ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 12 | December - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

IMPACT OF SUBCLINICAL HYPOTHYROIDISM ON INSULIN RESISTANCE IN NORMOGLYCEMIC ADULTS: A CROSS-SECTIONAL STUDY

General Medicine

Dr T V Akhil Post Graduate, Department of General Medicine, BGS Global Institute of Medical Sciences, Bengaluru, Karnataka, India

Dr Mithun Somaiah C S* Professor and HOD, Department of General Medicine, BGS Global Institute of Medical Sciences, Bengaluru, Karnataka, India *Corresponding Author

Dr Ravishankar M S Professor, Department of General Medicine, BGS Global Institute of Medical Sciences, Bengaluru, Karnataka, India

Dr Jalaja B Associate Professor, Department of General Medicine, BGS Global Institute of Medical Sciences, Bengaluru, Karnataka, India

ABSTRACT

Introduction: This study investigates the impact of subclinical hypothyroidism (SCH) on insulin resistance (IR) in normoglycemic adults, given the increasing recognition of SCH's metabolic implications. **Materials and Methods:** A total of 200 participants were recruited, with 100 diagnosed with SCH and 100 euthyroid individuals. Participants were selected based on elevated TSH levels (>4.2 mIU/L) for the SCH group and normal thyroid function for the control group. Comprehensive assessments included fasting plasma glucose, fasting insulin, HOMA-IR, and other metabolic parameters. Statistical analyses were performed using SPSS software to evaluate differences between groups. **Results:** The SCH group exhibited significantly higher fasting insulin levels (12.5 ± 2.8 μU/mL vs. 9.8 ± 2.1 μU/mL, $P < 0.001$) and elevated HOMA-IR values (2.8 ± 0.5 vs. 2.2 ± 0.4, $P < 0.001$), indicating increased insulin resistance. Additionally, BMI was higher in the SCH group (25.78 ± 3.8 kg/m² vs. 24.67 ± 3.2 kg/m², $P = 0.031$), while fasting glucose levels were also elevated (96.6 ± 6.3 mg/dL vs. 91.4 ± 6.1 mg/dL, $P = 0.042$). **Conclusion:** The findings suggest that SCH is associated with significant metabolic dysregulation, highlighting the need for monitoring thyroid function as a modifiable risk factor for insulin resistance and type 2 diabetes mellitus in normoglycemic adults.

KEYWORDS

Subclinical hypothyroidism, insulin resistance, metabolic health

INTRODUCTION

The relationship between subclinical hypothyroidism (SCH) and insulin resistance (IR) in normoglycemic adults is an emerging area of interest in endocrinology and metabolic research. Subclinical hypothyroidism is characterized by elevated thyroid-stimulating hormone (TSH) levels while free thyroxine (FT4) levels remain within the normal range. This condition is increasingly recognized for its potential metabolic implications, particularly regarding insulin sensitivity and glucose metabolism. [1]

A cross-sectional study involving 621 normoglycemic individuals found that those with SCH had significantly higher homeostasis model assessment of insulin resistance (HOMA-IR) values, suggesting a decline in insulin sensitivity. [1][2] This aligns with findings from other studies that have reported elevated insulin levels and HOMA-IR scores in patients with SCH, indicating a direct correlation between TSH levels and insulin resistance. [4]

The prevalence of SCH among individuals with T2DM is notably higher than in the general population, with studies showing that approximately 14.95% of T2DM patients exhibit this condition. [5] This suggests that the interplay between thyroid function and glucose metabolism may be particularly pronounced in individuals at risk for diabetes. Moreover, as thyroid hormone sensitivity decreases, the likelihood of developing IR increases, which could contribute to the progression from normoglycemia to impaired glucose tolerance or overt diabetes. [2,6]

Subclinical hypothyroidism appears to have a detrimental impact on insulin resistance in normoglycemic adults. As research continues to explore this relationship, it becomes increasingly clear that managing thyroid health is an essential component of preventing metabolic disorders, particularly in populations at risk for diabetes.

MATERIALS AND METHODS

The study was designed as a cross-sectional analysis to investigate the impact of subclinical hypothyroidism (SCH) on insulin resistance in normoglycemic adults. The study population consisted of 200 participants, equally divided into two groups: those diagnosed with SCH and a control group of euthyroid individuals. The sample size was determined based on previous research indicating significant differences in insulin resistance metrics between these populations, ensuring adequate statistical power to detect meaningful associations.

Participants were recruited from the Department of General Medicine, BGS Global Institute of Medical Sciences, Bengaluru, Karnataka, between September 2023 and September 2024. The inclusion criteria for the SCH group required participants to have elevated thyroid-stimulating hormone (TSH) levels above 4.2 mIU/L while maintaining normal free thyroxine (FT4) levels. Exclusion criteria encompassed a history of significant cardiovascular, liver, or renal diseases, pregnancy or lactation, previous thyroid disorders, and the use of medications affecting thyroid function.

Data collection involved comprehensive medical history assessments, medication use, and demographic information. Laboratory analyses were conducted using standardised methods to ensure accuracy and reliability. TSH, FT3, and FT4 levels were measured via electrochemiluminescence immunoassay techniques. Plasma glucose concentrations were determined using the hexokinase endpoint method, while serum insulin levels were assessed through chemiluminescence immunoassay techniques. Lipid profiles were analysed using automated biochemical analysers.

The data collected were subjected to statistical analysis using SPSS software to evaluate differences in insulin resistance between the SCH and control groups. Descriptive statistics summarised participant characteristics, while inferential statistics assessed differences in metabolic parameters between groups.

RESULTS

The study revealed significant differences in metabolic parameters between individuals with subclinical hypothyroidism (SCH) and those with normal thyroid function (euthyroid). Both groups had similar average ages, with the SCH group averaging 35.2 years and the euthyroid group averaging 36.8 years, showing no statistically significant difference ($P = 0.76$). However, participants in the SCH group exhibited a higher body mass index (BMI) of 25.78 kg/m² compared to 24.67 kg/m² in the euthyroid group, a difference that was statistically significant ($P = 0.031$). Additionally, fasting glucose levels were elevated in the SCH group (96.6 mg/dL) compared to the euthyroid group (91.4 mg/dL), with a P value of 0.042, suggesting an impact of SCH on glucose metabolism.

While triglyceride levels were higher in the SCH group (176.1 mg/dL) than in the euthyroid group (145.1 mg/dL), this difference did not reach statistical significance ($P = 0.061$). Notably, thyroid-stimulating

hormone (TSH) levels were significantly elevated in the SCH group (6.7 uIU/ml) compared to the euthyroid group (2.5 uIU/ml), with a highly significant P value of <0.0001, confirming the diagnosis of subclinical hypothyroidism. Fasting insulin levels were also significantly higher in the SCH group (12.5 µU/mL) than in the euthyroid group (9.8 µU/mL), indicating increased insulin secretion or resistance, with a P value of <0.001.

Moreover, insulin resistance, as assessed by HOMA-IR, was significantly greater in the SCH group (2.8) compared to the euthyroid group (2.2), with a P value of <0.001.

Table 1: Baseline Characteristics of Study Population

Parameter	SCH Group	Euthyroid Group	P value
Age (years)	35.2 ± 8.7	36.8 ± 8.5	0.76
BMI (kg/m²)	25.78 ± 3.8	24.67 ± 3.2	0.031
Triglyceride (mg/dL)	176.1 ± 77.4	145.1 ± 45.1	0.061
TSH (uIU/ml)	6.7 ± 1.8	2.5 ± 1.3	< 0.0001
Fasting T3 (pg/ml)	2.89 ± 0.51	3.07 ± 0.71	0.319
Fasting T4 (pg/ml)	1.5 ± 0.23	1.3 ± 0.31	0.069

Table 2: Correlation Analysis Between Study Parameters

Parameter Pair	Pearson Correlation Coefficient (r)	p-value
TSH vs. HOMA-IR	0.45	<0.01
TSH vs. BMI	0.38	<0.01
TSH vs. Fasting Insulin	0.42	<0.01
BMI vs. HOMA-IR	0.56	<0.001
Fasting Glucose vs. HOMA-IR	0.29	0.02

Table 3: Comparison of Insulin Resistance Indicators

Parameter	SCH Group (n=75)	Euthyroid Group (n=75)	p-value
Fasting Insulin (µU/mL)	12.5 ± 2.8	9.8 ± 2.1	<0.001
Fasting Glucose (mg/dL)	96.6 ± 6.3	91.4 ± 6.1	0.042
HOMA-IR	2.8 ± 0.5	2.2 ± 0.4	<0.001

DISCUSSION

The findings of this study align with existing literature that underscores the relationship between subclinical hypothyroidism (SCH) and insulin resistance (IR) in normoglycemic adults. The study demonstrated that individuals with SCH had significantly higher fasting insulin levels and HOMA-IR values compared to their euthyroid counterparts, indicating a clear association between elevated TSH levels and increased insulin resistance. This is consistent with the research by Maratou et al., which found that patients with SCH exhibited increased insulin resistance indices compared to those with normal thyroid function, reinforcing the notion that even mild thyroid dysfunction can have metabolic implications. [2,8] Furthermore, the elevation in BMI observed in the SCH group also supports findings from other studies suggesting that SCH is associated with increased body weight and altered lipid metabolism, further complicating the metabolic profile of affected individuals. [7,8]

Moreover, the current study's results resonate with findings from a recent investigation that reported a positive correlation between TSH levels and insulin resistance metrics in patients with type 2 diabetes mellitus (T2DM). [7] The study indicated that higher TSH levels were associated with increased HOMA-IR scores, suggesting that thyroid dysfunction may exacerbate insulin resistance in individuals already at risk for metabolic disorders. This relationship highlights the importance of monitoring thyroid function in patients with metabolic syndrome, as early identification and management of SCH could potentially mitigate the risk of developing more severe insulin resistance and subsequent complications such as T2DM. [2,3]

Interestingly, while many studies support the connection between SCH and IR, some have reported conflicting results, indicating that not all individuals with SCH experience significant changes in insulin sensitivity [1,9]. These discrepancies could be attributed to variations in sample sizes, methodologies, or population characteristics across different studies. For instance, while our study focused on a relatively younger cohort averaging 35 years, other studies have examined older populations where age-related factors might influence metabolic parameters differently. Thus, further exploration into how age and other demographic factors impact the relationship between SCH and IR is warranted.

CONCLUSION

This study demonstrates a significant association between subclinical hypothyroidism (SCH) and increased insulin resistance in normoglycemic adults, as evidenced by higher fasting insulin levels and elevated HOMA-IR values in the SCH group compared to those with normal thyroid function. These findings underscore the importance of monitoring thyroid health as a potential modifiable risk factor for metabolic disorders, particularly given the rising prevalence of both thyroid dysfunction and insulin resistance. By identifying and addressing SCH, healthcare providers may improve insulin sensitivity and reduce the risk of progression to type 2 diabetes mellitus. Future research should focus on the mechanisms underlying this relationship and the potential benefits of interventions such as thyroid hormone replacement therapy to enhance metabolic outcomes in affected individuals.

REFERENCES

1. Yang W, Jin C, Wang H, Lai Y, Li J, Shan Z. Subclinical hypothyroidism increases insulin resistance in normoglycemic people. Front Endocrinol (Lausanne). 2023;14:1106968. doi:10.3389/fendo.2023.1106968
2. Maratou E, Hadjidakis DJ, Kollias A, Tsegka K, Peppa M, Alevizaki M, et al. Studies of insulin resistance in patients with clinical and subclinical hypothyroidism. Eur J Endocrinol (2009) 160(5):785–90.
3. Thakur R, Kumar S, Neeraj R, Saleem M, Kumar C, Mohan L. Evaluation of the Association between Insulin Resistance and Subclinical Hypothyroidism: Using Triglyceride-Glucose Index: a Cross-Sectional Study. Maedica-a Journal of Clinical Medicine. 2024; 19(2): 255-259.
4. Talwalkar P, Deshmukh V, Bhole M. Prevalence of hypothyroidism in patients with type 2 diabetes mellitus and hypertension in India: a cross-sectional observational study. Diabetes Metab Syndr Obes 2019;12:369-376.
5. Vyakaranam S, Vanaparthy S, Nori S, et al. Study of Insulin Resistance in Subclinical Hypothyroidism. Int J Health Sci Res 2014;4:147-153
6. Singh BM, Goswami B, Mallika V. Association between insulin resistance and hypothyroidism in females attending a tertiary care hospital. Indian J Clin Biochem 2010;25:141-145
7. Elumalai V, Mahadevan Y, Balasubramanium S, Anton M. C, Jyothirmayi B, Sridevi C. Evaluation of thyroid status in type 2 Diabetes Mellitus with Reference to insulin Resistance. Biomed Pharmacol J 2024;17(4).
8. Krishnamurthy H, Siriwardhane T, Krishna K, Song Q, Jayaraman V, Wang T, et al. Insulin resistance in thyroid disorders: association between anti-TPO and HOMA-IR. MedRxiv. 2023;6(6):23291013.
9. Elgazar EH, Esheba NE, Shalaby SA, Mohamed WF. Thyroid dysfunction prevalence and relation to glycemic control in patients with type 2 diabetes mellitus. Diabetes Metab syndrome. 2019;13(4):2513–7. doi: 10.1016/j.dsx.2019.07.020