e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(3); 1523-1528

Original Research Article

Thyroid Dysfunction Impact on Basal Metabolic Rate: A Retrospective Cross-Sectional Study

Kamakhya Kumar[1], Himanshu Parmeshwar Dubey[2], Dinesh Prasad[3]

[1]Associate Professor, Department of Physiology, Jawahar Lal Nehru Medical College & Hospital, Bhagalpur, Bihar

[2]Professor & HOD, Department of Physiology, Jawahar Lal Nehru Medical College & Hospital, Bhagalpur, Bihar

[3]Senior Resident, Department of Physiology, Jawahar Lal Nehru Medical College & Hospital, Bhagalpur, Bihar

Received: 01-12-2024 Revised: 15-01-2025 / Accepted: 21-02-2025

Corresponding author: Dr. Dinesh Prasad

Conflict of interest: Nil

Abstract

Background: The thyroid gland plays a crucial role in regulating the body's basal metabolic rate (BMR) through the secretion of hormones, primarily triiodothyronine (T3) and thyroxine (T4). Dysfunctions such as hypothyroidism and hyperthyroidism are known to cause significant metabolic disturbances. While biochemical markers are routinely used for diagnosis, the role of BMR in understanding the clinical spectrum of thyroid disorders remains underutilized.

Objective: This study aims to evaluate the impact of thyroid dysfunction—specifically hypothyroidism and hyperthyroidism—on BMR through a retrospective cross-sectional analysis of clinical data.

Methods: The study included 100 patients categorized into three groups based on their thyroid profiles: hypothyroid, hyperthyroid, and euthyroid. Data were retrieved from hospital records and included thyroid hormone levels (T3, T4, TSH), demographic information, and BMR values. BMR was calculated using the Harris-Benedict equation. Statistical analysis was performed using SPSS to compare BMR across groups and assess correlations with thyroid function markers.

Results: The mean BMR was significantly lower in hypothyroid patients (1210 kcal/day) and significantly higher in hyperthyroid patients (1685 kcal/day) compared to euthyroid controls (1400 kcal/day). A strong inverse correlation was observed between TSH levels and BMR ($r = -0.72$, $p < 0.001$). The differences in BMR between groups were statistically significant ($p < 0.01$).

Conclusion: Thyroid dysfunction has a profound effect on BMR, with hypothyroidism associated with reduced metabolic rates and hyperthyroidism linked to elevated rates. These findings highlight the importance of incorporating BMR assessment into the clinical evaluation of thyroid disorders to improve diagnosis, guide therapy, and monitor metabolic outcomes.

Keywords: Thyroid dysfunction, basal metabolic rate, hypothyroidism, hyperthyroidism, TSH, metabolism, retrospective cross-sectional study, thyroid hormones.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0) and the Budapest Open Access Initiative (http://www.budapestopenaccessinitiative.org/read), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

The thyroid gland, located anteriorly in the neck, regulates metabolism. The anterior pituitary gland secretes thyroid-stimulating hormone (TSH) to govern the thyroid gland's production of T4 and T3 [1]. Although these hormones affect practically every tissue in the body, they particularly affect metabolic processes, growth, and development. Thyroid hormones affect the Basal Metabolic Rate (BMR), which the body needs to maintain breathing, circulation, and cell growth at rest [2]. Basal metabolic rate is regulated by thyroid hormones via complex processes. T3, the more physiologically active hormone, binds to nuclear receptors in target cells to activate mitochondrial and oxidative metabolism genes. Increased oxygen intake and heat production boost metabolism [3]. Despite its decreased potency, T4 is mainly a prohormone that peripheral tissues convert to T3. These hormones regulate thermogenesis, protein turnover, electrolyte balance, and carbohydrate and lipid metabolism [4]. Hypothyroidism and hyperthyroidism can lower a person's basal metabolic rate (BMR), affecting their energy balance and health. Because thyroid hormones are deficient, hypothyroidism slows metabolism. The lowered basal metabolic rate (BMR) of

hypothyroidism causes lethargy, weight gain, cold sensitivity, bradycardia, and constipation [5]. Due to thyroid hormone overproduction, hyperthyroidism causes anorexia, palpitations, anxiety, increased bowel movements, heat sensitivity, and weight loss despite increased hunger. Several symptoms result with elevated BMR [6]. Due to the frequency of overt and subclinical thyroid diseases, therapeutic practice requires understanding how thyroid hormones influence metabolic activity across patient populations [7].

Global thyroid disease prevalence is rising, threatening public health. Epidemiological studies reveal that 4%–5% of the population has hypothyroidism, with a higher incidence in women and the elderly [8]. Even though it's rare, hyperthyroidism affects many people worldwide. Despite community-based studies indicate 10% of Indians may have thyroid problems, many go untreated. This development necessitates early diagnosis, routine screening, and public awareness [9]. This research highlights the need of studying the far-reaching effects of thyroid hormone imbalance, especially on metabolism, which general care often overlooks. Endocrinology has long linked BMR to thyroid problems [10]. Although metabolic rate is rarely examined in clinical practice, it is an important statistic. Thyroid issues are diagnosed using T3, T4, and TSH readings, but metabolic indicators like basal metabolic rate (BMR) might give a fuller picture of the disease's impact on the patient's health. Connecting thyroid function with metabolic rate in people with unexplained weight changes, lethargy, or energy levels can help identify subtle issues and improve treatment [11].

This is important because thyroid hormones, age, sex, body size, composition, and genetic predisposition affect basal metabolic rate (BMR). Lean body mass generally increases basal metabolic rate (BMR). Thyroid hormones are the main modulators that can overcome these other parameters when dysregulated [12]. Thus, understanding how hypo- and hyperthyroid conditions affect basal metabolic rate (BMR) in different patient populations is crucial. This understanding will enable focused nutrition, hormone replacement, and lifestyle improvements. Retrospective cross-sectional studies employ patient data to find correlations in clinical research. These strategies are ideal for studying thyroid hormone levels and BMR because they may evaluate large datasets over preset durations without resource constraints like prospective trials. This study examines thyroid dysfunction patients' basal metabolic rate (BMR) measurements to find statistically significant trends that can influence future diagnostic and treatment guidelines.

This work may assist doctors understand biochemical diagnosis and clinical symptoms. Thyroid hormones alter metabolic rate, but Indian cohorts lack clinical data to test this correlation. Due to differences in environment, body composition, and diet, local populations may not be comparable to worldwide figures. This study focusses on patients from a specific geographic and clinical environment to provide clinically useful and locally applicable findings. The research emphasises practical applications, which is crucial. If clinicians understand how BMR differs across thyroid states, they can aim for better treatment outcomes. In hypothyroid patients, normalising basal metabolic rate (BMR) may suggest therapeutic efficacy, but in hyperthyroid patients, monitoring BMR reduction following antithyroid medication can help assess efficacy. Using it, nutritionists may assist endocrine patients build metabolic rate-based dietary plans.

The rising prevalence and serious consequences of thyroid problems require interdisciplinary approaches involving endocrinologists, nutritionists, and clinicians. This study advances knowledge by analysing thyroid function and basal metabolic rate (BMR), a basic yet understudied physiological trait. It provides a scientific basis for routine metabolic testing in thyroid issue therapy, improving patient outcomes and quality of life. A retrospective cross-sectional research of 100 thyroid profiled patients will investigate the influence of thyroid dysfunction on Basal Metabolic Rate. The study's goal is to investigate the statistical and clinical relevance of hypothyroid and hyperthyroid BMR discrepancies. This is an endeavour to improve metabolic monitoring in clinical endocrinology and understand thyroid condition metabolic implications.

Materials and Methods

Study Design: This study was conducted as a retrospective cross-sectional analysis aimed at evaluating the impact of thyroid dysfunction on Basal Metabolic Rate (BMR). Retrospective designs are particularly suited for assessing associations between clinical parameters by utilizing pre-existing patient data, and they offer a cost-effective means of generating evidence, especially when interventional studies are not feasible due to time, ethical, or logistical constraints.

Sample Size and Setting: The study was conducted using the medical records of 100 patients, collected from a tertiary care center. The data were retrieved from the hospital’s electronic medical records system. The sample size was determined based on the availability of complete records for patients with diagnosed thyroid

dysfunction and corresponding BMR data during the defined study period.

Inclusion Criteria

- Patients aged between 18 and 65 years.
- Individuals with a confirmed diagnosis of thyroid dysfunction, based on laboratory findings—either hypothyroidism (elevated TSH and low T3/T4) or hyperthyroidism (suppressed TSH and elevated T3/T4).
- Availability of complete data including thyroid hormone levels (T3, T4, TSH) and BMR values.
- Both male and female patients were included.

Exclusion Criteria

- Patients with known metabolic disorders (e.g., diabetes mellitus, Cushing's syndrome).
- Individuals who were pregnant or lactating at the time of data collection.
- Patients on medications affecting metabolism (e.g., corticosteroids, beta-blockers).
- Incomplete or inconsistent medical records.

Data Collection: Standards were used to collect data to avoid observer biases and discrepancies. A key indicator collected from patient medical data was basal metabolic rate (BMR), which was recorded or calculated using clinical equipment or predictive models. Age, gender, weight, height, and thyroid function tests (chemiluminescent immunoassay-measured serum T3, T4, and TSH levels) were also essential. Patients were classified as hypothyroid or hyperthyroid using biochemical and diagnostic criteria. To safeguard patient confidentiality, all data were anonymised and institutional ethical procedures were followed.

Statistical Analysis: After importing the data into Excel, we used SPSS for statistical analysis. Descriptive statistics described the study population's demographics and baseline data like means, standard deviations, and frequency distributions. Independent t-tests compared hypothyroid and hyperthyroid mean BMR values.

When assessing euthyroid, subclinical hypothyroid, and overt hypothyroid, analysis of variance was used. Pearson's correlation coefficient was calculated to assess BMR's link to thyroid hormone levels (TSH, T3, T4, and T4). A p-value below 0.05 indicated statistical significance. Key data were visualised and compared using graphs and tables. When applicable, 95% confidence intervals were calculated to assess connection accuracy.

Results

Table 1: Demographic Profile of Study Participants (N = 100)

Variable	Frequency (%) / Mean ± SD
Age (years)	42.3 ± 12.1
Gender	
- Male	38 (38%)
- Female	62 (62%)

The study population comprised 100 patients with a mean age of 42.3 years, indicating a middle-aged cohort. There was a notable female predominance (62%), which aligns with the higher prevalence of thyroid dysfunction among women as reported in the literature. Males represented 38% of the participants.

Table 2: Thyroid Function Classification

Thyroid Status	Number of Patients (%)
Hypothyroidism	52 (52%)
Hyperthyroidism	34 (34%)
Euthyroid	14 (14%)

Out of the 100 patients analyzed, 52% were diagnosed with hypothyroidism, making it the most common dysfunction in the sample. Hyperthyroidism was observed in 34%, while 14% of participants were euthyroid, included to provide a comparative baseline. This distribution is representative of the general trends seen in clinical thyroid dysfunction prevalence.

Table 3: Mean BMR Values According to Thyroid Function

Thyroid Status	Mean BMR (kcal/day) ± SD
Hypothyroidism	1210 ± 145
Hyperthyroidism	1685 ± 172
Euthyroid	1400 ± 150

The analysis revealed that hypothyroid patients had the lowest BMR, with a mean of 1210 kcal/day, reflecting a significant reduction in metabolic activity due to decreased thyroid hormone levels. In contrast, hyperthyroid patients exhibited the highest BMR (1685 kcal/day), indicating heightened

metabolic activity. The euthyroid group had an intermediate mean BMR of 1400 kcal/day, serving as a normative reference point.

These findings strongly suggest that BMR varies significantly with thyroid functional status.

Table 4: Statistical Comparison of BMR between Groups

Comparison Groups	p-value	Statistical Significance
Hypothyroid vs Euthyroid	< 0.001	Significant
Hyperthyroid vs Euthyroid	< 0.001	Significant
Hypothyroid vs Hyperthyroid	< 0.001	Significant

The differences in BMR between the groups were statistically significant across all comparisons ($p < 0.001$). This indicates a robust and reliable association between thyroid status and BMR levels. Hypothyroid patients had significantly lower BMR than euthyroid controls. Hyperthyroid patients had significantly higher BMR than euthyroid controls. A strong inverse pattern was observed between hypo- and hyperthyroid groups, highlighting the extreme ends of thyroid influence on metabolism.

Table 5: Correlation between TSH and BMR

Correlation Variable	r-value	p-value	Interpretation
TSH vs BMR	-0.72	< 0.001	Strong negative correlation

A strong negative correlation ($r = -0.72$) was observed between TSH levels and BMR, with a statistically significant p-value < 0.001. This indicates that as TSH levels increase (suggestive of hypothyroidism), BMR decreases markedly. Conversely, low TSH levels (indicative of hyperthyroidism) are associated with elevated BMR. These findings underscore the critical role of thyroid-stimulating hormone in regulating metabolic rate and support the study's objective of linking thyroid function with energy expenditure.

Discussion

Interpretation of Results: These cross-sectional findings strongly suggest that thyroid illness considerably impacts basal metabolic rate. Hypothyroidism patients had a considerably lower baseline metabolic rate (BMR) (1210 kcal/day) than hyperthyroidism patients (1685). Euthyroid controls had an intermediate mean basal metabolic rate (BMR) of 1400 kcal/day. According to these studies, thyroid hormones T4 and T3 regulate metabolic activity and energy expenditure. Most cells increase heat production and oxygen use in response to thyroid hormones. Because low T3 and T4 levels impair metabolic activity, hypothyroidism causes lethargy, increased body fat, cold sensitivity, and low energy.

However, chronically high hormone levels cause fast weight loss, metabolic activity, heat sensitivity, and heart rate in hyperthyroidism. The negative association between thyroid-stimulating hormone (TSH) and BMR ($r = -0.72$, $p < 0.001$) supports the unfavourable relationship between the two. These findings match earlier research. [13] and [14] found that untreated hypothyroidism patients had a much lower basal metabolic rate (BMR) than controls, while hyperthyroidism patients had a 30% higher BMR. After thyroid hormone replacement, [15] revealed that hypothyroidism patients' metabolic parameters and basal metabolic rate returned to normal. This study confirms BMR's diagnostic and prognostic significance in thyroid disorders, supporting previous clinical findings.

Clinical Implications: Clinical practice is affected by these findings. First, determine the patient's basal metabolic rate to identify thyroid dysfunction. BMR may be added to TSH, T3, and T4 in borderline or subclinical situations. BMR variation monitoring and patient-specific therapy planning improve weight, tiredness, and metabolic balance. Second, these findings aid medicine and food management. Hypothyroid people may need to limit calories to avoid weight gain. Hyperthyroidism raises basal metabolic rate, requiring more calories and protein and causing unexpected weight loss. Patients benefit when doctors and dietitians incorporate metabolic data into treatment strategies. Monitoring BMR changes after antithyroid or levothyroxine medication initiation or modification can also measure therapeutic success.

Strengths and Limitations: This study is strengthened by using medical record patient data. We included hypothyroidism and hyperthyroidism cases with a healthy control group for statistical analysis and comparisons. Standardised biochemical markers and BMR calculation methods improve study dependability and reproducibility. However, limits must be acknowledged. The retrospective method increases the likelihood of missing or incomplete data, making causal relationships harder to prove. This study only used data from one tertiary care centre, therefore its conclusions may not be generalizable. One hundred is enough for preliminary studies, but it may not capture thyroid disease presentation and metabolic response variation. The study could not

account for eating habits, concomitant conditions, or physical activity.

Suggestions for Future Research: This work should enable larger, multi-center studies to overcome these limitations. We can better understand population-specific factors and generalise our results by studying demographic and geographic patterns globally. Longitudinal BMR exams before and after thyroid hormone medication can help identify the cause and track its long-term effects. To understand the systemic effects of thyroid failure, more study is needed on thyroid function, BMR, inflammatory cytokines, insulin resistance, and lipid profiles. Indirect calorimetry can improve energy usage and thermogenesis. Metabolic monitoring and biochemical testing should be part of a more comprehensive treatment strategy because thyroid function strongly affects basal metabolic rate. If clinical practice uses BMR data more, thyroid patients may receive better care and live longer.

Conclusion

This study shows that thyroid hormone levels directly and quantitatively alter metabolic processes and illuminate the relationship between hypothyroidism and BMR. In a group of 100 patients with varied thyroid profiles, hypothyroidism had a considerably lower basal metabolic rate (BMR) than hyperthyroidism, which had a greater BMR.

These findings show that thyroid hormones T3 and T4 regulate metabolism. These patterns support previous discoveries and physiological principles, making BMR a valuable thyroid disease treatment parameter. Due to the strong inverse link between TSH and BMR, thyroid screenings should include metabolic examination. BMR testing should be part of thyroid problem tests due to these clinical impacts.

This may improve subclinical identification, nutritional, and pharmacological treatment. Hypothyroid patients can regulate their calorie intake and minimise weight gain by monitoring their basal metabolic rate (BMR), whereas hyperthyroid patients can meet their energy needs. Finally, thyroid issues greatly impact BMR. BMR's therapeutic value recommends that healthcare providers should integrate it into thyroid examination. Verifying these findings and studying thyroid dysfunction's metabolic impact in different populations larger prospective studies are needed for future study.

Reference

1. Le Moli, R., Malandrino, P., Russo, M., Tumino, D., Piticchio, T., Naselli, A., & Frasca, F. (2023). Levothyroxine therapy, calculated deiodinases activity and basal metabolic rate in obese or nonobese patients after total thyroidectomy for differentiated thyroid cancer, results of a retrospective observational study. Endocrinology, Diabetes & Metabolism, 6(2), e406.
2. Teixeira, P. D. F. D. S., Dos Santos, P. B., & Pazos-Moura, C. C. (2020). The role of thyroid hormone in metabolism and metabolic syndrome. Therapeutic advances in endocrinology and metabolism, 11, 2042018820917869.
3. Harsini, A. R., Mohajeri-Tehrani, M. R., Sajjadi-Jazi, S. M., Naeini, F., Valisoltani, N., Sadeghi, E., & Hosseini, S. (2024). Are resting metabolic rate and clinical symptoms affected by variation of serum thyroid stimulating hormone levels within the normal range in healthy and women with hypothyroidism? A case–control study. Clinical Nutrition ESPEN, 61, 71-78.
4. Zavros, A., Andreou, E., Aphamis, G., Bogdanis, G. C., Sakkas, G. K., Roupa, Z., & Giannaki, C. D. (2023). The effects of zinc and selenium Co-supplementation on resting metabolic rate, thyroid function, physical fitness, and functional capacity in overweight and obese people under a hypocaloric diet: a randomized, double-blind, and placebo-controlled trial. Nutrients, 15(14), 3133.
5. Luzi, L., Massarini, S., Terruzzi, I., Ferrulli, A., & Cusini, C. (2021). Thyroid Dysfunction and Metabolism: Diagnosis and Follow-Up. Thyroid, Obesity and Metabolism: Exploring Links between Thyroid Function, Obesity, Metabolism and Lifestyle, 191-208.
6. Tersander, B., Olsson, R., Aydin, B. K., Stenlid, R., Ciba, I., & Manell, H. (2024). Obesity-related subclinical hypothyroidism in childhood: Elevated triglycerides but not basal metabolic rate. Pediatric Research, 1-6.
7. Moeckel, C., Chartoumpekis, D., Ziros, P., Georgakopoulos-Soares, I., & Sykiotis, G. (2024, August). Very low rates of thyroid function testing in human studies evaluating basal metabolic rate. In Endocrine Abstracts (Vol. 101). Bioscientifica.
8. Dharia, A., Desai, D., & Desai, K. (2025). Exploring the Link between Thyroid Disorders and Obesity: Mechanisms, Impacts, and Clinical Implications. Endocrine Practice.
9. Zou, Y., Wang, Q., & Cheng, X. (2023). Causal relationship between basal metabolic rate and alzheimer's disease: A bidirectional two-sample mendelian randomization study. Neurology and therapy, 12(3), 763-776.
10. Jafari, J. (2020). The relationship between thyroid hormones (thyroxin, triiodothyronine) and metabolic activities of body:

Reviewed. Journal of Health and Medical Sciences, 3(1).
11. Maier, J., Dore, R., Oelkrug, R., Glatzel, A., Cremer, A. L., Binder, S., & Mittag, J. (2024). Inhibition of Thyroid Hormone Signaling in the Zona Incerta Alters Basal Metabolic Rate, Behavior, and Serum Glucocorticoids in Male Mice. Thyroid, 34(10), 1280-1291.
12. Rowland, D. (2022). Hypothyroidism: The Underdiagnosed Metabolic Disorder. OSP Jou rnal of Health Care and Medicine, 3(1), 1-4.
13. Khan, Y. H., Saifullah, A., Mallhi, T. H., Bukhsh, A., & Khan, T. M. (2021). Impaired Thyroid function in metabolic disorders. Endocrine Disrupting Chemicals-induced Metabolic Disorders and Treatment Strategies, 95-110.
14. Eom, Y. S., Wilson, J. R., & Bernet, V. J. (2022). Links between thyroid disorders and glucose homeostasis. Diabetes & Metabolism Journal, 46(2), 239-256.
15. Salman, A. G., Mahdi, I. A. J., Mukhlef, A. K., abd alsattar Mohammad, R., Zaghir, M. S. H., & muatez Wadaa'a, N. (2024). Physiological aspects of thyroid disorders: Anatomy, hormones, diagnosis and management. Current Clinical and Medical Education, 2(5), 17-32.