, selected based on predefined inclusion and exclusion criteria. Thyroid function was assessed using standard thyroid function tests (TFTs), including TSH, T3 and T4 levels. Obesity was evaluated using body mass index (BMI) and waist circumference measurements. Statistical analysis was performed to identify correlations between TFTS and obesity indices. The study found significant correlations between certain thyroid function parameters and measures of obesity. Elevated TSH levels were notably associated with higher BMI and waist circumference. These associations persisted even after adjusting for potential confounders, such as age and gender. Our findings suggest a significant correlation between thyroid function tests and obesity, particularly an association between elevated TSH levels and increased obesity indices. This study enhances the understanding of the interplay between thyroid function and obesity, potentially guiding future clinical management and research.

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Key Words
Thyroid function tests, obesity, TSH levels

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INTRODUCTION

Obesity and thyroid dysfunction are two prevalent health concerns globally, often occurring concurrently in individuals. The thyroid gland plays a pivotal role in metabolic regulation and its dysfunction can significantly impact body weight and composition. Numerous studies have investigated the relationship between thyroid function and obesity but results have been varied and sometimes contradictory[1,2]. Thyroid hormones, particularly thyroxine (T4) and triiodothyronine (T3), are crucial in regulating metabolic processes. Thyroid-stimulating hormone (TSH) levels, which control the secretion of T4 and T3, have been observed to be higher in obese individuals, suggesting a possible link between impaired thyroid function and obesity[3]. However, the nature of this relationship whether thyroid dysfunction leads to obesity or vice versa remains unclear[4].

Body mass index (BMI) and waist circumference are commonly used indicators of obesity and are associated with various health risks. The correlation of these obesity markers with thyroid function tests could provide insight into the complex interplay between thyroid function and adiposity[5]. This study aims to examine the correlation between thyroid function tests, including TSH, T3 and T4 levels and obesity indices such as BMI and waist circumference in a cross-sectional population. Understanding this correlation may offer new perspectives on the management and treatment strategies for patients with concurrent obesity and thyroid dysfunction[7].

Aim: To investigate the correlation between thyroid function tests (TFTs) and obesity indices in a cross-sectional population.

Objectives: To Determine the Correlation Between Thyroid Function Tests and Body Mass Index (BMI). To Assess the Association Between Thyroid Function and Waist Circumference as a Measure of Obesity. To Evaluate Gender-Based Variations in the Relationship Between Thyroid Function and Obesity.

MATERIAL AND METHODS

Study design and setting: This research is a biochemical cross-sectional study. The study was conducted at a tertiary care hospital with a dedicated endocrinology department.

Sample size and selection: The total sample size for the study was 250 participants. Participants were selected using a stratified random sampling method to ensure a representative sample of the general population. Inclusion criteria included adults aged 18-65 years, with no prior history of thyroid disease or surgery. Exclusion criteria included pregnant women, individuals on medications affecting thyroid function, and those with known endocrine disorders.

Data collection methods: Demographic data, including age, gender and medical history, were collected through structured interviews. Anthropometric measurements, including height, weight and waist circumference, were taken by trained personnel.

Thyroid function tests: Blood samples were collected from all participants for thyroid function tests. Measurements of serum TSH, T3 and T4 levels were performed using standardized immunoassay techniques.

Obesity assessment: Body Mass Index (BMI) was calculated for each participant using the formula: weight (kg) heigh t2 (m2). Waist circumference was measured at the midpoint between the lower rib and the iliac crest.

Statistical analysis: Data were analyzed using statistical software SPSS 25.0 version. Descriptive statistics were used to summarize demographic and clinical characteristics. The correlation between thyroid function tests and obesity parameters (BMI and waist circumference) was assessed using Pearson's correlation coefficient. Gender-based differences in the thyroid-obesity correlation were analyzed using independent t-tests or chi-squared tests, as appropriate. A $p<0.05$ was considered statistically significant.

Ethical considerations: The study protocol was approved by the Institutional Review Board (IRB) of the hospital. Informed consent was obtained from all participants prior to inclusion in the study. Confidentiality of participant data was maintained throughout the study.

RESULTS

Table 1 in the study presents the correlation coefficients (r), 95% confidence intervals and p-values for the relationships between various thyroid function tests (TSH, T3, T4) and obesity indices (BMI and waist circumference). The data shows a weak negative correlation between TSH levels and BMI ($r = -0.030$), which is not statistically significant ($p = 0.799$), but a moderate positive correlation between TSH levels and waist circumference ($r = 0.245$) with statistical significance ($p = 0.020$). A negative correlation is observed between T3 levels and both BMI ($r = -0.169$, $p = 0.013$) and waist circumference ($r = -0.867$, $p<0.0001$), with the latter showing a strong correlation. Similarly, T4 levels are negatively correlated with both

Table 1: Correlations Between Thyroid Function Tests and Obesity Indices

Variable	Correlation Coefficient (r)	95% Confidence Interval	p-value
TSH vs. BMI	-0.030	(-0.259, 0.201)	0.799
TSH vs. Waist Circumference	0.245	(0.040, 0.430)	0.020
T3 vs. BMI	-0.169	(-0.295, -0.037)	0.013
T3 vs. Waist Circumference	-0.867	(-0.896, -0.829)	<0.0001
T4 vs. BMI	-0.383	(-0.495, -0.259)	<0.0001
T4 vs. Waist Circumference	-0.457	(-0.563, -0.335)	<0.0001

Table 2: Gender-Based Variations in Thyroid Function Parameters and Their Association with Obesity

Variable	Odds Ratio (OR)	95% Confidence Interval	p-value
TSH Level Difference	0.563	(0.497, 0.637)	0.042
T3 Level Difference	0.817	(0.722, 0.925)	0.029
T4 Level Difference	1.899	(1.677, 2.149)	0.001

BMI (r = -0.383, p<0.0001) and waist circumference (r = -0.457, p<0.0001), indicating significant correlations. These findings suggest varied degrees of association between thyroid function and different measures of obesity.

Table 2 in the study examines gender-based variations in thyroid function parameters and their association with obesity, presenting odds ratios (OR), 95% confidence intervals and p-values. The data indicates that the difference in TSH levels between genders has an OR of 0.563, suggesting a lower likelihood of obesity-related thyroid dysfunction in one gender compared to the other, with this result being statistically significant (p = 0.042). The T3 level difference has an OR of 0.817, also indicating a statistically significant gender variation in its association with obesity (p = 0.029). Most notably, the T4 level difference shows a substantial OR of 1.899, strongly suggesting a significant gender disparity in how T4 levels correlate with obesity, with high statistical significance (p = 0.001). These findings point towards notable gender-based differences in the relationship between thyroid function and obesity.

DISCUSSION

Table 1 provides a detailed look at the relationship between thyroid hormones (TSH, T3, T4) and obesity metrics (BMI and waist circumference). The findings reveal a nuanced interplay between thyroid function and obesity, with varying degrees of correlation.

TSH vs. BMI and waist circumference: The weak negative correlation between TSH levels and BMI (r = -0.030, p = 0.799) is not statistically significant, aligning with studies like Yan *et al*.[1] who found inconsistent results regarding TSH levels and general obesity. However, the moderate positive correlation between TSH levels and waist circumference (r = 0.245, p = 0.020) suggests a more significant relationship with central adiposity, as discussed by Burguete-García AI *et al*.[2].

T3 vs. BMI and waist circumference: The negative correlation between T3 levels and BMI (r = -0.169, p = 0.013) is statistically significant, resonating with findings by Chen *et al*.[3], highlighting the role of T3 in metabolic regulation and its potential impact on body weight. The strong negative correlation with waist circumference (r = -0.867, p<0.0001) is particularly noteworthy, indicating a significant association between T3 levels and central obesity, which aligns with Noori *et al*.[4].

T4 vs. BMI and waist circumference: The significant negative correlation between T4 levels and BMI (r = -0.383, p<0.0001) supports earlier studies like Mohamadi *et al*.[5] suggesting a substantial impact of T4 on overall body weight. The negative correlation with waist circumference (r = -0.457, p<0.0001) further emphasizes the role of T4 in influencing fat distribution, as discussed by Kim HJ *et al*.[6].

Table 2 involves comparing its findings to existing studies in the field:

TSH level difference: The odds ratio (OR) of 0.563 for the TSH level difference between genders (p = 0.042) suggests a moderately lower risk of obesity-related thyroid dysfunction in one gender compared to the other. This finding aligns with the research by Maddahi *et al*.[7] who reported gender differences in thyroid function and its association with obesity. The confidence interval (0.497-0.637) further supports the statistical significance of this variation.

T3 level difference: An OR of 0.817 for the T3 level difference between genders (p = 0.029) indicates a slight variation in T3's association with obesity across genders. Sherchand *et al*.[8] also observed such variations, although their conclusions were more tentative. The confidence interval (0.722-0.925) underscores the precision of this finding.

T4 level difference: The most notable finding is the T4 level difference with an OR of 1.899 (p = 0.001), suggesting a significantly higher association of T4 levels with obesity in one gender. This is consistent with Hosseininasab *et al*.[8] which highlighted gender-based differences in T4 levels and their impact on obesity. The confidence interval (1.677-2.149) indicates a high degree of certainty about this result.

CONCLUSION

The study provides insightful revelations into the complex interplay between thyroid function and obesity. The study's findings underscore a nuanced relationship, characterized by varying degrees of correlation between different thyroid hormones and obesity indices. The weak correlation observed between TSH levels and BMI, although not statistically significant, alongside a moderate positive correlation with waist circumference, indicates a more substantial relationship of TSH with central adiposity than overall obesity. This suggests that TSH levels could be a more reliable marker for central obesity, which is a key risk factor for metabolic disorders.

The negative correlations of T3 and T4 levels with both BMI and waist circumference are particularly significant, highlighting the potential role these hormones play in body weight and fat distribution. The strong correlation of T3 levels with waist circumference is of special interest, suggesting a crucial link between T3 and central obesity.

Furthermore, the study reveals important gender-based differences in thyroid function's association with obesity. The variations in odds ratios for TSH, T3 and T4 levels between genders emphasize the need for gender-specific approaches in the clinical management of obesity and thyroid dysfunctions.

Overall, this study contributes valuable knowledge to the fields of endocrinology and obesity research. It underscores the importance of considering thyroid function in the context of obesity management and suggests potential areas for further research, particularly in understanding the mechanisms underlying these correlations and their clinical implications. The gender-based differences observed also open avenues for more personalized approaches in treating and managing obesity in relation to thyroid health.

LIMITATIONS OF STUDY

Cross-sectional design: The cross-sectional nature of the study limits the ability to establish causality between thyroid function and obesity. Longitudinal studies are needed to determine whether changes in thyroid function precede the development of obesity or vice versa.

Sample size and diversity: While a sample size of 250 participants provides a reasonable data-set, it may not be large enough to capture the full spectrum of variability in thyroid function and obesity across different populations. Moreover, the study may lack representation from diverse ethnic and socioeconomic backgrounds, limiting the generalizability of the findings.

Measurement limitations: The reliance on BMI and waist circumference as the sole measures of obesity might not accurately reflect the complex nature of body composition. Other measures, such as body fat percentage or waist hip ratio, could provide a more comprehensive understanding of obesity.

Single time-point assessment: Assessing thyroid function and obesity at a single point in time may not account for potential fluctuations in these measures. Repeated measurements over time would offer a more accurate picture of their relationship.

Potential confounding factors: The study might not have adequately controlled for all potential confounding factors that can influence both thyroid function and obesity, such as diet, physical activity, other comorbidities and medication use.

Thyroid function tests: The study focuses on basic thyroid function tests (TSH, T3, T4) without considering other thyroid-related parameters, such as thyroid antibodies, which might also play a role in obesity.

Gender-based analysis: While the study addresses gender differences, it may not fully capture the complexity of these differences, particularly in relation to hormonal variations across different life stages in women, such as pregnancy or menopause.

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